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Oral presentations

O-01. Turnover of fluid after oral intake of tap water

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Background: The kinetic properties of three fluids were investigated with the purpose of determining absorption and elimination as well as time to and maximum effect on the blood volume.

Methods: Ten healthy volunteers ingested either 0.5 L of isotonic saline, tap water and carbohydrate-rich lemonade (10% glucose) on three different occasions. Venous blood samples for measurement of the blood haemoglobin (Hgb) and glucose concentrations were collected on 10 occasions over 2 hours. All participants voided before and after the fluid ingestion. A kinetic model based on the haemoglobin dilution and urinary excretion was used to estimate the rate of absorption, the blood volume expansion over time, and the rate of elimination.

Results: All 10 volunteers ingested all three fluids. Figures 1 and 2 illustrate that the rate of uptake and elimination of the ingested water volumes differed between the fluids. Tap water was absorbed at the highest rate but had the smallest blood volume effect. Most of the absorbed sugar drink volume remained in the blood, only minimal amounts were distributed to the tissues. Saline yielded an equally

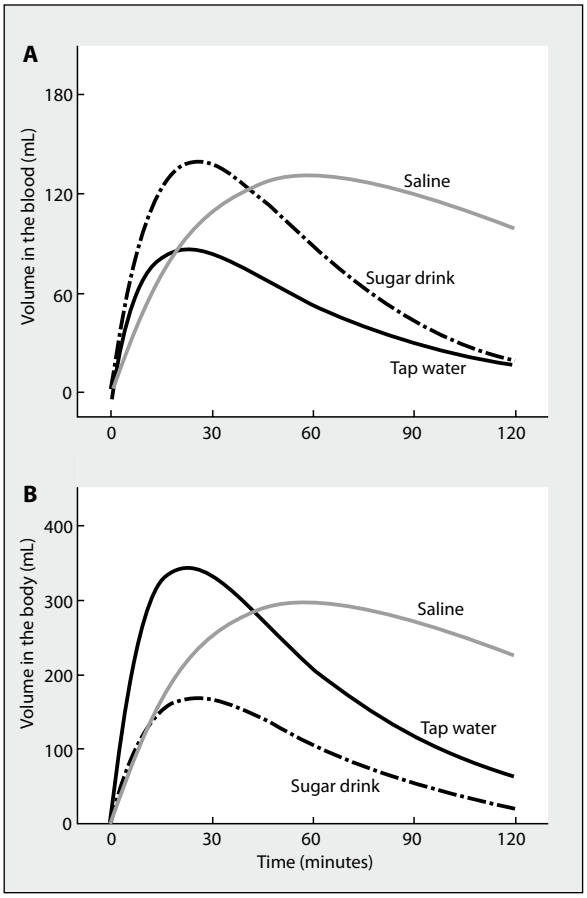

Figure 2. The modelled blood volume expansion (**A**) and the volume of infused fluid remaining in the body (**B**) after ingestion of the three different beverages

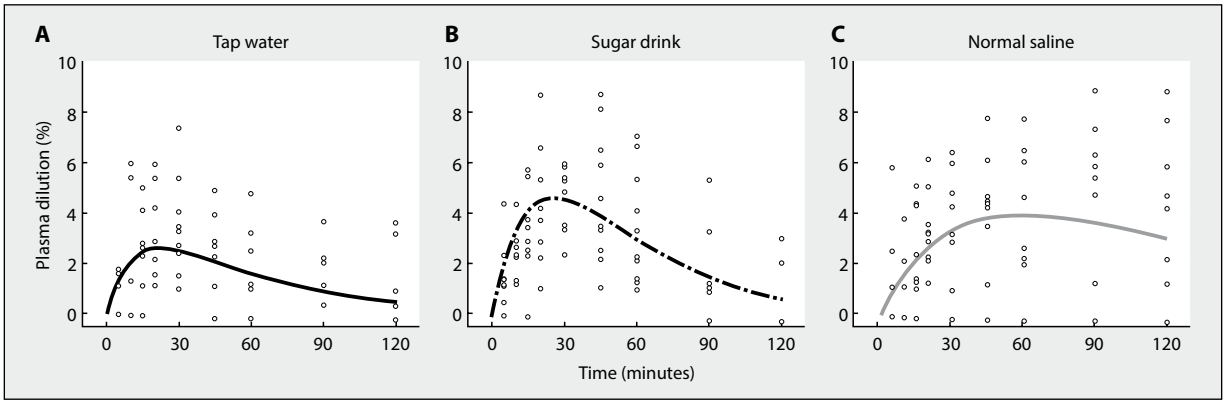

Figure 1. Dilution of venous plasma after ingestion of the three different beverages. Each point is one estimate of plasma dilution and the solid line is the modelled average curve

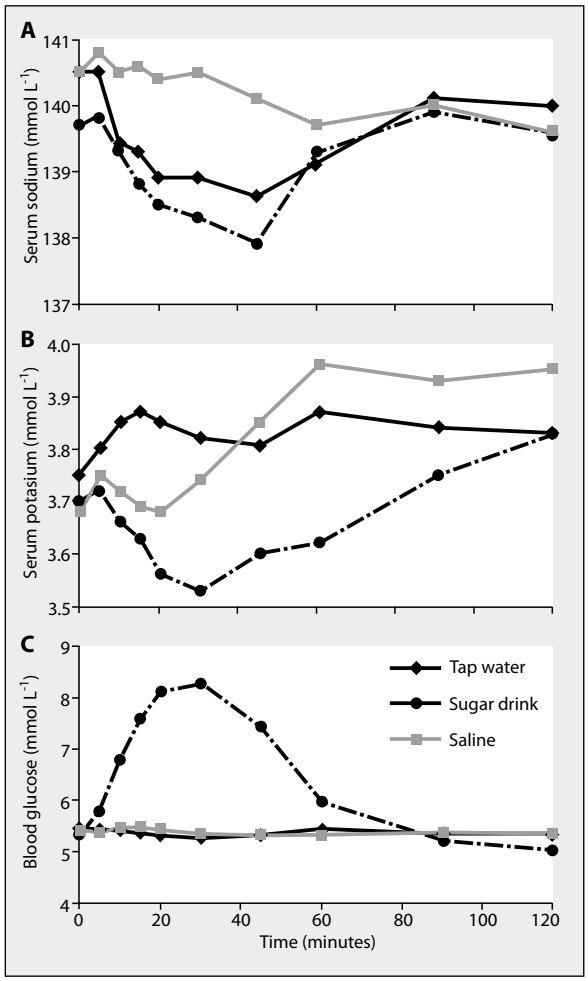

Figure 3. The serum sodium, serum potassium and blood glucose concentrations after ingestion of three different beverages. Each point is the mean of 10 measurements

pronounced blood volume expansion as the sugar drink, but it was more prolonged (Fig. 3). Excretion of the ingested volume was fastest for the sugar drink, intermediate for tap water, and slowest for saline. The half-lives were 15, 34 and 67 min, respectively. The total urinary excretion during the study period differed considerably between the three fluids, the largest being after ingestion of the sugar drink, at 567 (SD 207) mL, and tap water 505 (194) mL. Both were significantly higher ($P < 0.05$) than during the ingestion of saline, after which the urine volume amounted to 266 mL (144). The serum sodium concentration decreased after ingestion of both water ($P < 0.01$) and sugar drink ($P < 0.01$; Fig. 3A). Serum potassium increased slightly after water ingestion, but decreased after the sugar drink ($P < 0.05$). Saline increased serum potassium from 3.68 (0.23) at baseline to 3.96 (0.31) mmol L^{-1} after 1 hour ($P < 0.05$; Fig. 3B). Blood glucose rose quickly from 5.3 (0.5) to a maximum of 8.3 (1.3) mmol L^{-1} at 30 min after ingestion of the lemonade ($P < 0.01$; Fig. 3C). Blood glucose did not change in response to ingestion of the other two beverages.

Conclusion: The compositions of fluids have a profound effect on their volume distribution and elimination rate.

O-02. The incidence of an elevated admission serum potassium in crush injury patients at Dr George Mukhari academic hospital

S. Motilall, N. Dube, N. Kumar, A. Kirpichnikov, M. Koto

University of Limpopo-Medunsa, South Africa

Background: Hyperkalaemia is a significant concern in crush injury patients. This concern determines the choice of the initial resuscitation fluid i.e. a non-potassium containing fluid which is usually normal saline. The aim of this study was to determine the incidence of an elevated serum potassium (sK) on admission in patients with crush injury at the Dr George Mukhari Academic Hospital.

Methods: Retrospective review of data collected from March 2013–February 2014 in all patients who had a clinical suspicion of a crush injury. Patients were resuscitated as per ATLS principles. Fluid diuresis was predominantly with normal saline, however Balsol or Ringers Lactate were also used. Creatine Kinase (CK), urea and electrolytes (U&E) were part of the initial blood screen. The U&E was repeated within 24 hours and repeated again if deranged. Crush injury was defined as a CK > 1000 U L^{-1} within 24 hours of admission. Normal sK was defined as (3.5–5.1 mmol L^{-1}). Data collected included age, gender, CK, sK on admission. *P* values < 0.05 were considered clinically significant.

Results: Sixty one patients presented with a clinical suspicion of crush injury. Twelve patients were excluded because of incomplete data. In 3 patients CK remained below 1000 IU L^{-1} and they were excluded. The remaining 46 patients were all male. Average age was 27 years (range 17–64 years. Average CK over the first 24 hours was 2889 (range 1149–9417 IU L^{-1}). Only 1 (2.2%) patient had an elevated sK (6.2 mmol L^{-1}) on admission and his sK normalised within 24 hours. His CK was only 2523 IU L^{-1}. The remaining 45 (97.8%) patients had no hyperkalaemia on admission with 6 (13%) patients actually having hypokalaemia (range 2.9–3.4 mmol L^{-1}). In the 2 (4.3%) patients requiring dialysis for oliguria, pulmonary edema and acidosis the sK remained normal (3 days) up to the initiation of dialysis. Interestingly in 7/46 (15.2%) patients, Ringers Lactate (6 patients) or Balsol (1 patient) was used as the primary resuscitation fluid. Repeat sK in these 7 patients remained normal.

Conclusion: These results demonstrate that hyperkalaemia on admission in patients with crush injury has a very low incidence. The argument of using non-potassium containing resuscitation fluids in crush injury patients for this same

reason may not be valid. In the few patients in whom a potassium containing fluid was used, hyperkalaemia was not a problem through the entire admission.

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O-03. Hypocalcemia after bowel resection and its relation with the use of plasmalyte replacement fluid

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[2]Foundation year Doctor, Blackpool, United Kingdom

Background: Balanced solutions have osmolality and electrolyte compositions similar to plasma. Plasma-lyte is a balanced crystalloid, which does not contain calcium [1]. Studies comparing Plasma-lyte to Ringer's Lactate solution have shown that patients in the latter group had higher levels of lactate [2]. Plasma-lyte also has the advantage of containing less chloride as compared to Hartmann's solution and hence may be considered to be more physiological. When compared to Normal Saline, plasma-lyte has been shown to be associated with lower post operative morbidity [3]. However the absence of calcium in this solution may contribute to hypocalcemia and indeed the manufacturer advises avoidance in the presence of hypocalcemia. Little is known about the incidence of this problem in practice. Since changing from Hartmann's to Plasmalyte-148 in our trust in 2012, we have noticed a rising prevalence of biochemical hypocalcaemia (adjusted calcium < 2.20 mmol L^{-1}) in patients admitted to our critical care unit.

Methods: Following service evaluation approval, we retrospectively analysed the frequency of post-operative biochemical hypocalcaemia in elective patients who had major bowel resections in our hospital between February 2012 and February 2014. These cohorts were admitted on the day of surgery and received Plasmalyte-148 replacement fluid peri-operatively.

Results: Figure 1 exemplifies the transient drop of median adjusted calcium (IQR [range]) from 2.38 (2.33–2.44 [2.15-2.75]) mmol L^{-1} pre-op to 2.17 (2.10–2.23 [1.83–2.54]) mmol L^{-1} and 2.22 (2.14–2.28 [1.81–2.57]) mmol L^{-1} on post-op days 0 and 1. While 25% of patients had levels below 2.20 mmol L^{-1} immediately post-op, the lowest recorded value was 1.83 mmol L^{-1}. We postulate our change of crystalloids has contributed to the high occurrence of biochemical hypocalcaemia. A three six-monthly ANOVA test between groups A (Hartmann's; 2011–2012), B (Plasmalyte —148; 2012–2013) and C (Plasmalyte —148; 2013–2014) was performed. Figure 2 outlines the significant inter-group variability in mean adjusted calcium between group A vs B and C on post-op days 0 ($P < 0.001$, $F = 35.81$) and 1 ($P < 0.001$, $F = 48.21$). A drawback of our study is that we used serum adjusted calcium as a surrogate for ionised calcium. It is likely that a fall in serum adjusted calcium would also lead to a reduction in ionised calcium levels. Indeed plasma-lyte by its alkanising effect and raising pH may lower the concentration of ionised calcium. By using adjusted calcium levels rather than ionised calcium we may have underestimated the prevalence of hypocalcemia [4].

Conclusion: The use of Plasma-lyte Intravenous fluid during major abdominal surgery in this study population is associated with biochemical hypocalcemia. Clinicians should

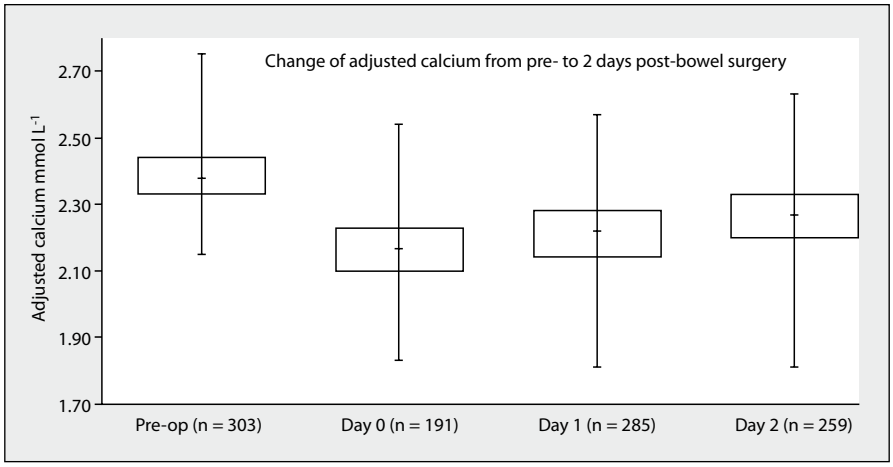

Figure 1. Box-and-whisker diagram representing the ranges; upper-, inter-, and lower-quarter ranges of adjusted calcium obtained at pre-op and up to two days post- bowel surgery. "n" represents the number of biochemistry results available on each post-op day

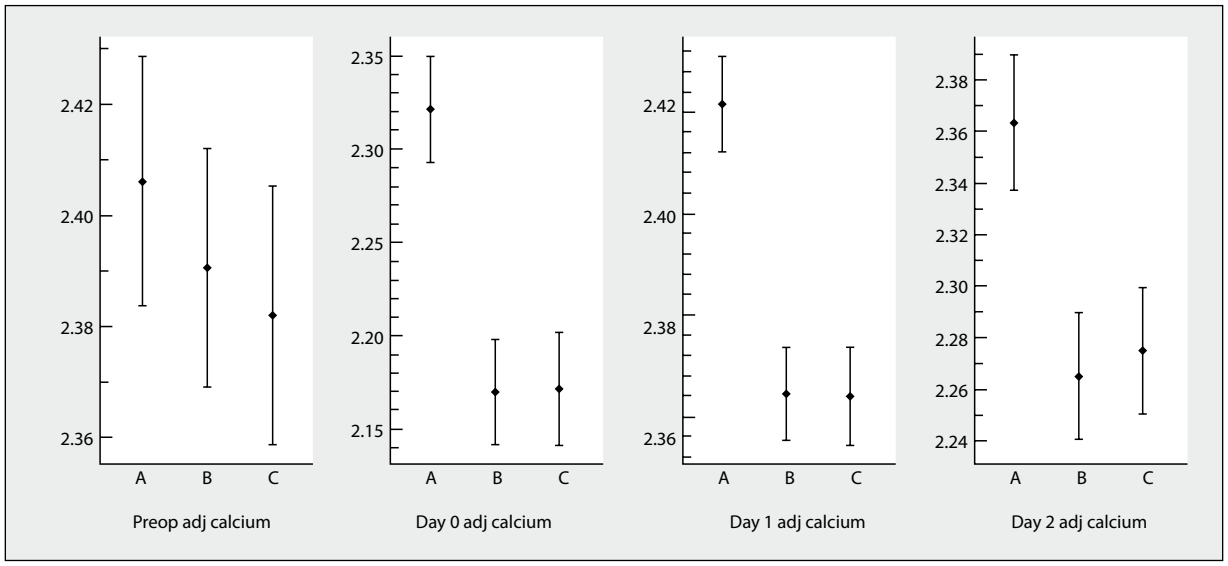

Figure 2. ANOVA test outlines the significant inter-group variability between groups A, B and C at pre-op and up to two days post-elective bowel surgery. Y axis represents the mean value of adjusted calcium

be wary of the potential for this complication especially when using large volumes of this fluid and in the setting of major haemorhage.

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O-04. The effect of excess fluid balance on the mortality rate of thoracic surgical pediatric patients

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Background: In some studies including small populations of patients undergoing thoracic surgery, an intraoperative liberal infusion of fluids was associated with increasing morbidity when compared to restrictive strategies. Therefore, to evaluate the role of excessive fluid infusion in a general population with high-risk surgery is very important. The aim of this study was to evaluate the impact of intraoperative fluid balance on the postoperative organ dysfunction, infection and mortality rate.

Methods: We conducted a prospective cohort study during one year in ICUs from Vinnitsa regional children hospital, which included patients aged 1 to18 years who required postoperative ICU after undergoing thoracic surgery. Patients who underwent palliative surgery and whose fluid balance could change in outcome were excluded. The calculation of fluid balance was based on preoperative fasting, insensible losses from surgeries and urine output minus fluid replacement intraoperatively.

Results: The study included 179 patients. Mean age was 14.2 ± 2.4 years and 6.9% of patients died at the hospital during the study. The median duration of surgery was 3.0 (2.2 to 4.5) h and the value of the Simplified Acute Physiology Score (SAPS) 3 score was 42.1 ± 14.4. Comparing survivors and non-survivors, the intraoperative fluid balance from non-survivors was higher (1,650 [1,400 to 2,400] mL vs 1,250 [1,000 to 1,800] mL, $P < 0.001$). Patients with fluid balance above 1,900 mL intraoperatively had a longer ICU stay (4.0 [3.0 to 8.0] vs 3.0 [2.0 to 5.0], $P < 0.001$) and higher incidence of infectious (33.9% vs 22.1%, $P = 0.001$), neurological (36.4% vs 10.8%, $P < 0.001$) and respiratory complications (30.9% vs 10.2%, $P < 0.001$). In multivariate analysis, the fluid balance was an independent factor for death (OR per 100 mL = 1.024; $P = 0.006$; 95% CI 1.007 to 1.041).

Conclusion: Pediatric patients with excessive intraoperative fluid balance have more ICU complications and higher hospital mortality.

O-05. Incidence, risk factors and prognosis of intra-abdominal hypertension in critically ill children: a prospective epidemiological study

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[2]Intensive Care Unit and High Care Burn Unit, Ziekenhuis Netwerk Antwerpen, ZNA Stuivenberg, Lange Beeldekensstraat 267, B-2060 Antwerpen , Belgium

Background: Although intra-abdominal hypertension (IAH) is an established cause of organ dysfunctions and increased mortality in the critically ill adult population, little is known about the incidence and risk factors of IAH in critically ill children. The aim of this study was to assess the incidence, risk factors and outcome of IAH in a pediatric intensive care unit.

Methods: Prospective cohort study from January 2011 to January 2013. All children consecutively admitted to the pediatric intensive care unit at Prince Sultan Military Medical City, Riyadh, Saudi Arabia, staying more than 24 hours and requiring bladder catheterization were included in the study.

Methods: On admission, demographic and epidemiologic data and risk factors for IAH were studied. The Intra-abdominal pressure (IAP) was measured every 6 hours through a bladder catheter using a standard method according to the consensus definitions of the World Society on Abdominal Compartment Syndrome (WSACS, www.wsacs.org). The IAP was measured until discharge, death or removal of the catheter. IAH was defined as a sustained increase in IAP of more than 10 mm Hg. Abdominal compartment syndrome (ACS) was defined as a combination of IAH and one or more new organ failure. Primary outcome measures were intensive care unit (ICU) mortality and ICU length of stay.

Results: One hundred seventy five patients were included in the study, the mean age was 44.7 ± 39.8 months and the mean PRISM score was 13.9 ± 8.4. A total of 22 patients (12.6%) had IAH and 7 (4%) had ACS during the ICU stay. The independent risk factors associated with IAH were the presence of abdominal distension (OR 7.1; 95%CI, 2.6–19.9; $P < 0.0001$) and a plateau pressure more than 30 cm H_2O (OR 6.42; 95%CI, 2.13–19.36; $P = 0.01$). The presence of IAH was associated with significant higher mortality (40.9% vs 15.6%, p = 0.01) and significant prolonged ICU stay (19.5 [3–97] days vs 8 [1–104] days, OR 1.02; 95% CI, 1.00–1.04; $P = 0.02$). Thirty three patients (18.8%) died in the ICU, IAH was an independent risk factor for mortality (OR 6.98; 95% CI, 1.75–27.86; $P = 0.006$).

Conclusion: IAH does occur in about 13% of the critically ill children, albeit less frequent than adult patients probably related to a better compliance of the abdominal wall. The presence of abdominal distension and a plateau pressure more than 30 cmH_2O were found to be independent predictors for IAH. Children with IAH had higher mortality rate and more prolonged ICU stay.

O-06. Mechanical intestinal obstruction in a porcine model: effects of intra-abdominal hypertension

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Background: Mechanical intestinal obstruction (MIO), a disorder associated with intra-abdominal hypertension (IAH), can result in abdominal compartment syndrome (ACS) [1–5]. A substantial number of patients with marked intestinal distension, due to caecal and colonic dilatation usually have a complete colonic obstruction with a competent ileocecal valve [6]. This situation may lead to increased intraluminal pressure in the colonic segment between the ileocaecal valve and the site of obstruction, resulting in increased intra-abdominal pressure (IAP) and a greater risk of intestinal ischemia and subsequent perforation [6, 7]. Previous studies [8–13] have focused on hypoperfusion and bacterial translocation without considering the concomitant effect of IAH, and thus only partially reflect the real clinical situation. The objective of this study was to design and validate an experimental pig model of MIO and IAH under similar conditions to those described in the clinical setting. The use of a porcine model is ideal since its hemodynamic, ventilatory and physiological features are similar to humans [14–17].

Methods: Ten Large White pigs were divided into two groups: a control group (C, n = 5) and a group with IAH induced by MIO (MIO, n = 5). The MIO was performed with a lapa-

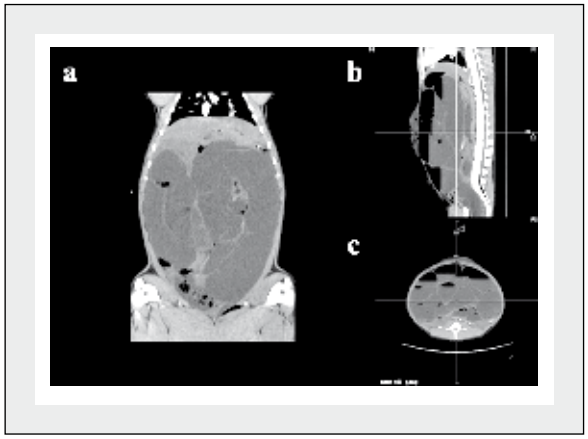

Figure 1. A — CT image in frontal plane of the pig abdomen; **B** — CT image in sagittal plane of the pig abdomen; **C** — CT image in transversal plane of the pig caudal abdomen

roscopic stapler at the ileocecal valve and physiological saline was introduced in the colon until an IAP of 20 mm Hg was reached (Fig. 1). The IAP was maintained for 5 hours. Hemodynamic, respiratory and gastric intramucosal pH (pHi) values were recorded every 1 hour from the IAP was stabilized until the end of experiment.

Results: Significant differences in hemodynamic (Fig. 2), respiratory (Fig. 3), blood perfusion and pH_i (Fig. 4) between the control and MIO groups were noted. The mean arterial pressure (MAP), dynamic pulmonary compliance (C_{dyn}) and abdominal perfusion pressure (APP) decreased. However, the central venous pressure (CVP) increased within 2 hours from starting IAH ($P < 0.05$). In addition, we observed incre-

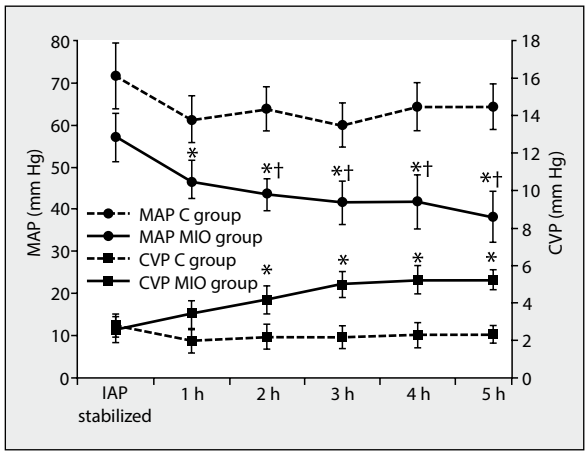

Figure 2. Hemodynamic changes. Mean arterial pressure (MAP, mm Hg) and central venous pressure (CVP, mm Hg) values up to 5 hours after IAH stabilization;*Indicates significant differences between the C and MIO groups at the same sampling interval ($P < 0.05$); †Indicates significant differences in MIO compared to IAP stabilized ($P < 0.05$)

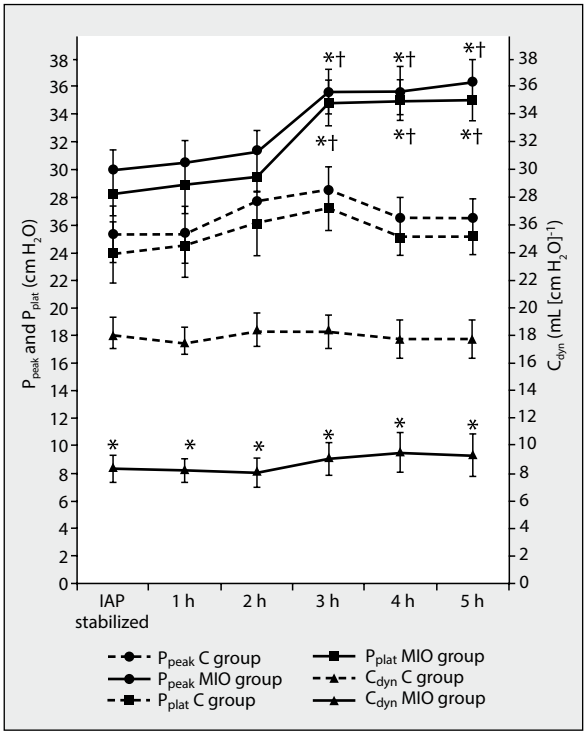

Figure 3. Respiratory changes. The hemodynamic, respiratory, blood perfusion and pH_i changes Peak pressure (P_{peak}, cm H_2O), plateau pressure (P_{plat}, cm H_2O) and pulmonary compliance (C_{dyn}, ml/cm H_2O) values up to 5 hours after IAH stabilization;*Indicates significant differences between the C and MIO groups at the same sampling interval ($P < 0.05$; †Indicates significant differences in MIO compared to IAP stabilized ($P < 0.05$)

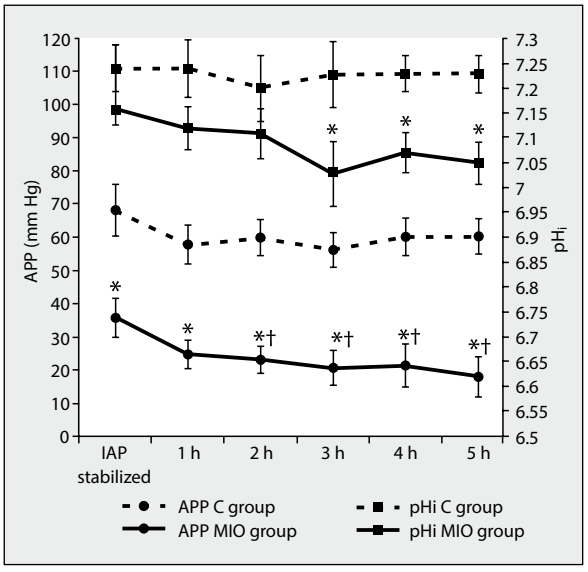

Figure 4. Blood perfusion changes. Abdominal perfusion pressure (APP, mm Hg) and gastric intramucosal pH (pHi) values up to 5 hours after IAH stabilization;*Indicates significant differences between the C and MIO groups at the same sampling interval ($P < 0.05$);†Indicates significant differences in MIO compared to IAP stabilized ($P < 0.05$)

ased values for the peak (P_{peak}) and plateau (P_{plat}) airway pressures, and low values of pH_i in the MIO group that were significant after 3 hours.

Conclusion: The MIO model appears to adequately simulate the pathophysiology of intestinal obstruction that occurs in humans. The hemodynamic, respiratory, blood perfusion and pH_i changes obtained mimic those previously described in IAH studies both in humans and animals. Monitoring APP, C_{dyn} and pH_i values may provide insight in predicting the effects on endorgan function in patients with MIO.

Acknowledgments: CCMIJU staff of Cáceres (Spain) and department of Veterinary Anatomy and Embryology at the University of Murcia (Spain) for their assistance in conducting this research. This work was funded by "Fundación para la Investigación de los Profesionales de la Salud de Extremadura" (Fundesalud), Spain. Dr MLNG Malbrain is a member of the medical advisory board of Pulsion Medical Systems. Drs.: L. Correa-Martín, E. Párraga, M. García-Lindo, F.M. Sánchez-Margallo, R. Latorre, O. López Albors, R. Wise and G. Castellanos, have no conflicts of interest or financial ties to disclose.

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O-07. Intra-abdominal hypertension complicating pancreatitis-induced acute respiratory distress syndrome in 3 patients on extracorporeal membrane oxygenation

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Background: ARDS often requires ventilatory support1 and contributes to early death in severe acute pancreatitis [2]. A $Pa0_2/FiO_2$ less than 100 mm Hg or a Murray score greater than 3.5 is associated with mortality in excess of 80% [3]. BMI > 30, PEEP > 10 cm H_20, use of vasopressors/inotropes, cumulative fluid balance and pancreatitis are all risk factors for the development of IAH in mechanically ventilated patients [4].

Methods: Retrospective review of case notes. We describe three male patients successfully treated with VenoVenous (VV) ECMO for respiratory failure secondary to acute alcoholic pancreatitis.

Results: Pre-ECMO data: mean $Pa0_2/Fi0_2$ 56 mm Hg, mean Murray Score 3.5, mean duration on ECMO 408 hours. All had evidence of Intra-abdominal compartment syndrome (managed with non-surgical strategies), enteral feed and renal failure. Patient 1 had percutaneous ultrasound guided ascitic drains sited. The three patients have since been discharged home.

Conclusion: It is our opinion that these patients would not have survived without ECMO support and certainly it provided time for the medical treatment of IAH, resolution of the ARDS and improvement in respiratory compliance. A UK case series of three surviving patients was reported in 19983. A US series reported a 63% survival to discharge in 8 patients [5]. Abdominal compartment syndrome complicating ECMO has been described in the paediatric literature [6] and all seven cases undergoing decompressive laparotomy died in a case series from the US [7]. We believe this is the first time measurement and discussion of IAH in pancreatits on VV ECMO in adults has been published in the literature. Patients on ECMO will undoubtedly have many of the risk factors for developing IAH. We would therefore recommend measuring a baseline pressure in all ECMO patients.

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O-08. Prognostic value of bio-electrical impedance analysis (BIA) derived parameters in healthy volunteers and critically ill patients

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Background: Little is known on the water content composition in critically ill patients. Recent studies advocate the use of crystalloids over colloids, but this may lead to extravascular fluid accumulation. Massive fluid resuscitation, which is recommended as the initial goal directed treatment for septic shock, may lead to an increase in extracellular water (ECW), intracellular water (ICW) and total body water (TBW) content, because of the presence of vascular endothelial hyperpermeability with capillary leak [1, 2]. Recent studies show that BIA may provide additional information to the fluid balance [3]. The aim of this study is to compare the variables that can be obtained with bioelectrical impedance analysis (BIA) in healthy volunteers and critically ill patients.
Methods: Retrospective data-analysis of 95 BIA measurements that were obtained in 64 critically ill patients and compared with the data collected in 40 healthy individuals (nurses and doctors). Fluid volume excess (VE), TBW, ECW, ICW and the ECW/ICW ratio were measured by whole-body BIA using the BioScan 920-II multi-frequency analyser (Maltron International, Essex, United Kingdom). Prior to examinations, patients' weight was measured and body mass index was calculated. Two electrodes were placed on the wrist (proximally to the metacarpophalangeal joint and on the wrist) and 2 on the ankle (proximally to the transverse metatarsal arch on the superior side of the foot). Bioimpedance was measured at 4 frequencies of 5, 50, 100 to 200 kHz in supine body position. BIA measurements were performed within the first week of ICU stay (on day 5.1 ± 2.1).

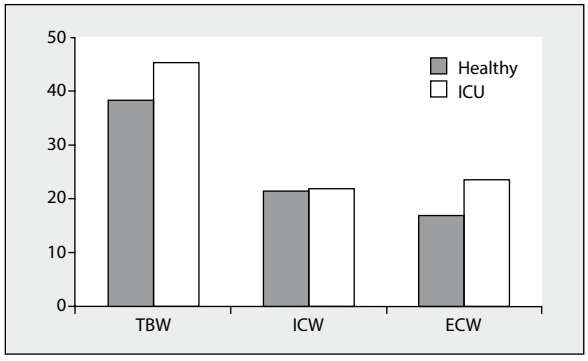

Figure 1. Bar graph showing body water distribution in healthy volunteers (dark grey) and patients (white bars)

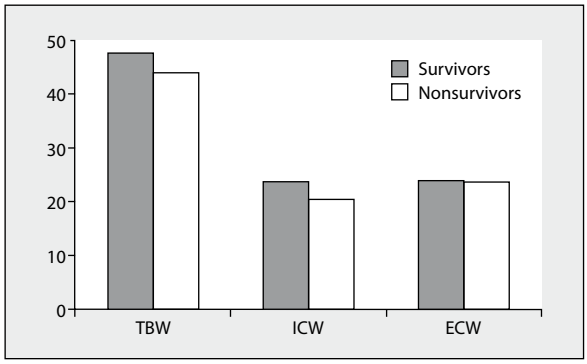

Figure 2. Bar graph showing body water distribution in survivors (dark grey) and nonsurvivors (white bars)

Results: The patients were older (64 ± 15.9 vs 36.9 ± 12.8 years, $P < 0.0001$) and heavier (83.5 ± 26.7 vs 71.4 ± 19.1 kg, $P = 0.01$) with higher body mass index (29 ± 9.1 vs 23.8 ± 4.5, $p = 0.0007$) than the healthy volunteers. Significant differences were observed in body water composition between patients and healthy individuals. Patients had higher values for TBW (45.3 ± 10.8 vs 38.3 ± 9.1 L, $P = 0.0004$), ECW (23.5 ± 7.4 vs 16.8 ± 4.8 L, $P < 0.0001$) and ECW/ICW ratio (1.1 ± 0.2 vs 0.8 ± 0.1, $P < 0.0001$) while ICW remained unchanged 21.8 ± 4.4 *vs* 21.4 ± 4.7, P = NS). Patients had a VE of 6.9 ± 7 *vs* −0.3 ± 0.5 L in healthy volunteers ($P < 0.0001$). Fluid distribution showed increased extracellular (24.4 ± 7.6 vs 17.5 ± 5 L, $P < 0.0001$), plasma (4.9 ± 1.5 vs 3.5 ± 1 L, $P < 0.0001$) and interstititial (17.1 ± 5.5 vs 12.2 ± 3.5 L, $P < 0.0001$) fluid in patients. There were no significant differences in protein, mineral, muscle, glycogen mass and dry weight. The ICU mortality was 37.5% (n = 24) and hospital mortality was 45.3% (n = 29). The nonsurvivors were older (70 ± 11.1 vs 57.9 ± 17.7 years, $P = 0.0001$) and shorter (167.1 ± 9.9 vs 171.9 ± 8.3 cm, $P = 0.01$) than survivors. Patients who die in the hospital had similar values for TBW and ECW but significantly lower values for ICW (20.1 ± 3.3 vs 23.5 ± 4.8 L, $P = 0.0001$), resulting in an increased ECW/ICW ratio (1.2 ± 0.2 vs 1 ± 0.2, $P = 0.0001$). Nonsurvivors had a higher VE of 8.1 ± 5.9 vs 5.7 ± 7.9 L in survivors ($P = 0.09$). Importantly nonsurvivors had significantly lower values for protein, mineral, muscle, and glycogen mass (Figs 1, 2).

Conclusions: BIA analysis allows obtaining a good idea of body water composition in critically ill patients and this may help the clinician to guide fluid resuscitation and de-resuscitation. Patients had distinct differences as compared to healthy individuals and nonsurvivors had distinct differences as compared to survivors.

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O-09. Fluid and nutrient delivery in the ICU: a retrospective review

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Background: The optimal level of fluid and nutrient delivery in the intensive care unit (ICU) remains a controversial issue [1, 2]. This study was undertaken as a baseline assessment of total fluid and nutrient delivery in a multidisciplinary adult ICU, and to determine the contribution of non-nutritional intravenous (IV) fluids to total nutrient intake.

Methods: A retrospective, descriptive, observational study in the 12-bed ICU of a Johannesburg Academic Hospital. Consecutive patients (≥ 18 years) with APACHE II scores ≥ 10 and on ≥ 72 hours nutrition therapy (NT) were enrolled. Fluid and nutrient intake via all routes, inclusive of non-nutritional energy sources (NNES), were reviewed from admission until discharge, discontinuation of NT or death for 7 days. Protein and energy delivery were compared to calculated targets of 1.3–1.5 g kg^{-1} and 25–29 kCal kg^{-1} respectively, and the data analysed.

Results: A total of 71 patients (49% male), average age 49.2 ± 17.1, average APACHE II score 21.0 ± 6.1, 68% medical and 32% surgical, were included. Mean body mass index was 28.5 ± 8.1 kg m^{-2} (range 16.7–55.1). Fluid and nutrient delivery were reviewed over 5.7 ± 1.1 days. Mean daily fluid delivery was 3.2 ± 0.6 L (1.7–5.2). IV fluid therapy contributed 32.0 ± 12.0% to total fluid delivery (TFD), whereas IV drug administration, including fluids used for reconstitution and dilution purposes, contributed 20.7 ± 8.1% to TFD. NT was initiated within 14.5 ± 14.1 hours, contributing 40.2 ± 12.1% (12.2–68.5) to TFD. The majority (80%) received enteral nutrition (EN). Mean daily protein and energy delivery were 72 ± 22 g (1.1 g kg^{-1}) and 1613 ± 380 kCal (25.1 kCal kg^{-1}), meeting 93.6 ± 17.7% and 82.8 ± 19.9% of target respectively. NNES, mostly derived from carbohydrate-containing IV fluids, contributed 10.1 ± 7.5% to total energy delivery. Mean cumulative protein and energy balance was −86.0 ± 106.9 g and −674.0 ± 1866.1 kCal respectively. The majority (73%) received > 90% of the minimum energy target but only 49% > 90% of minimum protein target. Only 59% of those with energy intake 90–110% of target had adequate protein intake. A significant negative correlation was found between cumulative protein/energy balance and the time to initiation of NT (protein: r = −0.32, $P = 0.01$; energy: r = −0.28, $P = 0.02$) (Table 1).

Conclusion: NT contributes significantly to TFD in the ICU. Early initiation of NT with conventional energy-rich EN formulae is insufficient to achieve adequate protein delivery [3]. NNES, mostly in the form of carbohydrate-containing IV fluids, add significantly to total energy delivery. The inclusion of NNES in the calculation of feeding prescriptions, along with the use of EN formulae with a more favourable nitrogen to non-protein energy ratio, may help to optimise protein delivery without simultaneously delivering excess calories.

Acknowledgments: The authors are grateful to Prof DG Nel for his assistance in the statistical analysis of the data.

Table 1. Energy contribution of non-nutritional energy sources (NNES)

Variables	n-size	Mean kCal d^{-1}		% of total energy	
		Mean ± SD (median)	Range	Mean ± SD (median)	Range
All NNES	71	156.3 ± 114.2 (133.0)	0–561.3	10.1 ± 7.5 (8.2)	0–29.1
Dextrose via crystalloids	45	85.3 ± 63.2 (65.6)	5.1–258.9	5.4 ± 3.9 (4.2)	0.3–13.4
Starch via colloids	56	49.8 ± 35.9 (41.3)	8.9–135.8	3.5 ± 3.0 (2.3)	0.4–12.7
Sucrose via Polygam	3	101.3 ± 54.6 (97.8)	48.5–157.5	4.9 ± 2.0 (4.7)	3.1–7.0
Lipid via Propofol	7	139.0 ± 120.8 (88.2)	31.2–316.6	7.2 ± 6.6 (3.8)	1.9–18.1
Dextrose via IV drug dilution	41	41.9 ± 30.0 (37.4)	4.5–112.2	2.9 ± 2.2 (2.3)	0.3–8.0
Dextrose via treatment of hypoglycaemia/ /hyperkalaemia	41	36.1 ± 25.1 (29.2)	6.1–109.8	2.3 ± 1.9 (1.7)	0.3–9.4

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O-10. The association between global hemodynamics, cerebral oxygenation and survival in post-cardiac arrest patients

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Background: the relationship between global hemodynamics, cerebral saturation and patient survival has been poorly investigated in post-cardiac arrest patients. In analogy with sepsis, current guidelines recommend to target mean arterial pressure (MAP) above 65 mm Hg. This is unsupported by mortality or cerebral perfusion data. Therefore the aims of the present study were to explore the relationships between MAP, cerebral oxygenation and survival in post--cardiac arrest patients.

Methods: Prospective observational study in 82 post--cardiac arrest patients

Results: Thirty-nine patients died and 43 survived (43/82 patients, 52%) until hospital discharge. The mean MAP range associated with maximal survival was 76–86 mm Hg (OR 2.63, 95% CI [1.01; 6.88], $P = 0.04$). Multivariate regression revealed early bystander CPR, the presence of a shockable rhythm and a mean MAP in the optimal range (OR 3.88, 95% CI [1.22; 12.33], $P = 0.02$) as independent factors associated with increased survival. Based on more than 1625000 data points, we found a strong linear relation between MAP and average cerebral saturation (R_2 0.70) until a plateau MAP of 87 mm Hg. Achievement of the currently recommended MAP above 65mm Hg was not associated with increased survival and resulted in cerebral desaturation. Based on a dynamical index of cerebral autoregulation (TOX), an optimal individual MAP per patient could be determined in 65% of our patients (mean 81 ± 19 mm Hg). The percentage of time under the predicted optimal MAP was a better predictor of mortality than the percentage of time under any other suggested fixed MAP target (OR 0.97, 95% CI [0.96; 0.99], $P = 0.02$).

Conclusion: Overall, we found a MAP between 76–86 mm Hg during the first 24 hours after cardiac arrest to result in optimal cerebral oxygenation while being associated with maximal survival. The currently recommended MAP of 65 mm Hg was not associated with increased survival and resulted in cerebral desaturation. A patient tailored MAP based on an index of cerebral autoregulation could better predict mortality than any other fixed MAP target. Our data indicate that we should target higher MAP's in general and that we should individualize our hemodynamic goals based on cerebral perfusion monitoring. Prospective intervention studies to reach or maintain these targets are needed to confirm these findings

O-11. Body water content is an index of inflammation in critically ill patients

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Background: Increase in vascular permeability is one of the main pathologies characteristics for general inflammation. Several studies have showed an association between severity of inflammation and fluid shift, which leads to tissue edema [1, 2]. Unfortunately, the correlation between body water content and severity of inflammation has been poorly documented. The purpose of the present study was to compare the severity of inflammation measured by plasma cytokine, procalcitonin and CRP-protein concentrations with body water content in septic or septic shock patients admitted into intensive care unit (ICU).

Methods: Adult patients were studied. Plasma tumour necrosis factor alpha (TNFα), interleukins: 1β (IL-1β), IL-6, IL-17α, PCT and CRP concentrations were measured immediately after patients' admission. Body water content was assessed by volume excess (VE), total body water (TBW) and extracellular body water (ECW). Whole body bioimpedance was used for VE, TBW and ECW measurement. Based on clinical outcomes, the data were analysed for patients, who survived 28 days (survivors) compared to those who died during 28 days of treatment (non-survivors).

Results: 40 patients (16 female and 24 male) aged 24–73 were enrolled. The 28 day mortality was 32.5% (13 patients). In studied population, TBW and ECW correlated with: TNFα, IL-6 and PCT. Plasma TNFα, IL-17α, PCT and CRP concentrations were significantly higher in non-survivors ($P < 0.05$), whereas IL-6 was higher in survivors group ($P < 0.05$). In survivors, VE correlated with PCT, TBW and ECW with TNFα, IL-6, IL-17α, PCT and CRP. In non-survivors, VE and ECW correlated with TNFα (Table 1).

Table 1. The correlations between body water content and proinflammatory cytokines. NS–statistically not significant correlations

		TNFα	IL-1β	IL-6	IL-17α	PCT	CRP
Studied population	VE	NS	NS	NS	NS	NS	NS
	TBW	$P < 0.01$, r = 0.46	NS	$P < 0.001$, r = 0.51	NS	$P < 0.001$, r = 0.56	NS
	ECW	$P < 0.01$, r = 0.5	NS	$P < 0.01$, r = 0.49	NS	$P < 0.01$, r = 0.46	NS
Survivors	VE	NS	NS	NS	NS	$P < 0.01$, r = 0.56	NS
	TBW	$P < 0.05$, r = 0.46	NS	$P < 0.001$, r = 0.7	$P < 0.01$, r = 0.6	$P < 0.001$, r = 0.75	$P < 0.01$, r = 0.49
	ECW	$P < 0.05$, r = 0.47	NS	$P < 0.01$, r = 0.53	$P < 0.01$, r = 0.56	$P < 0.001$, r = 0.63	$P < 0.05$, r = 0.43
Non-survivors	VE	$P < 0.05$, r = 0.65	NS	NS	NS	NS	NS
	TBW	NS	NS	NS	NS	NS	NS
	ECW	$P < 0.05$, r = 0.58	NS	NS	NS	NS	NS

Conclusions: 1) ECW is an index of severity in inflammation in critically ill patients; 2) TBW is an index of inflammation only in survivors.

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O-12. Cutaneous microcirculation in preterm neonates: comparison between Sidestream Dark Field (SDF) and Incident Dark Field (IDF) imaging

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Background: Incident dark field imaging (IDF) is a new generation handheld microscope for bedside visualization and quantification of microcirculatory alterations. IDF is the technical successor of sidestream dark field imaging (SDF), currently the most used device for microcirculatory measurements. In (pre)term neonates the reduced thickness of the skin allows non-invasive transcutaneous measurements. This study compares SDF and IDF neonatal cutaneous imaging

Methods: After written informed consent was obtained, skin microcirculation was consecutively measured on the inner upper arm with de SDF and IDF device. Images were exported and analyzed offline using existing software (AVA 3.0). Vessel density and perfusion were calculated using the total vessel density (TVD) proportion of perfused vessels (PPV) and perfused vessel density (PVD). The microcirculation images quality score was used to evaluate the quality of the video images

Results: In a heterogeneous group of twenty preterm neonates (median GA 27.6 weeks, range 24–33.4) IDF imaging visualized 19.9% more vessels resulting in a significantly higher vessel density (TVD 16.9 mm^{-1} vs 14,1 mm^{-1}, *P*-value = < 0.001). The perfusion of vessels could be determined more accurately in the IDF images, resulting in a significant lower PPV (88.7% vs 93.9%, *P*-value = 0.002). The IDF video images scored optimal in a higher percentage compared to the SDF video images (Table 1).

Conclusion: IDF imaging of the cutaneous microcirculation in preterm neonates resulted in a higher vessel density and lower perfusion compared to the existing SDF device. This is likely to be explained by the higher video-quality of the images.

Table 1. Mean microcirculatory parameters crossings, total vessel density (TVD), perfused vessel density (PVD) and proportion of perfused vessels (PPV) for small and non-small vessels measured by IDF and SDF

	IDF (n = 20)	SDF (n = 20)	Change	*P*-value*
TVD small (n mm^{-1})	14.8	12.5	+18.4%	.001
TVD non-small (n mm^{-1})	2.1	1.6	+31.3%	.070
TVD total (n mm^{-1})	16.9	14.1	+19.9%	.000
PPV small (%)	88.0	93.6	-5.6%	.003
PPV non-small (%)	95.1	98.9	-3.8%	.023
PPV total (%)	88.7	93.9	-5.2%	.002
PVD small (n mm^{-1})	13.0	11.6	+12.1%	.033
PVD non-small (n mm^{-1})	2.0	1.6	+25.0%	.103
PVD total in (n mm^{-1})	15.0	13.2	+13.6%	.001

* Wilcoxon signed rank test for paired continuous data

O-13. Sonographic B-lines and pressure of end tidal CO_2 in differentiatioing acute cardiac dyspnea

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Background: Acute dyspnea is a common presentation in the emergency department and critical care setting. Early differentiation of cardiac causes of dyspnea from pulmonary related causes is of great significance. Clinical data including history and clinical examination may sometimes fail to differentiate the cause of dyspnea. Point of care Lung ultrasound and pressure end tidal CO_2 may help to differentiate. Our study compared the diagnostic accuracy of clinical criteria for diagnosis of heart failure related acute dyspnea as calculated with modified Boston criteria to pressure of end tidal CO_2 and to b lines on lung ultrasound.

Methods: We conducted a prospective study. In Cairo university hospitals, between December 2012 to February 2014, 250 patients with acute dyspnea were recruited, of whom 25 patients were excluded. 225 patients were subdivided based on final hospital diagnosis into heart failure related acute dyspnea group (n = 118) and pulmonary (asthma/COPD) related acute dyspnea group (n = 107). History, clinical examination, standard laboratory tests, chest X ray, lung ultrasound for bilateral symmetrical b lines and pressure end tidal CO_2 level were collected.

Results: Lung ultrasound had the best performance,with sensitivity 100% and specificity of 94% and area under the receiver-operating curve (AUROC) 0.98. Clinical evaluation using modified Boston criteria had sensitivity 85% and specificity of 83% and AUROC 0.96. The pressure of end tidal CO_2 had sensitivity 79% and specificity of 79% and AUROC 0.94.

Conclusion: Point of care lung ultrasound gives accurate differentiation between cardiac related acute dyspnea from pulmonary related acute dyspnea.

Acknowledgments: We conducted our study within the course of our regular work at Cairo university hospitals, with no extra funding in any form.

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O-14. Human body fluid composition during uncomplicated pregnancy and preeclampsia: a bioelectrical impedance analysis (BIA) approach

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Background: It is well known that major fluid shifts occur during pregnancy and that these changes are different between uncomplicated and preeclamptic gestations. These fluid shifts can be measured using bio-impedance analysis (BIA). BIA is based upon the conduction of an applied electrical current at different frequencies. The intra- and extracellular fluids behave as electrical conductors, whereas cell membranes act as electrical condensers. The aim of this study was (1) to validate the BIA device, (2) to assess longitudinal changes of body fluid composition during uncomplicated pregnancies and (3) to identify the differences with preeclamptic gestations.

Methods: BIA fluid assessment (Maltron Bioscan 920-II; Maltron International Ltd, Essex, UK) was performed in supine position. Total body water (TBW) in L(%) was calculated as the sum of intra- (ICW) and extracellular water (ECW). BIA reliability was assessed by three consecutive measurements performed twice/day (AM and PM session, irrespective of physical activity or food/fluid intake) and calculation of Pearson Correlation coefficient (PCC). 14 uncomplicated pregnant women were assessed monthly between 12 weeks and term. Patients diagnosed with preeclampsia (PET, n = 30) were assessed once at the time of diagnosis. Intergroup differences according to gestational age were calculated using an independent student t-test ($P < 0.05$). A linear mixed model was fitted to the data, with two linear functions in time (weeks), one for UP and one for the preeclamptic group. In UP, allowance was made for the correlation between various measurements of the same patient.

Results: BIA reliability for all parameters was high (PCC > 0.82). TBW, ECW and the ECW/ICW increased progressively throughout UP (36.47 L ± 3.61 vs 39.61 L ± 2.66, $P = .012$; 15.88 L ± 1.82 vs 17.99 L ± 1.33, $P = 0.001$ and .76 ± .04 vs .83 ± .05, $P = 0.001$, respectively). ICW did not significantly change during pregnancy ($P = 0.117$). ECW% increased (43.48% ± 1.32 vs 45.42% ± 1.36, $P = 0.001$) and

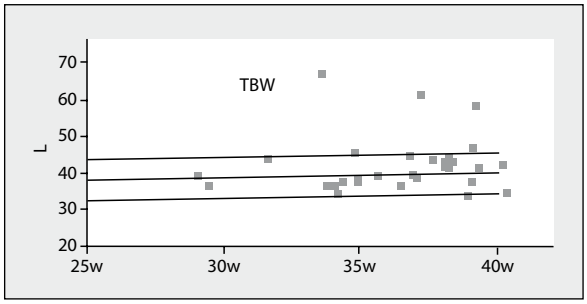

Figure 1. Longitudinal data presented as mean with 10th and 90th centile, PET plotted according to gestational age: Total body water (TBW)

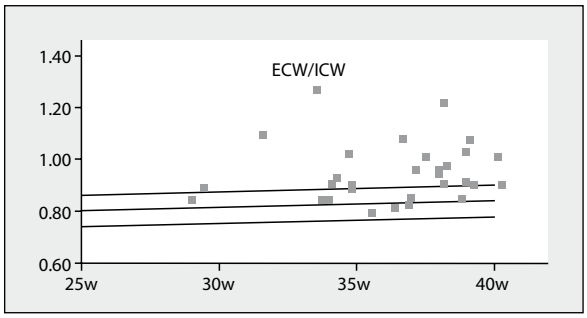

Figure 2. Longitudinal data presented as mean with 10th and 90th centile, PET plotted according to gestational age: Extracellular over intracellular water ratio (ECW/ICW)

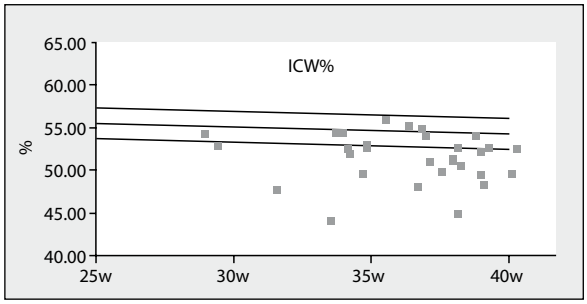

Figure 3. Longitudinal data presented as mean with 10th and 90th centile, PET plotted according to gestational age: Percentage extracellular water (ECW%)

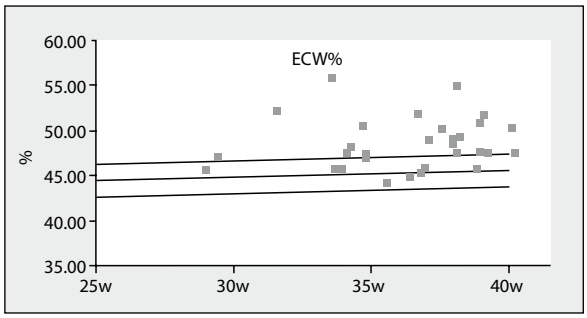

Figure 4. Longitudinal data presented as mean with 10th and 90th centile, PET plotted according to gestational age: Percentage intracellular water (ICW%)

ICW% decreased (56.51% ± 1.32 vs 54.56% ± 1.37, *P* = .001) during UP (Figs 1–4). Table 1 shows different measurements between UP and preeclamptic patients for all parameters except TBW and ICW.

Conclusion: One single BIA-measurement is valid to perform fluid assessment in pregnant patients. During UP, the gradual increase of TBW is due to increased ECW, whereas there is no change in ICW. As compared to UP, ECW% is higher in PE whereas TBW is not different.

Acknowledgments: This work is part of a PhD-thesis, which is supported by the Limburg Clinical Research Program (LCRP) UHasselt-ZOL-Jessa, supported by the foundation Limburg Sterk Merk, Hasselt University, Ziekenhuis Oost--Limburg and Jessa Hospital.

Table 1

	UP (n = 14)	PET (n = 30)	*P*-value
TBW	39.68 ± 2.76	42.22 ± 7.76	0.259
ECW%	45.55 ± 1.06	48.51 ± 2.86	0.001
ECW	18.07 ± 1.28	20.69 ± 4.89	0.010
ICW%	54.44 ± 1.06	51.48 ± 2.86	0.001
ICW	21.60 ± 1.60	21.59 ± 3.06	0.988
ECW/ICW	.84 ± .04	.95 ± .11	0.001
Gestage	36.02 ± .78	36.26 ± 2.92	0.778

0-15. Hemodynamic effects of crystalloids vs colloids: a subgroup analysis of the CRISTAL trial

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Background: The Colloids Compared to Crystalloids in Fluid Resuscitation of Critically Ill Patients (CRISTAL) multicentre randomised trial included 2857 patients (Annane *et al.* JAMA 2013). The primary outcome, 28-day mortality was not different between both groups; however mortality at 90 days was significantly lower in the colloid group. Additionally, the number of days alive without vasopressor therapy within the first 7 days was significantly higher in the colloid than in the crystalloid group. In order to better characterise these findings, we sought to compare the hemodynamic effects of crystalloids vs colloids in the subgroup of patients who underwent pulmonary artery catheterization.

Methods: We identified 221 such patients included in the CRISTAL trial. We retrospectively extracted hemodynamic data from their medical files starting at randomisation and at 3, 6 and 12 hours after randomisation. We also collected hemodynamic data at 08h00 on the 7 following days. We herein report preliminary data from 140 of these patients.

Results: 78 patients were included in the crystalloid group vs 62 in the colloid group, mean age was respectively 62 ± 17 and 68 ± 15 years (P = 0.048). Respectively 63% and 68% of the subjects were male (P = 0.5). SAPS II at inclusion was respectively 54 ± 19 and 56 ± 18 (P = 0.52) while the SOFA score at admission was respectively 9 ± 4 and 9 ± 4 (P = 0.58). Mortality at 28 days was respectively 35% and 33% (P = 1) while LOS in the ICU was respectively 20 ± 20 and 24 ± 22 days (P = 0.37). Heart rate (respectively 104 ± 24 vs 106 ± 25 bpm), systolic (112 ± 24 vs 114 ± 25 mm Hg), mean (75 ± 19 vs 77 ± 16 mm Hg) and diastolic blood pressure (59 ± 15 vs 58 ± 12 mm Hg), cardiac index (4 ± 2.3 vs 3.15 ± 1.1 L min^{-1} m^2) or capillary wedge pressure (16 ± 9 vs 13.5 ± 4.3) did not differ significantly between both groups 6 hours after inclusion. No difference was found therafter on days 1 through 7 after inclusion. Metabolic parameters did differ between both groups. 6 hours after inclusion arterial lactate levels were higher in the crystalloid group (5.2 ± 3.9 vs 3±1.7, P = 0.028) while bicarbonate levels were lower in the crystalloid group (18.4 ± 5.4 vs 21.8 ± 5.8 P = 0.016) and arterial pH levels were similar (7.28 ± 0.18 vs 7.32 ± 0.13 P = 0.42). These differences were non-significantly different between both groups on days 1 through 7 after randomisation.

Conclusion: These preliminary results indicate that crystalloid fluid therapy may be associated with microcirculatory dysfunction during hypovolemia.

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Poster presentations

P-01. Effects of supplementing resuscitation fluids with N-acetylcysteine on renal hemodynamics, oxygenation and inflammation in a rat model of septic shock

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Background: Fluid resuscitation is considered crucial for the preservation of adequate intravascular volume and blood pressure and, therefore, the promotion of microvascular perfusion and tissue oxygenation during sepsis. However, there is increasing evidence that inappropriate use of fluid resuscitation can also activate oxidative pathways and inflammation, resulting in a heterogeneous distribution of blood flow and tissue oxygenation, especially in the renal cortex, contributing to acute kidney injury (AKI). N-acetylcystein (NAC) is regarded as an important antioxidant as it is a source of sulfhydryl and glutathione groups in cells and is a scavenger of free radicals. The aim of this study was to investigate the acute effects of Hydroxyethyl starch- ringer acetate (HES-RA) as a resuscitation fluid supplemented with NAC on physiological factors and renal function during lipopolysaccharide (LPS)-induced endotoxemic shock in rats.
Methods: Rats were first randomized at the baseline (BL) time point to receive intravenous administration of 10 mg kg^{-1} LPS or vehicle in 30 min. After 120 min of evolution without fluid resuscitation, LPS groups were subsequently randomized to receive either a volume replacement regimen (n = 8) consisting of a balanced 6% HES-RA 130/0.4 dissolved in a balanced preparation (Volulyte; 30 mL kg^{-1} h^{-1}), (LPS + HES-RA)) or this volume plus NAC (150 mg kg^{-1} h^{-1}) (LPS+HES-RA+NAC). The effects of NAC was also determined in the absence of LPS (Control+NAC) as well as a Control group and LPS group without resuscitation. The resuscitation period at 180 min was defined as a steady plateau in mean arterial pressure.
Results: Fluid resuscitation significantly improved systemic and renal hemodynamic parameters. However, addition of NAC to the fluid did only improve renal parameter compared to LPS group. Compared to controls, LPS infusion induced a significant decrease of cortical renal oxygenation. Fluid resuscitation with HES-RA alone did not improve cortical renal oxygenation. Administration of HES-RA combined with NAC improved significantly cortical renal oxygenation, renal oxygen consumption and renal oxygen delivery during sepsis. Moreover, fluid supplemented with NAC improved early markers of acute kidney injury, such as NGAL or L-FABP. Fluid supplemented with NAC decreased significantly renal nitric oxide levels and hyaluronic acid levels after sepsis.
Conclusion: In conclusion, addition of NAC to fluid resuscitation may improve renal oxygenation, microvascular dysfunction and AKI. Decrease of renal nitric oxide levels and acid hyaluronic levels may be involved in this beneficial effect.

P-02. Comparative analysis of the hemostatic parameters in patients with early stage of acute necrotizing pancreatitis complicated by gastrointestinal bleeding and without hemorrhagic complications

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Background: Dysfunction of the coagulation system is one of the most important pathophysiological factors in the development of acute pancreatitis [1]. The aim of this study was to identify the differences in coagulation parameters in patients with acute pancreatitis complicated by gastrointestinal bleeding and those who did not develop GI bleed.
Methods: We studied hemostatic parameters in 70 patients admitted to the Moscow City hospital number 36 (mean age 50.04 ± 17.98 years) with acute necrotizing pancreatitis (ANP). The diagnosis of acute necrotizing pancreatitis was based on the clinical data, as well as the results of laboratory methods and instrumental investigations. On admission to the hospital, all patients had their Full Blood Count, coagulation screen, blood biochemistry performed as well as instrumental studies. All patients were divided into 2 groups:

Table1. Hemostatic parameters

	Reference	GIB	No complications
RBC — red blood cells	$4.3–5.7 \times 10^{12}$ L^{-1}	3.98 ± 1.02	4.18 ± 0.85
Hb — hemoglobin	12-16 g L^{-1}	12.13 ± 2.95	13.17 ± 2.54
Ht — hematocrit	35–54%	35.01 ± 8.9	37.93 ± 7.88
PLT — platelet number	$180–360 \times 10^9$ L^{-1}	219.27 ± 120.9	254.92 ± 114.23
PCT — platelet crit	0.108–0.282%	0.14 ± 0.07	0.2 ± 0.08
APPT — Activated Partial Thrombin Time	24–35 sec	33.22 ± 10.07	31.34 ± 9.33
INR — International Normalized Ratio	1.0–1.4	1.24 ± 0.18	1.16 ± 0.33
Fibrinogen	1.8–3.5 g L^{-1}	4.07 ± 1.51	4.95 ± 1.76
Thrombin time	12–16 sec	13.4 ± 2.59	14.68 ± 1.78
Antithrombin	80–120%	53.34 ± 22.02	62.99 ± 19.96
D-dimer HS	250–500 ng mL^{-1}	1090.5 ± 258.88	1080.03 ± 437.5
Plasmin inhibitors	80–120%	105.11 ± 23.53	102.08 ± 25.18
Plasminogen	80–120%	61.78 ± 32.62	86.44 ± 23.19
Protein S	60–140%	141.71 ± 27.02	109.74 ± 53.88
Protein C	70–130%	39.7 ± 26.62	70.02 ± 29.42
VWF — von Willebrand factor	65–166%	134.15 ± 13.08	151.27 ± 18.78

*reference data are given on the basis of *Kishkun AA:* Guide to laboratory diagnostic techniques, GEOTAR Media 2007; GIB — gastrointestinal bleeding

with no hemostatic complications (55 patients, mean age — 49.66 ± 35.2) and with hemostatic complications presented as gastrointestinal bleeding (GIB) (15 patients, mean age — 44 ± 35.2. Statistic analysis was performed using exact two-tailed Mann-Whitney-Wilcoxon criteria.

Results: Patients with severe acute pancreatitis complicated by GIB showed statistically significant lower values of platelet crit ($P = 0.04$: 0.14 ± 0.07%) compared to the patients without GIB (0.2 ± 0.08%) and statistically higher von Willebrand factor ($P = 0.04$: 134.15 ± 13.08% and 151.27 ± 18.78% respectively). They also had a significant decrease in Protein C concentration ($P = 0.002$: 39.7 ± 26.62% and 70.02 ± 29.42%, respectively). We observed lower numbers of erythrocytes (3.98 ± 1.02 × 1012 L^{-1} and 4.18 ± 0.85 × 1012 L^{-1}), increased fibrinogen concentration (4.07 ± 1.51 g L^{-1} vs 4.95 ± 1.76 g L^{-1}), higher Protein S content (141.71 ± 27.02% and 109.74 ± 53.88%), a significant elevation in the D-dimer level (1090.5 ± 258.88 ng mL^{-1} and 1080.03 ± 437.5 ng mL^{-1}), decreased antithrombin concentration (105.11 ± 23.53% and 62.99 ± 19.96%) and plasminogen (61.78 ± 32.62% and 86.44 ± 23.19%) in patients with GIB. However, our findings did not reveal statistically significant differences for those indicators. The results are summarized in Table 1.

Conclusion: in acute necrotizing pancreatitis complicated by GIB there was a significant and sharp decrease in the protein C concentration.

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P-03. Application of laser correlation spectroscopy of biological fluids for the differential diagnosis of pancreatitis

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Background: Severe pancreatitis (SP) still remains an important medical and social problem. This is due to the preferential development of SP in people of working age, early and late purulent-septic complications leading to severe

Table 1. Changes of spectral composition of plasma/serum samples for different pathologies

Pathological shifts		Changes of spectral composition of plasma/serum samples
Hydrolytically directed	Dystrophic-like	Increase of particles of the 1st fraction
	Catabolic-like	Increase of particles of the 2nd fraction
	Intoxication-like	Increase of particles of the 2nd fraction with moderate increase of particles of the 3rd fraction
Synthetically directed	Allergy-like	Increase of particles of the 4th fraction
	Autoimmune-like	Increase of particles of the 5th fraction
Combined	Allergy-dystrophic-like	Combination of increase of particles of 1st and 5th fraction
	Allergy-intoxication-like and Autoimmune intoxication-like	Combination of increase of particles of 2nd and 5th fraction

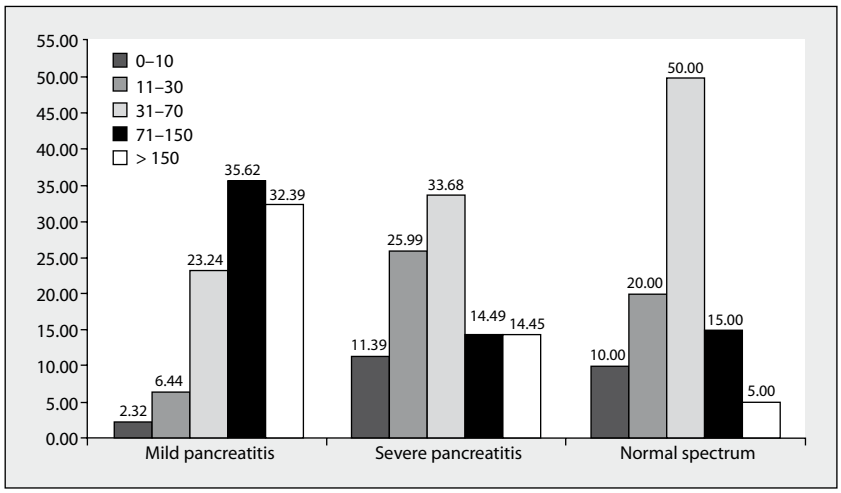

Figure 1. Laser correlation spectroscopy (LCS) of blood in patients with mild and severe pancreatitis (1st day since hospitalization)

organ failure, infectious -toxic shock, which are the cause of high mortality. Therefore, early diagnosis of SP is important for the timely initiation of intensive treatment and reduction of septic complications risk. Method of laser correlation spectroscopy (LCS) allows the study of the macromolecules spectrum (MS) in range of 5 to 5000 nm in various test environments, as well as changes in MS at various pathological processes. Given the ease of implementation, the high sensitivity of the method, even in high dilution environments, and low cost LCS is a promising method for early diagnosis, monitoring of the of treatment effectiveness and outcome prediction in patients with SP. The aim of this study was to determine changes of plasma and urine MS specific for SP and mild pancreatitis (MP) in the 1st day of the disease in order to create reliable criteria of early differential diagnosis between the SP and MP of the basis of these changes.

Methods: The study was conducted in 30 patients with MP and 39 patients with SP. Both groups were matched by sex, age, time of admission since the onset of the disease. Plasma urine samples were taken on the 1st day of stay in the hospital. Clinical and biochemical blood tests, abdomen ultrasonography (US), and in case of insufficient information of ultrasound-computed tomography (CT) scan of the abdomen — were also conducted. Results of LCS blood plasma and urine samples were analyzed and compared with currently used in clinical practice diagnostic methods of SP and MP.

Results: In patients with MP plasma SM showed a significant increase in the contribution to the light-scattering particles (LSP) in zones IV and V, which is specific for allergy-like and autoimmune-like changes. Patients with SP had increase of in LSP of plasma SM in zones I and II, which is specific for dystrophic-like and catabolic-like shifts (Table 1). LSP level in zone III in both groups is decreased (Fig. 1). Differences in SM blood plasma in patients with MP and SP are consistent with more severe intoxication, laboratory changes in the blood of patients with SP compared with those with MP, as well as by ultrasound and CT of the abdomen data. The histograms of urine in day 1 were not significantly different in patients with MP and SP and were characterized by LSP decline in zone II and increase in its level in zones I and III (Fig. 2), which is specific for dystrophic-like and allergen--autoimmune-like shifts (Table 2).

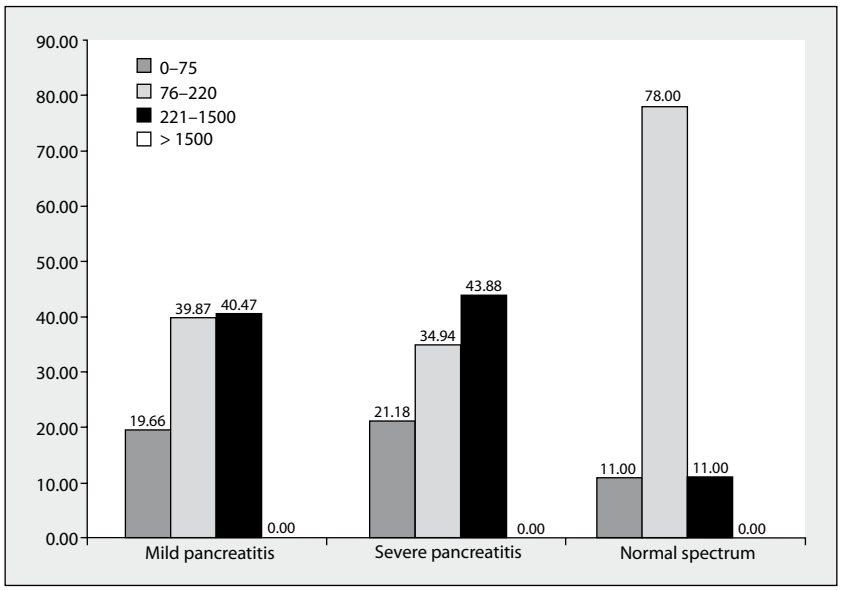

Figure 2. Laser correlation spectroscopy (LCS) of urine in patients with mild and severe pancreatitis (1st day since hospitalization)

Table 2. Changes of spectral composition of urine samples for different pathologies.

Pathological shifts		Changes of spectral composition of urine samples
Hydrolytically directed	Dystrophic-like	Increase of particles of the 1st fraction
	Catabolic-like	Increase of particles of the 2nd fraction and partially of the 1st fraction
Synthetically directed	Allergy-like	Increase of particles of the 3rd fraction
	Autoimmune-like	Increase of particles of the 3rd fraction

Conclusion: blood plasma LCS can be used for early (at day 1) differential diagnosis of MP and SP. At the present time we study this method for the purpose of pancreatitis prognosis.

P-04. Implementation of a new intravenous fluid therapy algorithm at a large UK teaching hospital

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Background: Many adult hospital inpatients need intravenous (IV) fluid therapy to prevent or correct problems with their fluid and/or electrolyte status. The National Institute for Health and Care Excellence (NICE) has recognised fluid administration as a key concern and so issued guidance in December 2013 entitled 'Intravenous fluid therapy in adults in hospital' [1]. We have performed an audit to establish current practice at our hospital and define what area's this Trust does well in and what areas it may need to improve upon. We also sent out a questionnaire survey to new first year doctors in the trust to assess their confidence in prescribing fluid, how and when they prescribe fluid, and whether they use any algorithms.

Methods: We examined the notes of 100 acute adult patients (aged 16 years or over) within the Queen Elizabeth Hospital Birmingham, UK. The 5 wards were a General Medical Ward, General Surgical Ward, Geriatric Ward, Trauma Ward and an Acute Admission Ward. 10 data sets were collected from each ward on 2 separate occasions, making a total of 100. The questionnaire was sent to all new first year doctors via an online questionnaire site. When the next group of new doctors started at the hospital we delivered a teaching session on fluid management. The questionnaire survey was then sent out to this new set of first year doctors to assess any difference in confidence and prescribing practice.

Results: Data was collected from 56 females and 44 males. 78 were greater than 60 years of age. 58/100 patients' fluid and electrolyte needs were assessed on the day of study. 16 patients were prescribed IV fluid therapy for routine maintenance alone. 31% had an appropriate 25–30 mL kg^{-1} per day volume of water prescribed, 19% had approximately 50–100 g per day of glucose prescribed, but

not a single patient had prescribed the approximate 1 mmol kg^{-1} per day of potassium, sodium and chloride recommended. The initial questionnaire returned 71 replies. 66 (94%) felt confident to prescribe IV fluid. 36 (50%) of respondents had received formal teaching in intravenous fluid therapy in the last 2 years. 18 (26%) used a particular system or algorithm for prescribing fluids. The repeat questionnaire returned 60 replies. 60 (100%) felt confident to prescribe IV fluid. 56 (93%) had now received formal teaching in the past 2 years. 40 (66%) used a particular system or algorithm for prescribing fluids.

Conclusions: Documentation of assessment of patient's fluid and electrolyte needs happened at only 58% of the daily ward reviews. The actual number assessed may be higher but without documentation to that effect we are unable to confirm this. None of the prescriptions we saw contained the daily electrolyte amounts recommended by NICE. A formal teaching session for newly started doctors increased confidence in prescribing IV fluids. More doctors also tended to use a system or algorithm to prescribe IV fluid.

Reference

1. http://www.nice.org.uk/nicemedia/live/14330/66015/66015.pdf

P-05. The orthostatic hemodynamic response identifies hypertensive diseases in pregnancy

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Background: Posture changes elucidate cardiovascular responses, which may differ between types of hypertensive disease. The aim is to evaluate the orthostatic response of impedance cardiography (ICG) measurements from supine to active standing position, in uncomplicated and hypertensive pregnancies.

Methods: A standardized ICG protocol in supine and standing position was performed in 5 groups of women: early (< 34weeks) and late (> 34weeks) uncomplicated pregnancies, gestational hypertension (GH), early-onset (EPE, < 34weeks) and late-onset (LPE, > 34weeks) preeclampsia. Measurements were recorded of blood pressure, aortic flow velocity and acceleration, Heather index, cardiac output, pre-ejection period and left ventricular ejection time.

Results: 202 patients were assessed: 41 uncomplicated pregnancies (19 early and 22 late), 59 GH, 35 EPE and 67 LPE. There was no difference in orthostatic shift between early and late uncomplicated pregnancies. Orthostatic shifts were different between all other groups ($P < .001$). Uncomplicated pregnancies were different from the hypertensive complicated gestations in the orthostatic change of the aortic acceleration. In contrast to patients with preeclampsia, those with GH had an increased blood pressure and Heather index, and stable pre-ejection period after posture change. EPE differed from LPE by change in blood pressure and aortic flow parameters. In addition to static ICG-measurements, orthostatic shifts improved group characterization from 57.4% to 65.8%.

Conclusion: The orthostatic response assessed by ICG--measurements is similar in early vs late uncomplicated pregnancy, but significantly altered in hypertensive pregnancies. ICG measurements in the upright as well as during an orthostatic test might have the potential to improve the diagnostic yield to identify preeclampsia.

Acknowledgments: This work is part of a PhD-thesis, which is supported by the Limburg Clinical Research Program (LCRP) UHasselt-ZOL-Jessa, supported by the foundation Limburg Sterk Merk, Hasselt University, Ziekenhuis Oost--Limburg and Jessa Hospital.

P-06. Pitfalls of rectal intra-abdominal pressure measurements in pregnant women

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Background: It has been suggested that intra-abdominal pressure (IAP) might play a role in the pathophysiology of gestational complications [1]. However, no data about the normal evolution of IAP throughout the course of pregnancy is available in literature. Rectal IAP-measurements (rIAP) seems to be a minimally invasive method to assess IAP. However, to date no standardized protocol is known to measure rIAP in pregnant women. The aim of this study is to measure rIAP throughout the course of normal pregnancy.

Methods: rIAP was measured using a 12CH 2-lumen rectal catheter (Andromeda, Potzham, Germany) (Fig. 1) connected with a pressure transducer system. This unit was flushed

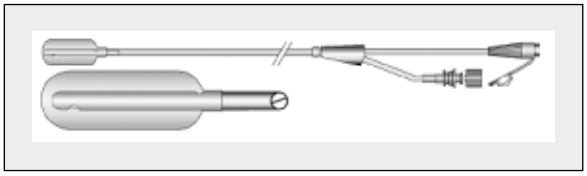

Figure 1. Rectal catheter

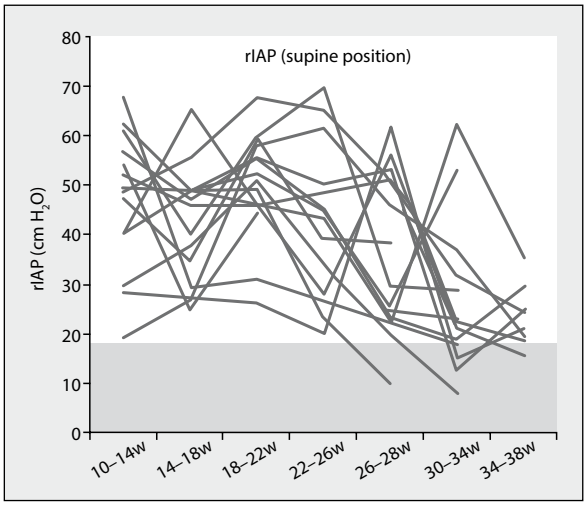

Figure 2. Evolution of rectal IAP during pregnancy

before measurement to avoid column discontinuity from air bubbles. The balloon-tipped catheter was inserted into the rectum and inflated with a saline solution. To avoid displacement during the measurement, the catheter was attached to the leg of the patients. A rapid oscillation test was performed by asking the patient to cough. Measurements were performed in supine, dorsal recumbent position and standing position. After each position change, the pressure transducer was equalized with the rectal catheter and calibrated to the ambient pressure. After informed consent, rIAP-measurement was performed in 23 healthy term pregnant women by 2 researchers. Inter- and intraobserver variability was calculated for repeated measures without removing the rectal catheter or deflating the balloon. Following this, rIAP was measured monthly in 15 healthy pregnant women from the first trimester till term.

Results: In term pregnancy, intra-observer correlation was > 0.936 ($P < 0.001$) in all positions for both researchers. Inter-observer correlations exceeded 0.95 ($P < 0.001$) in every position. Throughout the course of pregnancy, strongly fluctuating measurements were observed within a patient, with most values out of the reported physiological range (Fig. 2).

Conclusion: rIAP measurements in pregnant women is unreliable according to the protocol presented in this study. There are different explanations for this: (a) volume of inflated fluid and thereby the wall stress of the balloon (b) the presence of stool into the rectum, (c) peristaltic movements of the bowel, (d) fetal position and movements. A different technique for rIAP and/or a different route measurement according to a standardized protocol is preferable.

Acknowledgments: This work is part of a PhD-thesis, which is supported by the Limburg Clinical Research Program (LCRP) UHasselt-ZOL-Jessa, supported by the foundation Limburg Sterk Merk, Hasselt University, Ziekenhuis Oost--Limburg and Jessa Hospital.

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P-07. Intravenous fluid management in emergency admission

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Background: Fluid management is a common intervention in Acute Medicine. Junior doctors often have the task of prescribing intravenous fluids [1]. We set out to assess the knowledge and practice of doctors prescribing intravenous fluids to patients on admission in a large teaching hospital, as compared to the NICE guidelines published in December 2013.

Methods: Pre-audit questionnaire was used to assess knowledge of foundation doctors regarding intravenous fluid management. This was carried out prior to any formal teaching on fluid management. Forty patients (20 medical and 20 surgical) who were admitted as an emergency in the previous 48 hours and received intravenous fluids were randomly chosen. Data was collected from medical notes and electronic prescribing system, including the purpose of intravenous fluids, co-morbidities, clinical and laboratory features used to guide fluid management, the type, volume and rate of fluid administered, and whether their fluid and electrolyte status was reassessed.

Results: Only 14% of junior doctors knew the volume of routine maintenance fluid per kg body weight per day, and 30% knew the maintenance amount of potassium. Regarding fluid resuscitation, 50% chose the correct combinations of type, volume and rate of intravenous fluids. Assessment of fluid status was generally poor, with most clinical signs such as capillary refill time and mucous membranes not being recorded. In patients requiring fluid resuscitation, 93% received 0.9% sodium chloride or Hartmann's solution, and others received colloids. 77% received 1 L of the chosen fluid, and 54% was prescribed as "stat" on the drug chart. Six out of 40 patients received fluids solely for maintenance, were nil by mouth and were not considered to be fluid deplete. For these patients, only one patient received any potassium

in the first 48 hours, and 2 patients received any glucose. The volume of fluid was variable, ranging from 10 mL to 49 mL kg^{-1} per day.

Conclusion: The questionnaire suggested that junior most doctors did not know the amount of fluid and electrolytes that should be administered for routine maintenance. They had better knowledge regarding fluid resuscitation. Assessment of fluid status was poor, and the few patients receiving intravenous fluids for maintenance did not receive sufficient potassium or glucose. The results suggest that further education of junior doctors will improve intravenous fluid prescribing. Future work includes formal teaching sessions and the development of hospital guidelines that are accessible through the electronic prescribing system.

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P-08. A multifaceted approach towards implementing NICE guidelines on Intravenous (IV) fluid therapy in a UK district general hospital

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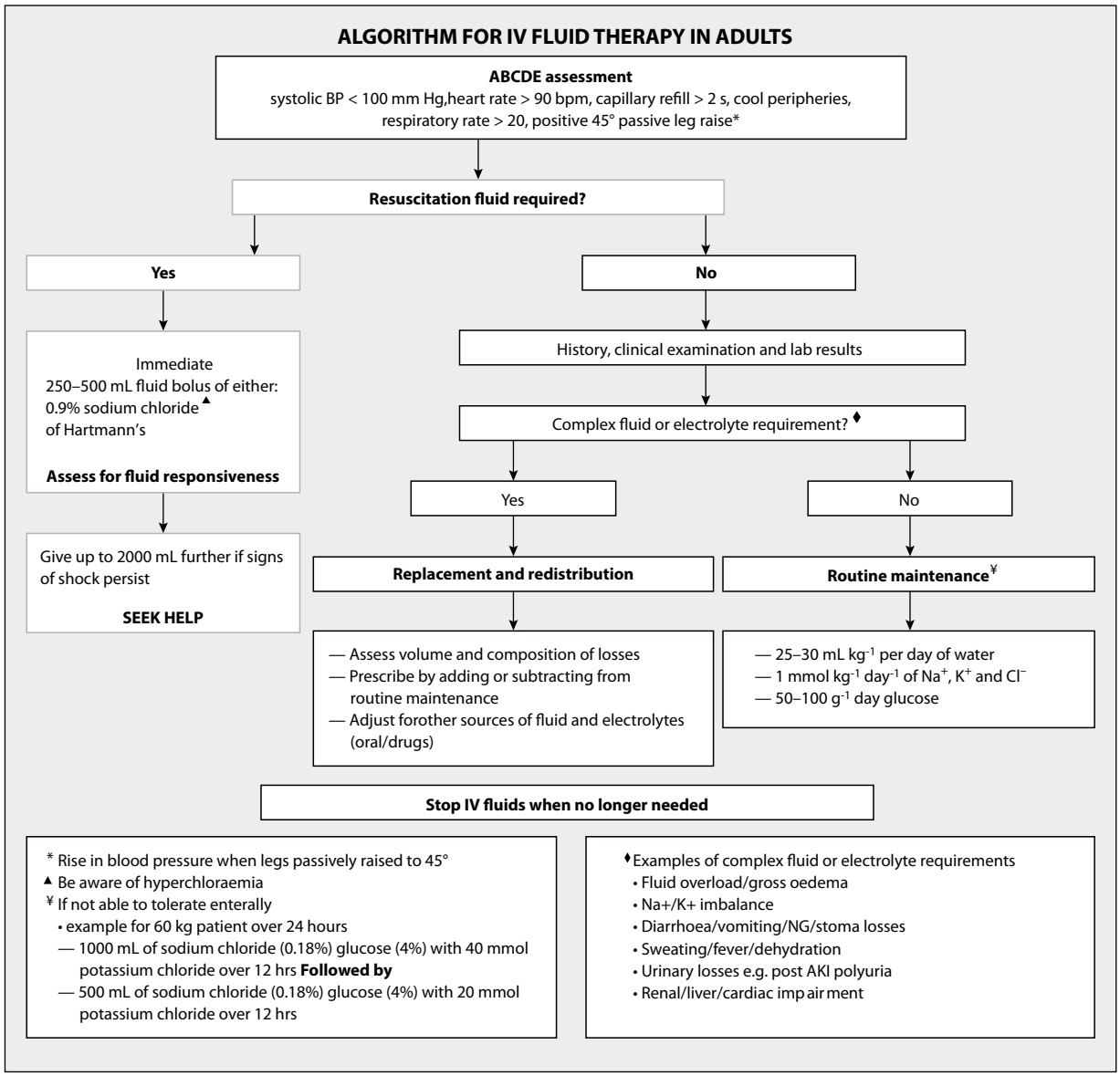
Background: Evidence based clinical guidelines on IV fluid therapy in hospitalised adults were published by National Institute for Clinical Excellence (NICE) in UK [1]. Previous national level enquiry in UK highlighted significant number of deaths due to inappropriate fluid management [2]. NICE recognises that as many as 1 in 5 patients on IV fluids and electrolytes suffer complications or morbidity due to their inappropriate administration. With this background, we audited our fluid management practice in a cohort of mixed medical and surgical patients over the age of 16; followed by multifaceted intervention including education, training and simplified protocol to improve fluid management.

Methods: We prospectively collected data on fluid prescriptions and collaborative information from patient notes and observation charts using NICE audit tool. The data was analysed using NICE Microsoft excel spread-sheet tool. The information regarding outcome of this audit was presented at clinical governance meetings to highlight deficiencies in fluid prescriptions and potential harm that may have been caused as a result. The second step involved a hospital wide educational programme for the junior doctors to increase their awareness of the guidelines as well as to improve their understanding of the principles behind fluid and electrolyte management for acutely unwell hospitalised patients. For third step; we adopted the NICE fluid management protocol (supplementary material) in to a poster format for local use. This has been submitted to the trust safe medicine prescription committee for review and implementation on all the acute wards in the hospital. The recommendation will be available in October 2014.The fourth step included devising

Table 1. IV fluid therapy audit results

	Domain	Result
	Total number of patients reviewed	210
	Patients on IV fluid therapy	89 (42.4%)
A	**Patients on routine maintenance**	**34/89**
A1	Patients meeting entire standards of water, electrolytes and energy requirements	2/34 (6%)
A2	Patients meeting standards of water requirement	16/34 (47%)
A3	Patients meeting standards of electrolytes (Na+, K+ and Cl-) requirement	5/34 (15%)
A4	Patients meeting standards of Glucose requirement	14/34 (41%)
B	**Information regarding rate, volume and type of fluid in prescription**	**89/89 (100%)**
C	**Adequacy of fluid prescription over entire 24 hrs**	
C1	Documentation of full standards over 24 hrs	39/89 (44%)
C2	Documentation of details of fluid and electrolyte prescription over 24 hrs	59/89 (65%)
C3	Documentation of details of the assessment	58/89 (64%)
C4	Documentation of details of the monitoring plan	40/89 (45%)
D	**Patients requiring IV fluid resuscitation**	**17/89 (19%)**
D1	Identification of the cause of fluid deficit	14/17 (82%)
D2	Fluid bolus of 500mls given if appropriate	5/17 (29%)
D3	Reassessment of patients who received initial fluid resuscitation	11/17 (65%)



a fluid management document (supplementary material) to prompt daily assessment of fluid and electrolytes requirement and their accurate prescription.

Results: We audited 210 medical and surgical patients over the age of 16. Four key domains of IV fluid prescription as suggested by the NICE (routine maintenance; Information regarding rate, volume and type of fluid; adequacy of fluid prescription over entire 24 hrs and management of patients needing fluid resuscitation) were audited and the findings are presented in the tabular form. These results indicate that although for an individual bag of fluid prescription details of type and rate are included; they seldom fulfil the criteria for water, electrolytes and energy provision. The results also suggest a lack of holistic 24 hrs fluid assessment and management plan for a significant number of patients (Table 1).

Conclusion: Deciding on the optimal composition, volume and rate of fluid prescription can be complex and often left to junior doctors. Our audit has highlighted significant short-comings in this area of clinical medicine which led us to implement educational tools for the junior doctors. This teaching is now a routine part of new doctors' educational activity.

Acknowledgments: Audit Department and Pharmacy Directorate Princess Royal Hospital TELFORD

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P-09. Fluid balance does not predict estimated sodium balance in critically ill mechanically ventilated pediatric patients

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Background: Distribution of total body water (TBW) depends on local and systemic factors including osmolality, relative sodium content and permeability. Although positive fluid balance has been associated with increased morbidity and mortality in critically ill pediatric patients, the mechanisms and relative roles of sodium balance and water distribution are uncertain.
Methods: The aim of this study was to track changes in sodium and fluid balance, respiratory function and body composition in patients who required mechanical ventilation for > 48 hours. Prospective observational study, set in a tertiary intensive care unit, of 42 patients with a mean age of 10 years (standard deviation [SD], 2 years) and mean admission Acute Physiology and Chronic Health Evaluation (APACHE) III score of 67 (SD, 27). Sodium and fluid balances were estimated daily for up to 5 days, following institution of mechanical ventilation on Day 0. Serum sodium level, oxygenation (PaO_2/FIO_2), body weight, intracellular and extracellular fluid (ECF) distribution (bioelectrical impedance spectroscopy), and blinded chest x-ray oedema scores were performed daily.
Results: After 5 days of mechanical ventilation, the cumulative fluid balance was — 563 mL (SD, 1148 mL) and estimated cumulative sodium balance was 248 mmol (SD, 342 mmol). Serum sodium had increased from 141 mmol L^{-1} (SD, 4 mmol L^{-1}) to 148 mmol L^{-1} (SD, 5 mmol L^{-1}). Cumulative sodium balance was weakly correlated with worsening chest x-ray score ($r = 0.34$, $P = 0.003$), a reduction in PaO_2/FIO_2 ratio ($r = -0.50$, $P = 0.001$) and 24-hour urinary sodium ($r = -0.22$, $P = 0.02$). Between Days 1 and 5, body weight decreased (−1.4 kg; SD, 0.8 kg) and TBW decreased (−2.2 L; SD, 0.7 L), despite a rise in ECF distribution (1.3% of TBW; SD, 1.7% of TBW).
Conclusions: Fluid balance may not reflect sodium balance in critically ill pediatric patients. As sodium balance correlates with respiratory dysfunction and increased extracellular volume, further studies examining sodium balance and morbidity seem warranted.

P-10. Association of positive fluid balance with complications and abdominal compartment syndrome after laparotomy in children

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Background: The purpose of this study was to explore the influence of positive fluid balance on complications abdominal compartment syndrome after laparotomy in children
Methods: After approval from an institutional review board, a retrospective cohort study was conducted. All consecutive patients undergoing laparatomy between January 1, 2009 and September 1, 2014 in a single medical center were recruited. The primary outcome of the study was the incidence of complications abdominal compartment syndrome. Univariate and multivariate risk regression analyses were used to evaluate the association between positive fluid balance and complications abdominal compartment syndrome.
Results: A total of 543 patients were included in this study. The incidence of abdominal compartment syndrome complications after laparatomy in children was 9.02% (49 of 543). Patients with positive fluid balance > 2,000 mL had a significantly higher incidence of abdominal compartment syndrome complications than those with positive fluid balance > 2,000 mL (24.3% vs 6.7%, $P = 0.005$). Univariate risk regression showed that positive fluid balance > 2,000 mL was a significant risk factor (risk ratio = 3.15, 95% confident interval [CI] = 1.42–6.78, $P = 0.004$). After adjustment for all potential confounding variables during multivariable risk regression analysis, positive fluid balance > 2,000 mL remained a strong risk factor for abdominal compartment syndrome complications (risk ratio = 2.12, 95% CI = 1.28–3.32, $P = 0.001$).
Conclusion: Positive fluid balance was a significant risk factor for abdominal compartment syndrome complications. Strategies to minimize positive fluid balance during surgery for patients at high risk of abdominal compartment syndrome complications include preparing adequate blood and blood products, considering appropriate hemoglobin level as a transfusion trigger, and adjusting the optimal dose of local anaesthetic for intraoperative epidural analgesia.

P-11. Risk of major bleeding with the use of low molecular weight heparines

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Background: Low molecular weight heparines (LMWH) are nowadays widely used for the prevention and treatment of thromboembolic disorders. Severe bleeding with LMWH treatment is a known complication, however underestimated in severity and frequency especially in the elderly. In clinical practice, bleeding events under LMWH administration appear to be a common reason for admission to the intensive care unit (ICU).

The aim of this study was to determine the frequency and the severity of major bleeding caused by LMWH with need for ICU admittance. We also would like to identify the risk factors.

Methods: We performed a retrospective observational single centre study in a 30 bed mixed ICU of a 3th-line non university hospital. Over a period of 5 years (January 1, 2009 and January 1, 2014) all patients admitted with major bleeding caused by LMWH were identified. Demographic characteristics, dose of LMWH and relevant clinical data were recorded.

Results: Among the patients analysed, 32 patients were admitted to the ICU because of major bleeding while under LMWH treatment. Most bleeding events occurred in patients receiving therapeutically dosed LMWH (n = 21, 65.6%). Two-thirds of the patients were men, and more than 40% of them were aged 80 years or older (mean age ± SD: 75.1 ± 11.2 years). Retroperitoneal bleeding was the most common localization (n = 9, 28.1%), followed by upper GI tract bleeding (n = 8, 25.1%). Mean ± SD hemoglobin value was 7.9 ± 1.76 g dL^{-1}. Although renal impairment is known to be associated with an increased risk of bleeding under LMWH treatment, 13 out of 32 patients (40.6%) included in this study had an apparently normal creatinine level below 1.0 mg dL^{-1} on admission.

Conclusions: The risk of major bleeding in patients receiving LMWH is real and should not be underestimated. The results of this study indicate that precaution is warranted with the use of LMWH, especially in elderly patients who appear to be particularly at risk of serious bleeding.

P-12. PROtocolized Care to Reduce HYpotension after Spinal Anesthesia (ProCRHYSA trial)

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Background: The PROtocolized Care to Reduce HYpotension after Spinal Anesthesia (ProCRHYSA trial) is a randomized, monocentric, prospective, three-arm, parallel-group trial created to assess if a controlled volemic repletion can reduce both episodes of significant hypotension and total amount of fluid given in patients undergoing spinal anesthesia. Spinal anesthesia is a regional anesthesia technique widely employed in clinical practice. The common side effects consist in a reduction of systemic vascular resistances, with systemic hypotension. To prevent this complication an administration of fluids is widely used. However this repletion is accomplished on empirical basis, without having an insight of hemodynamic status, carrying risk of possible volume overload [1–19]. The aim of this presentation is to state our analysis and statistical plan for trial data.

Methods: Our plan is to guide data collection and analysis using non-invasive test like echocardiography and Passive Leg Raising Test to determine an adequate volemic repletion before spinal anesthesia. Here we develop a protocoled care with this two experimental approaches and compare it to the usual standard care (Fig. 1).

Results: The hypothesis that we want test is that the use of these two methods before spinal anesthesia, compared to the standard method (empirical fluid administration) can reduce the impact of systemic hypotension through an adequate titrated volemic repletion, avoiding both hypotension and fluid overload. The final purpose is to ensure spinal anesthesia in the safest possible way.

Conclusions: By using measures to adequate volemic repletion before spinal anesthesia, we hope to reduce episodes of arterial hypotension in order to open the way for new applications for local anesthesia (for example, in frail or unstable patients).

Acknowledgement: The trial is registered on www.clinicaltrials.gov with number NCT02070276. Special thanks to Dr. Costanzo Limoni for the statistical analysis plan

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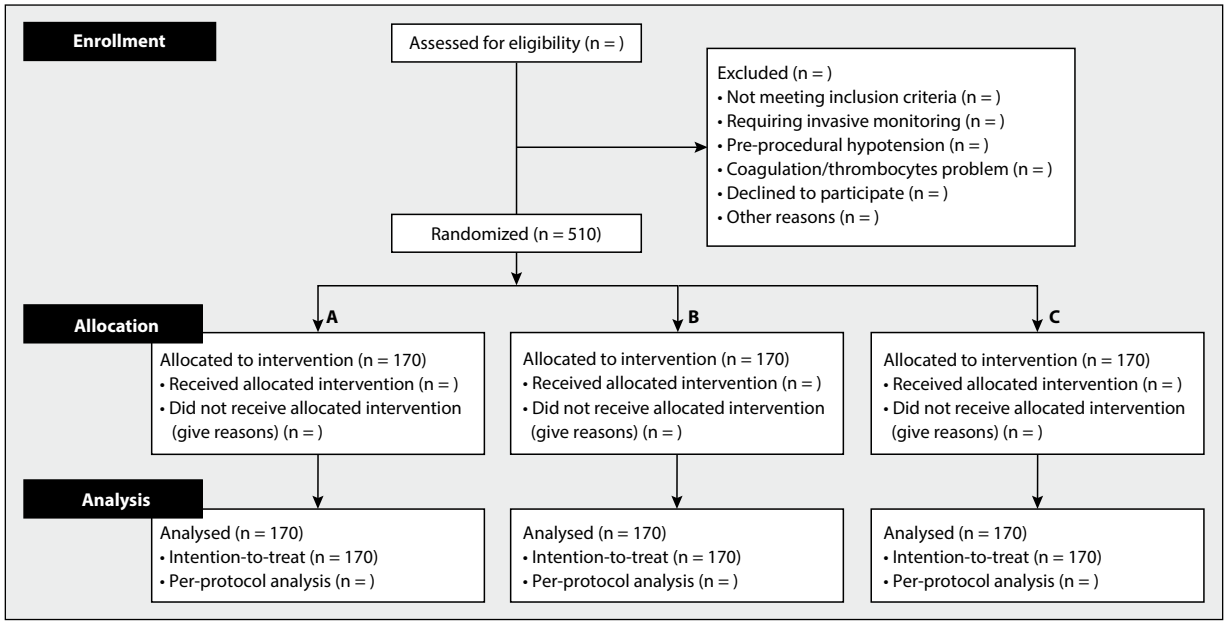

Figure 1. Study plan

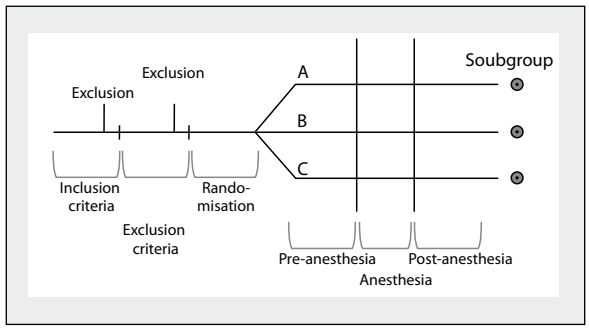

Figure 2. Randomisation and stratification

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P-13. L-lysine aescinate improves intestinal barrier permeability during severe acute pancreatitis

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Background: Gastrointestinal tract barrier disruption is involved in the development of systemic septic complications of sever acute pancreatitis (SAP) [1, 2]. Still there is no effective treatment of such unfavorable event of pathogenesis of SAP. So aim of our research was to investigate the effect of lysosomal ferments inhibitor L-lysine aescinate on structure of small intestinal barrier (glycoproteins and proteoglycans of mucus and extracellular matrix) and permeability during SAP.

Methods: SAP was induced in 90 Wistar rats by intraperitoneal injection of 250 mg per 100 g of L-arginine solution twice during 1 hour [3]. L-lysine aescinate has been infused intraperitoneal 0.015 mg per 100 g twice per day in 1 group or normal saline — in 2 group. Changes of level of oxyproline, hexosamine, fucose, sialic and hexuronic acids were investigated in small intestinal mucus and mucosal layer and in serum during 6–48 h after induction of AP. Intestinal permeability was evaluated by lactulose/mannitol ratio [4].

Table 1. Influence of l-lysine aescinate on small intestinal permeability during severe acute pancreatitis (mean ± SD)

	Hematocrit		Lactulose/manitol urinary excretion ratio		Oedema index		Ascites mL	
	1	2	1	2	1	2	1	2
Sham-operated	0.47 ± 0.03		0.0146 ± 0.005		0		0	
6 hours	0.54 ± 0.02	0.53 ± 0.03	0.0346 ± 0.0035*	0.0226 ± 0.0031**	2.1 ± 0.1	1.7 ± 0.2	3.7 ± 0.2	2.4 ± 0.3**
12 hours	0.61 ± 0.04*	0.56 ± 0.03	0.0587 ± 0.0038*	0.0411 ± 0.0027	2.8 ± 0.2	2.1 ± 0.2	5.9 ± 0.3	3.0 ± 0.1**
24 hours	0.60 ± 0.02*	0.52 ± 0.02**	0.0768 ± 0.0032*	0.0257 ± 0.0041**	2.8 ± 0.3	1.6 ± 0.2**	7.4 ± 0.5	2.8 ± 0.3**
48 hours	0.56 ± 0.04	0.49 ± 0.04	0.0535 ± 0.0043*	0.0221 ± 0.0053**	2.9 ± 0.1	1.1 ± 0.3**	7.7 ± 0.4	3.2 ± 0.5**

*$P < 0.05$ in comparison with sham-operated group; ** $P < 0.05$ in comparison with sham-operated 1 group; 1 — animals with SAP; 2 — animals with SAP and L-lysine aescinate infusion

Table 2. Influence of l-lysine aescinate on mucus glycoprotein contents of small intestine during severe acute pancreatitis (mean ± SD)

	Sialic acids (μmol g^{-1})		Hexosamines (μmol g^{-1})		Fucose (μmol g^{-1})		Hexuronic acids (μmol g^{-1})		Hydoxyproline (μmol g^{-1})	
	1	2	1	2	1	2	1	2	1	2
Sham-operated	30.6 ± 0.67		101.4 ± 6.7		1.53 ± 0.077		30.6 ± 2.7		0.269 ± 0.011	
6 hours	41.7 ± ± 0.57*	32.4 ± ± 1.5**	148.7 ± ± 11*	120 ± ± 9	1.67 ± ± 0.09	1.75 ± ± 0.11	56.5 ± ± 5.7*	32.4 ± ± 1.5**	0.44 ± ± 0.015*	0.29 ± ± 0.012**
12 hours	42.4 ± ± 2.67*	35.0 ± ± 1.1**	138 ± ± 12*	111 ± ± 8**	1.68 ± ± 0.12	1.60 ± ± 0.11	57.9 ± ± 2.3*	35.0 ± ± 1.1**	0.4 ± ± 0.021*	0.3 ± ± 0.018**
24 hours	40.6 ± ± 1.36*	29.8 ± ± 4.3	136 ± ± 9*	127 ± ± 8	1.601 ± ± 0.09	1.19 ± ± 0.08	58.4 ± ± 3.6*	29.8 ± ± 4.3**	0.38 ± ± 0.018	0.34 ± ± 0.022
48 hours	33.8 ± ± 2.67	29.0 ± ± 3.3	123 ± ± 7*	108 ± ± 6	1.53 ± ± 0.12	1.45 ± ± 0.08	56.7 ± ± 6.1*	29.0 ± ± 3.3**	0.44 ± ± 0.017*	0.3 ± ± 0.021**

*$P < 0.05$ in comparison with sham-operated group; **$P < 0.05$ in comparison with sham-operated 1 group; 1 — animals with SAP; 2 — animals with SAP and L-lysine aescinate infusion

Results: In animal of 2 group induction of SAP was followed by disorders of structure of intestinal barrier: concentration of free oxyproline, hexosamine, fucose, sialic and hexuronic acids increased on 33,6–56,8% ($P < 0,05$) during 6–48 h both in small intestine and blood which was followed with elevation of lactulose/mannitol ratio on 3,5–5,2 times. L-lysine aescinate infusion in 2 group significantly decreased concentration of free connective tissue markers and normalized intestinal permeability.

Conclusion: Infusion of L-lysine aescinate to rats with SAP defenses small intestinal mucosal glycoproteins and proteoglucans from lysosomal ferments activity and normalizes intestinal permeability.

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P-14. Selective binding of intestinal lipopolysaccharide decreases tissue injury during acute pancreatitis

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Background: Sepsis and multiple organ failure remains the most common cause of morbidity and mortality in severe acute pancreatitis (SAP) [1, 2]. The aims of this study were to determine the role of gut-derived lipopolysaccharide (LPS) in the pathogenesis of tissue injury and evaluate the effects of the selective binding of LPS by enteral administration of polymyxin (PMX) [3].

Methods: In 200 rats SAP was induced by intraperitoneal injection of 250 mg per 100 g of 20% L-arginine [4]. Enteral administration of 2 mg kg^{-1} of PMX every 6 h has been started just after SAP initiation in PMX high dose (PHD) group, 1 mg kg^{-1} every 12 h in PMX low dose (PLD) group, 1 mg kg^{-1} included in chitosan nanoparticles every 12 h

in PMX nanoparticles (PN) group and normal saline — in non-treated (NT) group. Levels of LPS in feces, portal and system blood were determined using quantitative spectrophotometric LAL test, central venous concentration of sCD14, TNFα — with commercial ELISA kits. Morphological changes in pancreas, other internal organs and intestinal microbiota have been studied during 7 days of acute pancreatitis.

Results: The mean LPS contents in sham controls were 80–220 mg per gram of faeces and 1,6–21 mg per gram of mucus. They were significantly increased in faecal and mucus material from different segments of the intestinal tract at 1–7 days after SAP initiation in NT animals accompanying with 3–8 times elevation of their portal and system blood contents. Furthermore, the increased LPS levels paralleled the overgrowth of gram-negative bacilli in the intestine. In response to LPS translocation sCD14 concentration elevated 2-3 times and TNFα — 10–15 times, which were followed with serious morphological injury of pancreas, liver and small intestinal mucosa. After intragastric administration of the PMX there was a reduction in the mean LPS levels of faecal supernatants to less than 0,1–10 per cent in all treated groups, but in mucus such events appeared only in PN group. LPS concentrations in portal and system blood were similar to sham control level in PN and elevated 2 and 4–5 times in PHD and PLD animals. Administration of PMX reduced amounts of sCD14 and TNFα in all treatment cases, but only in PN group there levels were close to sham animals (Fig. 1). Besides, histological investigation revealed that tissue injuries were much lesser in case of PMX nanoparticles

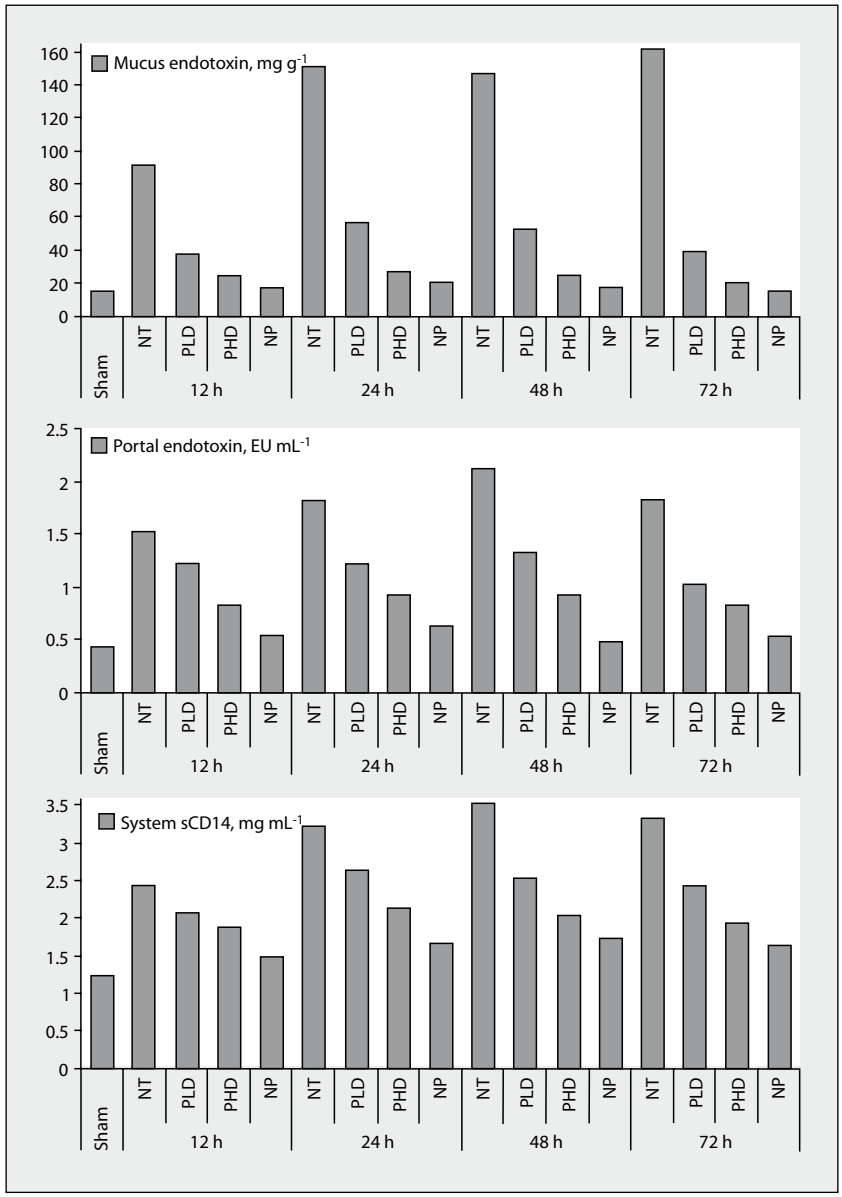

Figure 1. Evolution of endotoxin levels; see text for explanation

application even in comparison with PHD regimen and was not followed by dysbiotic changes of intestinal microbiota. In PLD group morphological changes in pancreas and internal organs were not significantly different from NT animals.
Conclusions: Selective binding of gut-derived LPS during SAP by enteral administration of PMX effectively decrease tissue injury in case it is incorporated to muco-adhesive nanoparticle delivery system or applied in high dose regimen.

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P-15. Sepsis with MODS and right ventricular heart failure caused by an obstruction of the urinary tract: a case report

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Background: Sepsis in Intensive Care Unit is related with considerable morbidity and mortality. It is also the most common cause of multiple organ dysfunction syndrome (MODS). Despite of extensive organ support, our therapeutic efforts are not successful in approximately one third of patients. In this case report we describe a case of sepsis shock due to an obstructive lithiasis in urinary tract, resulting in multiorgan failure with domination of right ventricular hearth failure.
Case report: A 73-year-old woman with hypertensis, type-2-diabetes and persistent atrial fibrillation was admitted to a hospital for hematemesis and signs of sepsis. The source of sepsis originated in urogenital system–lithiasis in right urinary tract. Despite swift insertion of percutaneous nephrostomy situation progressed to a septic shock with multiple organ dysfunction syndrome (cognitive dysfunction, cardiovascular, respiratory and renal failure, coagulopathy). Subsequently severe cardial instability with massive inotropic and vasopressoric support and continuous renal replacement therapy need occurred. Hemodynamic monitoring via pulmonary artery catheter showed domination of right ventricular heart failure. Strictly controlled infusion therapy based on pulmonary artery catheter monitoring was needed. After 12 days at ICU patient vital functions recovered, however intermittent dialysis need remained. During six months of follow-up, situation resolved in full restoration of the kidney functions.
Discussion: In this case, the swift insertion of nephrostomy, early Surviving Sepsis Campaign Bundles use along with hemodynamic monitoring via pulmonary artery catheter resulted in full recovery, however need of intermittent dialysis temporarily remained. Specific treatment regimes in the case of septic shock remain contentious due to a lack of adequately powered studies showing optimal haemodynamic goals or inotropic agents. Prompt diagnosis is crucial to the management of sepsis, as initiation of early goal directed therapy is the key to reducing mortality from sepsis shock.

Key words: sepsis, MODS, right ventricular heart failure, hemodynamic monitoring, PAC, goal-directed-therapy

P-16. The use of bioimpedance spectroscopy to monitor the fluid status in hemodialysis patients

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Background: Achieving and maintaining optimal fluid status and blood pressure remains a major challenge in chronic haemodialysis patients. Since 2012 we are using a whole-body bio impedance spectroscopy (50 frequencies, 5–1,000 kHz), to assess body composition (Body Composition Monitor–BCM, Fresenius Medical Care) and fluid status in our dialysis unit.
Methods: When requested by the attending physician the body composition was measured prior to the start of a haemodialysis session. In this analysis the use of this technology was retrospectively evaluated. Its impact on clinical decision making was evaluated. Overhydration (OH) was defined as an OH value of over 490 ml, underhydration as an OH value of –490 mL, values in between were considered to correspond to normohydration.
Results: Since the start in july 2012 a gradual increase in the use of the BCM was noted (53 measurements in 2012, 145 in 2013 and 101 in the first 6 months of 2014). Before the start of dialysis in 80,87% of the measurements overhydration was noted, in 10,40% underhydration. Only 8,72% of the patients were normohydrated. The mean amount of overhydration was 3,03 ± 2,41 L. Considering the planned ultrafiltration volume during the session, 32,00% of the patients remained overhydrated after dialysis, 51,64% underhydrated and 16,36% normohydrated. Often this resulmted in changes of dry weight-settings (Table 1). If the weight settings were changed, it was a decrease in 84,62% of the patients with overhydration after dialysis and an increase in 94,51% in case of underhydration. In a number of cases no adjustments were made or weight changes were contrary to the results of the measurements (Table 1).

Table 1

	Overhydration	Normohydration	Underhydration
	32.00%	16.36%	51.64%
Dry weight adjusted	73.86%	46.67%	64.08%
Dry weight increased	15.38%	66.67%	94.51%
Dry weight decreased	84.62%	33.33%	5.49%

Conclusion: This retrospective analysis demonstrates that the use of BCM to asses fluid status in dialysis patients revealed overhydration in 80,87% and resulted in frequent reduction of the dry weight. A prospective study, incorporating the body composition monitoring in an integrated procedure involving different techniques to establisch the diagnosis of hypertension and to direct the treatment in patients in hemodialysis will be starting shortly in our dialysis unit.

P-17. Personalised antibiotic therapy at surgical intensive care unit

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Background: The current efforts of intensivists focused on individual antibiotic treatment in patients suffering from sepsis has inspired us to conduct an open prospective clinical study to assess the relationship between body fluid retention (> 10 L per 24 hours) and the efficiency of hydrophilic time-dependent antibiotics used in critically ill patients [1–11]. Polytrauma and abdominal catastrophes are the most frequent causes of systemic inflammatory response syndrome (SIRS). Consequent body liquid retention is taken for a pathophysiological covariate modifying the pharmacokinetics (PK) and pharmacodynamics (PD) of hydrophilic time-dependent antibiotics (betalactams and carbapenems). Not only body fluid retention but also changes in renal clearance are thought to be responsible for failure in PK/PD target attainment necessary for effective antimicrobial activity.

Methods: Three patients with polytrauma and SIRS admitted at the ICU of the Surgical Department, Teaching Hospital Hradec Kralove, whose condition was characterized by cumulative body fluid retention (> 10 L), were eligible for enrolment. As per standard hospital protocol, the patients were administered with 4 g of piperacillin in combination with tazobactam 0.5 g intravenously by 1-hour (h) infusion every 8 h. A series of blood samples were taken 1, 2.5, and 5 h after the termination of the infusion. Urine was collected over each dosing interval and for 24 h. Piperacillin was detected using a previously validated HPLC method. Individual pharmacokinetic variables were estimated using non-compartmental pharmacokinetic analysis. Cumulative body fluid retention was calculated as the difference between fluid intake and output. Creatinine clearance (ClCr) was used for renal function evaluation.

Results: In 2/3 patients these pathophysiological changes as well as the clinical interventions administered resulted in augmented piperacillin clearance and an increase in distribution volume (Vd) (> 20 L) with a maximum at Day 2–8 after initiation of therapy. In such patients treated with a standard dose of piperacillin, only minimum PK/PD target attainment (50% Ft > MIC) was obtained. In contrast, a patient suffering from renal dysfunction attained both minimum (50% ft > MIC) and maximum PK/ PD target (100% ft > MIC).

Conclusion: In three critically ill patients with polytrauma and SIRS, pathophysiological changes (covariates) had a profound effect on the key determinants of the pharmacokinetics (Cl and Vd), resulting in significant intraindividual variability in pharmacodynamic/pharmacokinetic target attainment necessary for therapeutic time-dependent antibacterial activity of piperacillin. Consequently, patients with augmented clearance of piperacillin may be at risk for treatment failure, and/or bacterial resistance without dose up-titration.

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P-18. Systematic review and meta-analysis on the impact of a positive cumulative fluid balance on intraabdominal hypertension and outcome in critically ill patients

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Background: A positive daily and cumulative fluid balance has been associated with intra-abdominal hypertension (IAH) and worse outcomes in adult critically ill patients. This knowledge strengthened the current awareness that fluid overload is not only of cosmetic concern and suggested that deresuscitation should be performed in selected patients. The aim of this study was to look at the available literature on fluid overload in relation to morbidity and outcome.
Methods: We conducted a systematic review of published and unpublished studies. We searched MEDLINE, PubMed, EMBASE, Scopus, Web of Science, The Cochrane Database, Ovid, clinical trials registries and bibliographies of included articles. Two authors independently abstracted the data on study design, methodological quality, patient chracteristics and outcome. Statistical analysis was performed with SPSS version 17.1 and Review Manager 5 software.
Results: Among all identified citations, 1 meta-analysis, 11 randomized controlled clinical trials (of which 4 were blinded), 7 interventional studies, 24 observational studies, and 4 case series met the inclusion criteria. All together, a total of 19902 critically ill patients were studied and in 20 studies the intra-abdominal pressure (IAP) was also measured. The cumulative fluid balance after 1 week of ICU stay was more positive in nonsurvivors with 4.4 litres (95%CI 3–5.8, $P < 0.0001$). Interventions aimed to obtain a restrictive fluid management resulted in a less positive cumulative fluid balance after 1 week of ICU stay with 5.6 litres (95%CI 3.3–7.7, $P < 0.0001$). Restrictive fluid management resulted in a decreased mortality from 33.2% (in patients treated with liberal fluid management), to 24.7% with an accompanying OR of 0.42 (95%CI 0.32–0.55, $P < 0.0001$). Patients with IAH had a more positive cumulative FB after 1 week of ICU stay with 3.4 litres (95%CI 1.8–4, $P < 0.0001$). Interventions to decrease fluid balance resulted in a decrease in IAP: an average total body fluid removal of 4.9 litres resulted in a drop in IAP from 19.3 ± 9.1 mm Hg (range 8–38) to 11.5 ± 3.9 mm Hg (range 5–18).
Conclusions: A positive cumulative FB is associated with IAH and worse outcomes. Interventions to limit the development of a positive cumulative FB are associated with improved outcomes. In patients not transgressing spontaneously form the Ebb to Flow phase of shock late conservative fluid management and late goal directed fluid removal (deresuscitation) should be considered.

P-19. Association between different indexations of extravascular lung water (EVLW) in the age of obesity

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Background: Variability of body weight (BW) and height calls for indexation of volumetric hemodynamic parameters. Extravascular lung water (EVLW) has formerly been indexed to actual BW (BW(act)) termed EVLW-index (EVLWI). In overweight patients indexation to BW(act) might inappropriately lower indexed EVLWI(act). Several studies suggest indexation of EVLWI to predicted BW (EVLWI(pred)). However, data regarding association of EVLWI(act) and EVLW(pred) to mortality and PaO_2/FiO_2 are inconsistent. Two recent studies based on biometric database-analyses suggest indexation of EVLWI to height (EVLWI(height)). Therefore, our study compared the association of un-indexed EVLW, EVLWI(height), EVLW(pred) and EVLWI(act) to PaO_2/FiO_2 and Oxygenation index (OI = mean airway pressure*FiO_2*/PaO_2).
Methods: A total of 2119 triplicate transpulmonary thermodilutions (TPTDs; PiCCO; Pulsion Medical-Systems, Germany) were performed in 50 patients from the evaluation, and 181 patients from the validation groups. Correlations of EVLW and EVLWI to PaO_2/FiO_2, OI and ROC-AUC-analyses regarding $PaO_2/FiO_2 < 200$ mm Hg (primary endpoint) and OI > 10 were performed.
Indexations formulas of extravascular lung water (index) EVLW/EVLWI:

$$EVLWI_{act} = EVLW/BW_{act}$$

$$ELWI_{pred} = EVLW/BW_{pred}$$

BW_{pred} = Predicted body weight [kg]:
Male: $50 + 0.91 \times (height - 152.4)$,
Female: $45.5 + 0.91 \times (height - 152.4)$

$$EVLWI_{id} = EVLW/BW_{id}$$

BW_{id} = Ideal body weight [kg]:
Male: $(height - 100) \times 0.9$,
Female: $(height - 100) \times 0.85$

$$EVLWI_{adj} = EVLW/BW_{adj}$$

Adjusted body weight [kg]:
Male: idealmaleBW + (actual BW – idealmaleBW) × 0.4,
Female: idealfemaleBW + (actual BW – idealfemaleBW) × 0.4

$$EVLWI_{height} = EVLW/height\ [cm]$$

$$EVLWI_{BMI} = EVLWI/BMI$$

BMI = Body Mass Index [kg m^{-2}]: BW_{act} [kg]/(height[m])^2

$$EVLWI_{BSA} = EVLW/BSA_{Dubois}$$

$$BSA_{Dubois}\ [m^2] = 0.007184 \times weight\ [kg]^{0.425} \times height\ [cm]^{0.725}$$

$$EVLWI_{TLC} = EVLW/TLC$$

TLC = Total Lung Capacity TLC [L]:
Male: $7.99 \times height\ [m] - 7.08$,
Female: $6.60 \times height\ [m] - 5.79$

Results: In the evaluation group, un-indexed EVLW (AUC 0.758; 95%CI: 0.637–0.880) and EVLWI(height) (AUC 0.746; 95%CI: 0.622–0.869) provided the largest ROC-AUCs regarding PaO_2/FiO_2 < 200 mm Hg. The AUC for EVLWI(pred) was smaller (0.713). EVLWI(act) provided the smallest AUC (0.685). This was confirmed in the validation group: EVLWI(height) provided the largest AUC (0.735), EVLWI-(act) (0.710) the smallest. In the merged data-pool, AUC was significantly greater for EVLWI(height) (0.729; 95%CI: 0.674–0.784) compared to all other indexations including EVLWI(act) (ROC-AUC 0.683, p = 0.007) and EVLWI(pred) (ROC-AUC 0.707, *P* = 0.015). The association of EVLW(I) was even stronger to OI compared to PaO_2/FiO_2. In the merged data-pool, EVLWI(height) provided the largest AUC regarding "OI > 10" (0.778; 95%CI: 0.713–0.842) compared to 0.739 (95%CI: 0.669–0.810) for EVLWI(act) and 0.756 (95%CI: 0.688-0.824) for EVLWI(pred). Figure 1 shows the ROC curves. Figure 2 shows the percentage of measurements falling within a certain EVLWI category.

Conclusions: Indexation of EVLW to height (EVLWI(height)) improves the association of EVLW(I) to PaO_2/FiO_2 and OI compared to all other indexations including EVLWI(pred) and EVLWI(act). Also considering two recent biometric database analyses, EVLWI should be indexed to height.

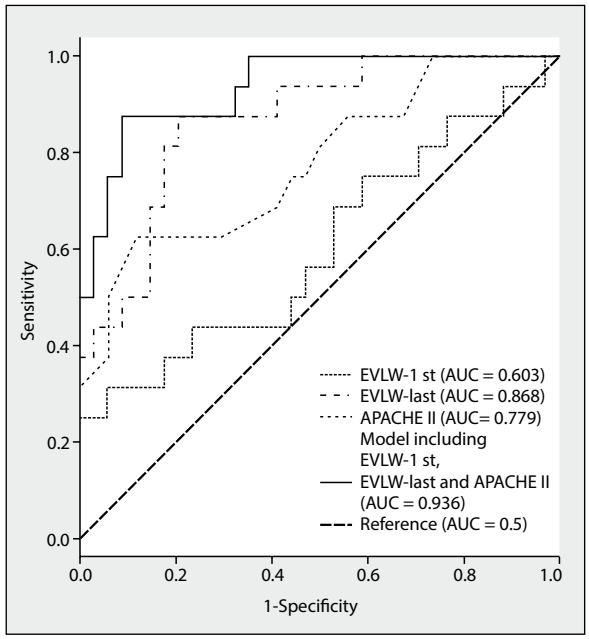

Figure 1. ROC curves

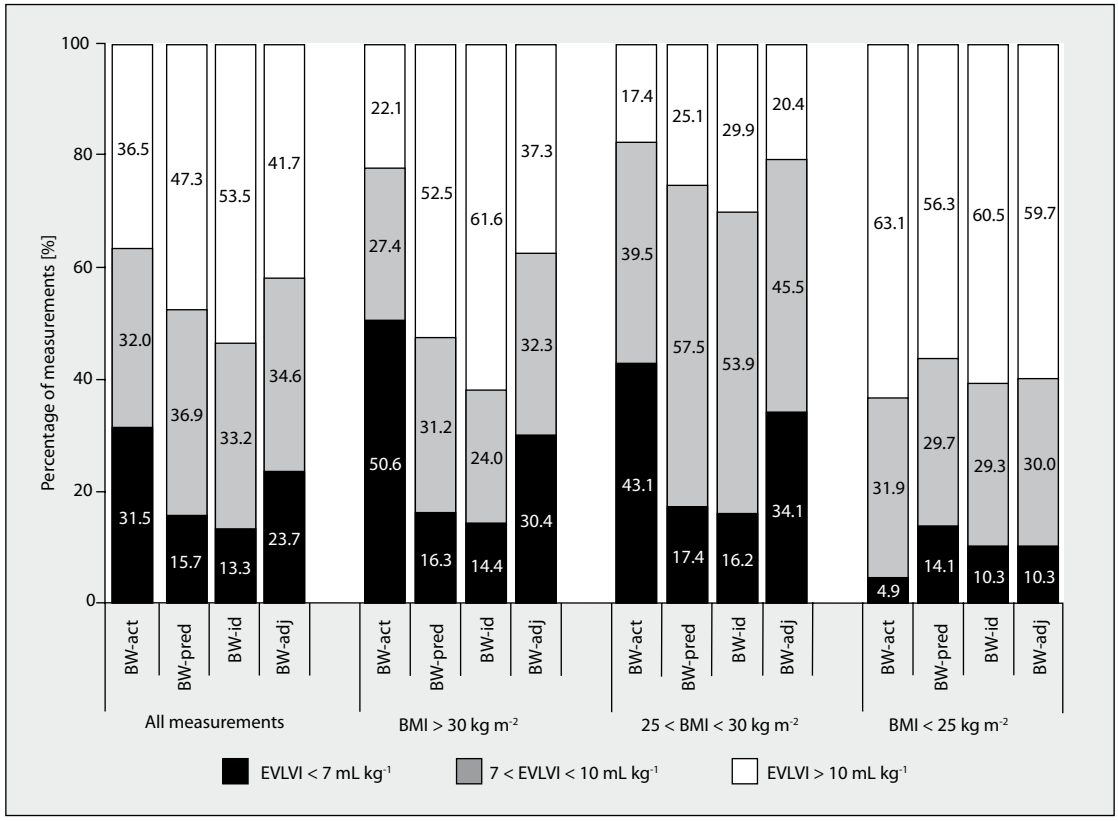

Figure 2. Distribution of EVLWI categories according to different indexations

P-20. Relation between cardiovascular function and body fluids during pregnancy

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Background: The maternal pregnant body is subject to various cardiovascular (CV) and body fluid (BF) changes. Bio-impedance can elucidate the role of all physiologic changes, both in healthy and hypertensive pregnancies. The aim of the study was to investigate the relation between BF parameters and CV parameters at various time points during pregnancy.

Methods: BF assessments were done using bioelectrical impedance (Maltron BIOSCAN 920-II; Maltron International LTD, Essex, UK) after positive confirmation of reliability of one simple measurement at any time point during the day, irrespective of physical activity or food/fluid intake. Registered parameters were: total body water (l), extracellular water (l), intracellular water (l), interstitial fluid (l), plasma fluid (l) and transcellular fluid (l). CV assessments were performed using Non-Invasive Continuous Cardiac Output Monitor (NICCO-MOTM, Software version 3.3, SonoSite, Medis Medizinische Messtechnik GmbH, Ilmenau, Germany), according to a standardized protocol [1–3]. Registered parameters were: systolic blood pressure (mm Hg), diastolic blood pressure (mm Hg), cardiac output (l), aorta flow parameters (VI, ACI, HI). After delivery, a population-specific birth weight chart was used to define customized birth weight centiles (BW%) for each neonate. Five groups of pregnancies were considered: (1) First trimester uncomplicated pregnancies (1T), (2) Second trimester uncomplicated pregnancies (2T), Third trimester uncomplicated pregnancies (3T), (4) Early hypertensive third trimester pregnancies (< 34w) (3EHT) and (5) Late hypertensive third trimester pregnancies (> 34w) (3LHT). Pearson Correlation Coefficients were calculated with SPSS software (version 22.0) to compare correlations (1) between each trimester of pregnancy and (2) between third trimester normal and hypertensive pregnancies. Correlations were considered significant at nominal level $P < 0.05$.

Results: A total of 324 pregnant women were assessed: 96 1T, 89 2T, 80 3T, 17 3EHT, 42 3LHT. There are significant correlations between all BF parameters and all CV parameters in 1T, 2T and 3T (Table 1). Those correlations are consistent at every stage of pregnancy. Correlations do not differ much between 3T and 3LHT, except the correlation of

Table 1. Pearson Correlation Coefficient (R) for each body fluid parameter (TBW, ECW, ICW, Interstitial fluid, Plasma fluid, Transcellular fluid) with each cardiovascular parameter (SBP, DBP, CO, VI, ACI, HI). Pearson Correlation Coefficient (R) of each body fluid parameter with birth weight centiles (BW) is also presented in the table

	SBP (mm Hg)	DBP (mm Hg)	CO (l)	VI (1/1000 s^{-1})	ACI (1/100 s^{-2})	HI (Ω s^{-2})	BW (%)
TBW (l)	◆ R = 0.362**	◆ R = 0.220*	◆ R = 0.704**	◆ R = -0.402**	◆ R = -0.493**	◆ R = -0.367**	◆ R = 0.390**
	■ R = 0.281*	■ R = 0.222*	■ R = 0.693*	■ R = -0.452**	■ R = -0.452**	■ R = -0.471**	■ R = 0.415**
	● R = 0.408**	● R = 0.394**	● R = 0.538**	● R = -0.448**	● R = -0.461**	● R = -0.388**	● R = 0.496**
	◖ R = -0.043	◖ R = -0.049	◖ R = 0.336	◖ R = -0.177	◖ R = -0.127	◖ R = 0.076	◖ R = -0.004
	◗ R = 0.347*	◗ R = 0.202	◗ R = 0.507**	◗ R = -0.553**	◗ R = -0.519**	◗ R = -0.483**	◗ R = 0.414*
ECW (l)	◆ R = 0.312*	◆ R = 0.172*	◆ R = 0.684**	◆ R = -0.382**	◆ R = -0.470**	◆ R = -0.377**	◆ R = 0.376**
	■ R = 0.253*	■ R = 0.18*	■ R = 0.657**	■ R = -0.433**	■ R = -0.440**	■ R = -0.470**	■ R = 0.393**
	● R = 0.445**	● R = 0.431**	● R = 0.437**	● R = -0.511**	● R = -0.485**	● R = -0.485**	● R = 0.508**
	◖ R = -0.045	◖ R = -0.001	◖ R = 0.499*	◖ R = -0.363	◖ R = -0.295	◖ R = 0.024	◖ R = 0.350
	◗ R = 0.342*	◗ R = 0.185	◗ R = 0.440*	◗ R = -0.572**	◗ R = -0.530**	◗ R = -0.509**	◗ R = 0.359*
ICW (l)	◆ R = 0.399**	◆ R = 0.260*	◆ R = 0.699**	◆ R = -0.408**	◆ R = -0.498**	◆ R = -0.343**	◆ R = 0.390**
	■ R = 0.307*	■ R = 0.268*	■ R = 0.715**	■ R = -0.451**	■ R = -0.451**	■ R = -0.457**	■ R = 0.427**
	● R = 0.354**	● R = 0.337*	● R = 0.636**	● R = -0.421**	● R = -0.404**	● R = -0.374**	● R = 0.456**
	◖ R = -0.016	◖ R = -0.032	◖ R = 0.639*	◖ R = -0.285	◖ R = -0.219	◖ R = 0.198	◖ R = 0.606*
	◗ R = 0.325*	◗ R = 0.218	◗ R = 0.562**	◗ R = -0.442*	◗ R = -0.433*	◗ R = -0.372*	◗ R = 0.442*
Interstitial fluid (l) Plasma fluid (l) Transcellular fluid (l)	◆ R = 0.313*	◆ R = 0.173*	◆ R = 0.683**	◆ R = -0.382**	◆ R = -0.470**	◆ R = -0.378**	◆ R = 0.375**
	■ R = 0.254*	■ R = 0.181*	■ R = 0.659**	■ R = -0.431**	■ R = -0.439**	■ R = -0.469**	■ R = 0.392**
	● R = 0.445**	● R = 0.431**	● R = 0.435**	● R = -0.511**	● R = -0.486**	● R = -0.486**	● R = 0.508**
	◖ R = -0.045	◖ R = 0.000	◖ R = 0.490*	◖ R = -0.362	◖ R = -0.294	◖ R = 0.024	◖ R = 0.35
	◗ R = 0.336*	◗ R = 0.178	◗ R = 0.435*	◗ R = -0.579**	◗ R = -0.534**	◗ R = -0.514**	◗ R = 0.364*

TBW — total body water; ECW — extracellular water; ICW — intracellular water; SBP — systolic blood pressure; DBP — diastolic blood pressure; CO — cardiac output; VI — velocity index; ACI — acceleration index; HI — Heather Index; BW — birth weight; ◆ — first trimester uncomplicated; ■ — second trimester uncomplicated; ● — third trimester uncomplicated; ◖ — early hypertension; ◗ — late hypertension
*$\alpha < 0.05$, **$\alpha < 0.001$

all BF parameters with DBP which is absent in 3LHT (Table 1). In 3EHT, no significant correlations were found, except the correlation of all BF parameters with CO (Table 1). There is a significant correlation between all BF parameters and BW% in the 1T, 2T, 3T and 3LHT group. This correlation is also absent in 3EHT (Table 1).

Conclusions: There is a correlation between the CV function and BF composition in both uncomplicated and late hypertensive pregnancies, but accounts less for early onset hypertension. Bio-impedance techniques are very useful to evaluate the physiological evolution and the pathophysiologic differences between all these variables in pregnancy.

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P-21. The effect of crystalloid therapy on body water content and intra-abdominal pressure in patients undergoing orthopaedic surgery under spinal anaesthesia: a pilot study

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Background: Crystalloids infusion is frequently used for correction of spinal anaesthesia-induced hypotension, intraoperative bleeding or vaporisation from surgical wound. Several studies have documented tissue edema and increase in intra-abdominal pressure (IAP) following massive crystalloids infusion [1,2]. Unfortunately, there have been no data documenting the effect of balanced fluid therapy on body water content and IAP. Therefore, the aim of this study was to analyse the effect of perioperative crystalloids infusion on IAP and body water content in patients undergoing elective orthopaedic surgery under spinal anaesthesia.

Methods: Adult patients undergoing hip or knee replacement were studied. IAP was measured in urinary bladder (Kron technique). Body water content was assessed by volume excess (VE), total body water (TBW) and extracellular body water (ECW). Whole body bioimpedance was used for VE, TBW and ECW measurements. All parameters were measured at four time points: A — just before anaesthesia (baseline value), B — just after surgery, C — 3 hours after surgery and 4 — on the morning of postoperative day 1. Additionally, IAP was measured after anaesthesia, just before surgery (A1).
Results: 25 patients (10 female and 15 male) aged 19––80 were enrolled. The mean duration of anaesthesia and surgery were 112 ± 21 min and 88 ± 18 min respectively. Patients received crystalloids infusion at the doses: 2531 ± 717 mL during surgery, 713 ± 283 mL during 3 postoperative hours and 1478 ± 785 mL to the morning of the postoperative day 1. The mean fluid balances were: 2149 ± 1364 mL postoperatively, 1569 ± 1106 mL after 3 hours and 259 ± 823 mL from 3 hours after surgery to the morning of the postoperative day 1. IAP decreased at time point A1 ($P < 0.001$) and increased at time points B ($P < 0.01$). VE increased at time points B ($P < 0.001$), C ($P < 0.01$) and D ($P < 0.05$). TBW and ECW also increased at time points B, C and D ($P < 0.001$ and $P < 0.01$, respectively).
Conclusions: 1) Perioperative crystalloids infusion increases body water content, 2) Crystalloids infusion increases IAP only after surgery, 3) Spinal anaesthesia reduces IAP.

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P-22. Implementation of the EarlySense™ system to prevent complications on a general ward

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Background: The EarlySense™ system is a contact-free piezoelectric sensor installed under the mattress of the patient. This sensor can monitor continuously, heart rate, respiratory rate and body movements in an accurate manner. It has been shown that patients frequently exhibit clinical signs of deterioration, hours before the actual cardiorespiratory arrest. By trending the vital parameters and proper alarm settings nurses and doctors can be alerted in time in case of deterioration. As such EarlySense could prevent complications (decubitus, pressure ulcers, fall accidents), near-fatal serious adverse events (bradycardia, tachycardia, bradypnea and tachypnea) and fatal events (apnea, cardiac arrest) from happening [1–4].
Methods: The aim of the present pilot study is to equip a 30-bed general internal medicine ward with EarlySense monitors at the ZNA Stuivenberg Hospital in Antwerp, Belgium. During the first 14 days of the study, nurses and doctors will get acquainted with the EarlySense systems and silent alarms will only be passed through to the doctors on call for the Outreach team but not to the nurses (baseline). During the next 3 months nurses and doctors will follow-up all consecutive patients. Primary endpoints are: hospital mortality (sudden death), ICU admission (code blue), near-fatal incidents and complications (bradypnea, tachypnea, bradycardia, tachycardia, pressure sores, fall accidents). The observed incidence will then be compared with historical data. Secondary endpoints are hospital and ICU stay (days) and number of ICU re-admissions (%). Statistical analysis will be performed with SPSS software.
Discussion: EarlySense may be beneficial for the hospital manager because of reduced operating cost, improved staff utilization, highly visible patient care as a marketing tool, reduced legal risk, reduced fines from insurance/federal programs, allows turn protocol compliance verification, easy access to up-to-date data and managerial reports. Assuming a 30-bed

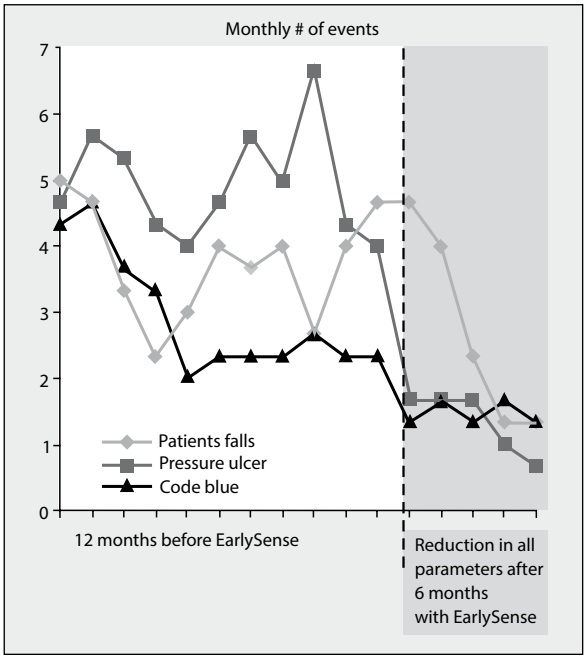

Figure 1. Simulation of reduction in hospital acquired pressure ulcer cases, patient falls, and code blue events/resuscitation

unit, with 2,000 patients admitted per unit per year return on investment can be expected within 1 year (Fig. 1). EarlySense may be beneficial for the doctor because of better clinical outcomes, low alarm fatigue, visual and personal notifications, nurses are empowered by reliable clinical data, possibility to manage patients remotely, intuitive and user friendly interface, integration with caregivers' shift workflow. Last but not least EarlySense may be beneficial for our patients because of better clinical outcomes, less complications, faster recovery, improved patient and family satisfaction, and a safer feeling.
Conclusions: We believe that the EarlySense system will significantly reduce primary endpoints in a general ward.

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P-23. Predictors of diminished corrected left ventricular mass index in female anorexic adolescents

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Background: About one third of the mortality in anorexia nervosa (AN) is cardiac-related. The purpose of our retrospective study was to determine, on the basis of clinical and biochemical variables, predictors of the reduction of the left ventricular mass index corrected for height (LVM/height $^{2.7}$). The second purpose was to design, on the basis of these risk factors, a model for the calculation of the corrected left ventricular mass (cLVM), in order to select these patients with a poor outcome and therefore in need for follow-up.
Methods: We included all anorexic girls during a period from Sept. 2002 till Dec.2012 for somatic assessment. The study was conducted according to the GCP guidelines. We excluded girls with a family history of any disease involving the cardiovascular system. 272 AN girls (14.63 ± 1.65 years) and BMI (15.72 ± 1.81 kg m^{-2}) were retained. The same nutritionist did somatic assessment in the acute stage. This included personal history, clinical examination, biometry and calculation of BMI using curves and centiles reported by Rolland-Cachera, 1991. A standard admission protocol included complete blood count, serum urea nitrogen, creatinine, sodium, potassium, chloride, cholesterol, thyroid hormones, insulin growth factor-1 (IGF-1), serum iron, ferritin, zinc, liver transaminases. Patients were examined by the same cardiologist and had a 2-D-Doppler echocardiography and a 12 lead ECG. QT and QTc intervals were measured in lead II and corrected for heart rate using Bazett's formula 1920 ($QTc = QT \sqrt{RR}$). QTc dispersion and the voltage of the T wave in V4 and the R wave in V6 was also measured. Based on the M-mode measurements in the long axis, left ventricular mass measurements were performed. The standard Devereux formula was used to calculate the left ventricular mass (LVM). To account for linear growth and body mass, the left ventricular mass index was corrected using the formula of de Simone 1992 (LVMc = LVM/height$^{2.7}$). Statistical analysis: The independent associations between different biochemical and endocrinological analyses and the left ventricular mass index corrected in each patient using the formula of de Simone 1992 (LVMc = LVM/height$^{2.7}$) were studied using a multiple linear regression analysis. Variables were described as the mean ± standard deviation. Data were analysed with the SPSS statistical software 20.0. Variables were kept in the model when $P < 0.01$.
Results: Ferritin, weight loss, IGF-1 and total cholesterol appear to be independent predictors of cLVM. They were kept in the final model (ferritin ($P = 0.002$), weight loss ($P < 0.001$), IGF-1 ($P < 0.001$) and total cholesterol ($P = 0.003$). With the aid of the regression coefficients given in Table1, we can further predict LVM/height$^{2.7}$.
Conclusions: Decreased cLVM is common in anorexic girls, especially with severe weight loss. Four factors predicted decreased cLVM in our anorexic population: ferritin, weight loss, IGF-1 and cholesterol level.

Table 1. Results from multiple linear regression model predicting the LVM/height2.7 (cLVM)

	Unstandardized Coefficients	Std Error	*P*-value
LVM/height$^{2.7}$ (g m$^{2.7}$) Constant	35.330	1.517	< 0.001
Ferritin (ng mL^{-1})	–2.472	0.004	0.002
Weight loss (%)	–0.165	0.038	< 0.001
IGF-1 (ng mL^{-1})	–0.009	0.002	< 0.001
Cholesterol (mg dL^{-1})	–0.020	0.010	0.003

P-24. Is a high level of ferritin a cardiac risk predictor in anorexic adolescent girls?

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Background: The aim of this study was to compare in the acute state , biometric, biochemical, endocrine parameters with electrographic and echocardiographic parameters between female anorexic adolescents with an high level of serum ferritin and a normal level of serum ferritin.

Methods: We studied 311 adolescent girls with anorexia nervosa according to the DMS-IV criteria. All subjects underwent a complete clinical examination, a full hematologic, biochemical and endocrine bilan together with a complete cardiac examination with 12-lead ECG and 2-D-echocardiography.

Results: 82/311 (26.4%) had high ferritin level > 137 ng mL^{-1}. Risk factors for developing a high ferritin are: BMI: 14.41 ± 1.59 kg m^{-2}; HR: 56.01 ± 16.36 bpm; LVM/height 2.7 : 23.99 ± 5.25 g/m^2.7; total cholesterol: 192.65 ± 50.70 mg dL^{-1}; AST: 31.58 ± 12.11 U L^{-1}; ALT: 43.93 ± 47.67 U L^{-1}, IGF-1: 113.16 ± 74.97 ng mL^{-1} and FT3: 3.08 ± 1.80 pmol L^{-1}.

Conclusion: The anorexic girls with a higher serum ferritin level are those with the lowest BMI, heart rate and LVM/height2.7 and these parameters are associated with a higher cholesterol level and lower FT3 level. The latter parameters are cardiovascular risk factors for atherosclerosis.

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P-25. Leptospirosis with multipleorgan failure : an unusual diagnosis in the ICU

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Background: Leptospirosis is the most common zoonosis infection that occurs worldwide except in polar regions [1]. It is caused by pathogenic spirochetes of the genus Leptospira. Traditionally, leptospirosis was an occupational illness (e.g.,farmers, sewage workers, and miners). Recently, however, recreational exposure (e.g., hikers, wild water rafters, and triathletes) has been increasingly recognized [1]. The organism is typically transmitted via exposure of mucous membranes or abraded skin to the body fluid of an acutely infected animal or by exposure to soil or fresh water contaminated with the urine of an animal that is a chronic carrier [2]. Characteristic symptoms may include fever, headache, myalgia, jaundice, and conjunctival irritation and effusion, but it often manifests as a nonspecific febrile illness [1]. In 10% of cases, the presentation is more dramatic, and leptospirosis infection has a mortality rate of 10%. Known as Weil disease or icteric leptospirosis, the classic definition of this form of leptospirosis includes fever, jaundice, renal failure, and hemorrhage. Other organ systems (ie, pulmonary system, cardiac system, central nervous system) are also frequently involved [2]. We present a case of leptospirosis that developed multiple organ failure. Our case is unusual given the season, location and patient's occupation. Overall leptospirosis is a rare diagnosis in the ICU in Turkey.

Case report: A 54-year-old previously healthy man presented to our hospital with hepatic and renal failure on January 7 in 2013. He was a tradesman. He presented with fever, cough, fatigue for approximately 1 month. On December 26 in 2012 he was admitted to another regional hospital where his initial lab results (Table 1) showed increased ESR (erythrocyte sedimentation rate), CRP (C-reactive protein), ALT (alanine transaminase) and AST (aspartate transaminase). His viral hepatitis markers were negative. Brucella and CMV were negative. The CT analysis of his neck, thoracic and abdomen were unremarkable. Empirirc systemic treatment with Tazocin® (4 g 4 times daily) and Ambizome® (300 mg once a day) was initiated. The patient was transferred to our institution because of deterioration of his general health condition, and development of Acute Kidney Failure with need for renal replacement therapy. On admission to the ICU the patient was confused, icteric, with conjunctival irritation and effusion. Chest auscultation revealed bilateral rales and oedema in both lower extremities was noted. The patient was anuric. A second opinion from infectious disease, rheumatology, oncology, nephrology, and gastroenterology departments was consulted. Antiobiotic treatment was switchex to Meropenem (1 g 3 times daily). Systemic prednisolone was administered and he was put on hemodialisys. During the next days, a microagglutination test confirmed the presence of antibodies against Leptospira Patoc and Ceftriaxone was added. On January 12 the patient developed septic shock. He was intubated and put on vasopressors. Despite adequate fluid resuscitation and vasopressors he developed refractory shock followed by cardiac arrest. CPR was started but remained unsuccessful.

Table 1. Laboratory results

Parameter	Day 0	Day 2	Day 5
Haemoglobin (g dL^{-1})	9	8.8	9.5
Platelet count (10^9 L^{-1})	56	24	13
White blood cell count (10^9 L^{-1})	5.2	3.7	6.0
ESR (mm h^{-1})	56	–	–
C-reactive protein (mg dL^{-1})	22.9	–	–
Procalcitonin (mg L^{-1})	24.8	22.8	13.
Potassium (mmol L^{-1})	5.41	4.57	7.67
Phosphorus (mg dL^{-1})	8.41	5.67	8.11
Bicarbonate (mmol L^{-1})	15.3	16.1	11.5
BUN (mg dL^{-1})	87.74	43.39	45.51
Creatinine (mg dL^{-1})	8.31	4.05	3.65
CK -MB (ng mL^{-1})	0.736	–	–
Troponin I (µg/L^{-1})	0.024	–	–
ASAT (IU L^{-1})	61.02	101.16	137.82
ALAT (IU L^{-1})	89.7	160.1	184.6
GGT (IU L^{-1})	132.6	94.1	59.1
ALP (IU L^{-1})	556.7	391.56	302
T. Bilirubin (µmol L^{-1})	15.46	16.81	20.84
LDH (IU L^{-1})	–	1466.7	1930.5
aPTT (sec.)	134.4	35.5	53.2
INR	2.59	1.73	2.61
Ferritin	10485	–	–
BNP (pg mL^{-1})	433.4	–	–

Discussion: Leptospirosis is caused by pathogenic spirochetes of the genus Leptospira. The incubation period is usually 5 to 14 days (range 2 to 30 days). Some human cases probably remain completely asymptomatic, and over 90% of symptomatic cases are relatively mild and self-limited. The remaining cases may be severe and potentially life-threatening, as these are often associated with jaundice, hemorrhage, renal failure, and myocarditis (Weil disease) or massive pulmonary hemorrhage. The course of the illness may be biphasic. The first phase or leptospiremic phase typically lasts 3 to 7 days and represents the period when organisms are present in the blood. The second phase or immune phase may be clinically silent and can last for 4 to 30 days or even longer. This phase coincides with the formation of circulating immunoglobulin M (IgM) antibodies [1]. The diagnosis of leptospirosis requires a high degree of clinical suspicion because the disease has numerous manifestations that can mimic other nonspecific febrile illnesses, as well as noninfectious diseases such as small vessel vasculitides, systemic lupus erythematosus or even malignancies [3]. A high index of suspicion is often needed to make the diagnosis, and a number of diagnostic "red flags" may help to alert clinicians [1]: History of contact with fresh water or mud, a history of contact with animals, a history of cuts or abrasions, abrupt onset of severe headache, severe myalgias (calves, thighs, lower back), conjunctival irritation or effusion, fever and new-onset atrial fibrillation, jaundice and relatively mild transaminase elevation, a combination of fever, jaundice and thrombocytopenia, hepatitis and neutrophil leukocytosis with left shift, a combination of fever and elevated creatine kinase, amylase or lipase levels. Leptospires grow slowly in culture, and recovery rates are low. Serologic tests are available only in specialized laboratories, and the sensitivity of acute serologic tests is low. Antibodies usually appear in the second week of illness. The gold standard for immunodiagnosis remains the microscopic agglutination test (MAT). Blood, cerebrospinal fluid (CSF), urine, and peritoneal dialysis fluid may all be cultured. It may take as long as 6–8 weeks for cultures to become positive. Consequently, those tests should not be the basis on which treatment is initiated. In a patient with susceptible symptoms and a plausible exposure history, empiric therapy should be started [2]. In the case presented we started Meropenem and after confirmation of the diagnosis Ceftriaxon was added. Supportive therapy was provided. Despite all supportive efforts, the patient's condition worsened, without improvement in acute kidney and hepatic failure. Our patient even developed respiratory and cardiovascular failure which ended with cardiac arrest. A review of the literature showed that only 71 cases have been reported in Turkey between 2005–2010, and 26 of the cases were reported in 2010. In 2011, 27 EU/EEA countries provided data on the disease and overall 526 confirmed cases of leptospirosis were reported. The highest numbers of confirmed cases were reported in Romania (98) and France (71) [4].

Conclusion: The diagnosis of leptospirosis was not initially considered in this case, because potential risk factors had not been recognized. The broad spectrum of severity as well as the unusual or rare clinical manifestations may result in a delay in the diagnosis. Serology is the most important tool for an accurate and quick diagnosis in order to administer the appropriate treatment. Leptospirosis should be considered early in the diagnosis of any patient with acute, non-specific febrile illness with multiple-organ system involvement or high fever not only in tropical and rural areas between late summer to early fall, but in any geographic location regardless of the typical seasonal characteristics, whenever risk factors are present.

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Invited abstracts

Ultrasound guidance for vascular access

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Background: In this theoretical and practical lesson, the important role of ultrasound during central venous cannulation will be discussed. Although the technique exists since many years and the need for ultrasound guidance in this setting has been published in many guidelines [1–3], the routine use of this technology is still lacking in the practice of many colleagues. To often they still rely on the blind, landmark technique, which has varying success and complication rates [4]. The ultrasound technique has proven to be faster and leading to less complications. A reduction in number of attempts and in hematomas and arterial punctures has clearly been observed [5, 6]. It is also shown that ultrasound guided CVC cannulation is cost effective [7]. Patients who benefit the most from the ultrasound guided technique are the ones with abberant anatomy (not always is the internal jugular vein located anterolaterally to the carotid artery), in cases of shock, trauma and the childhood population. By ultrasound guidance more vessels are in our reach to cannulate, fex the axillary and basilic veins.

Results: We suggest a practical, multi-step approach to US guided central venous cannulation. The first step is to look at the target vessel: clinically (are there collateral vessels?), its size and depth, thrombus?, nearby structures, not only at the intended puncture site. By doing this, one can avoid useless punctures and complications. The danger is to cannulate the carotid artery. Tips to make the difference between the artery and the vein are the thickness of the vessel wall (thicker in the artery), the compressibility (more in the vein) and the depth (the vein is usually more superficial). If necessary use the Doppler mode on your machine to distinguish the artery from the vein. The second step is to look for alternatives (quick scan, it only takes a few minutes) in case the target vessel is not ideal. There are many options: internal jugular, subclavian axillary, external jugular, cephalic, basilica veins. Look also on the contralateral side in order to obtain a complete access status of the patient. The third step involves patient preparation : the patient should be in Trendelenburg position, with an extension of the neck if needed. Tilting of the head however should be avoided as a contralateral turn of the neck increases the overlap between the internal jugular vein and the carotid artery. A sterile dressing should be applied on the probe and the puncture site desinfected. The fourth step. Now you are ready to cannulate! Check your probe orientation and apply the transducer in a transversal plane just above the clavicle. So now you look at the short axis of the vein. Puncture the skin and look for the tip of the needle. Follow the tip and aim for the vessel. Advance the needle in the vessel. This approach uses the out-of-plane technique and we prefer it to the in-plane approach because the first offers the best needle trajectory adaption. However, it is important to always look at the tip of the needle in order to prevent vessel wall perforation! With the in-plane approach it is difficult to keep the needle within the sub-millimetre width of the ultrasound beam along its trajectory.

Discussion: How do we train colleagues in ultrasound guided vascular access cannulation? We believe that the first attempts to apply this technique should take place in a calm, non stressful environment. In our experience, ultrasound phantoms are very useful in this regard. As an alternative to expensive commercially available ultrasound phantoms, we work with home made ones. Their main ingredients are gelatin, Metamucil, a colouring agent and penrose drains or party balloons. The recipe can be found on www.handsonecho.com/snacks/ whats-new-in-ultrasound. US phantom based initiation courses are organized on a regular basis in AZ St Lucas, Gent, for the medical stagairs and registrars of different specialties. Once familiar with the technique, the next step is to cannulate real patients under supervision of an experienced colleague.

Learning objectives: during the lecture the participants will learn how to perform ultrasound guided vascular access in a safe manner following the stepwise approach.

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The Stewart approach

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Learning objectives: The Stewart approach to acid–base balance is fascinating and is increasingly being used throughout the medical community and especially in intensive care units. Invented by the late Peter Stewart around 1980, the approach completely demystifies any acid base disturbance. This workshop will explain the Stewart method. Introduction and background One of the key concepts of the Stewart approach is that bicarbonate, or HCO_3^-, does not play any role in acid-base balance. This is usually very intimidating and counterintuitive to most clinicians as the commonly used Henderson Hasselbalch dictates otherwise [1]. Main message Interestingly, Stewart does not deny the value of the Henderson Hasselbalch equation. In fact, this equation is actually one of the six equations that Stewart proposes to describe acid–base equilibrium. This implies that both approaches are mathematically compatible and that the Stewart approach may provide the bigger picture. According to the Stewart approach there are only three independent variables that determine the concentration of H + and thus pH in any fluid, including plasma. These variables are the partial pressure of carbon dioxide (PCO_2), the total amount of not completely dissociated weak acids (Atot, mainly albumin) and the so-called Strong Ion Difference (SID). The strong ion difference is the sum of all positively charged fully dissociated ions (mainly Na^+) minus the sum of all negatively charged fully dissociated ions (mainly Cl^-). If PCO_2 goes down, the patient will become more alkalotic. If Atot goes down, the patient will become more alkalotic. If SID goes down the patient will become more acidotic. Thus, while HCO_3^- may follow a change in one of these independent variables it can never cause a change in pH by itself. One of the most fascinating aspects of the Stewart approach is that it becomes very easy to see how fluid therapy may alter acid base status. Normal concentrations of plasma sodium and chloride are about 140 mEq $L^{-1}$and 100 mEq L^{-1}. This implies a normal strong ion difference of 40 mEq L^{-1}. If we now infuse normal saline, which contains 154 mEq L^{-1} of Na^+ and Cl^- with an SID of 0 mEq L^{-1}, it becomes obvious that plasma SID will go down, which causes acidosis. Discussion At first glance, the Stewart approach may appear difficult, especially because it involves a number of equations. However, in our workshop we will show you that the Stewart approach is actually very easy to use and understand. We will focus on a number of difficult cases and solve these interactively. We will give you the tools to apply the Stewart approach at the bedside. After the workshop you will be able to fully understand, quantify and diagnose any acid base disturbance you may encounter in daily clinical practice.

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FAST and basics of abdominal ultrasound in emergency and intensive care medicine

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Background: After many years of just being a fancy gimmick for a few enthusiasts, echography is now fast moving into the mainstream teaching about almost any area of medicine, vastly extending the range of diagnostic capabilities of the dedicated bedside clinician. It is easily integrated into the clinical examination and decision–making process. For some applications like the short trauma echography known as FAST (Focussed Assessment Sonography in Trauma) or e-FAST (extended FAST) the learning curve is steep, for others such as haemodynamic evaluation or that of the parenchymatous abdominal organs a larger experience base is required.

Methods: The presenter draws mainly from his collection of ultrasound images and clinical experience. While not being a researcher, he can honestly claim to have been one of the first physicians to use echography in daily ICU work, now being able to look back on more than 20 years of experience with this.

Discussion: From the point of view of an emergency room or intensive care physician, echography is an integral part of the patient assessment from the first physical examination to advanced treatment in the ICU, being an extension of his or her physical senses much like the stethoscope, and, ideally, just as naturally being carried around. Point–of–care ultrasound makes a substantial difference in daily patient care. Physicians do need some training, though, and many find it hard to get over the initial threshold of not daring to use this tool.

Learning objectives: This presentation is to cover the basics of ultrasound application in the initial emergency assessment and the daily chores of an ICU physician. It is to encourage newcomers to choose some easily learnt techniques first, while cautioning about the complexities in other areas, as in the evaluation of vena-cava-inferior-dynamics in different haemodynamic and respiratory settings.

Resuscitating sepsis — how I do it after 6S

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Background: The results of the 6S trial showed that the use of starches is unfavourable in patients with sepsis as evidenced by an increased morbidity and mortality. The question then remains how we should resuscitate these patients in the future?

Results: The Scandinavian Starch for Severe Sepsis/Septic Shock (6S) trial randomised 800 patients with severe sepsis in 26 Scandinavian intensive care units to blinded fluid resuscitation with hydroxyethyl starch (HES) 130/0.42 in Ringer's acetate vs Ringer's acetate alone. Patients assigned to HES vs Ringer's had increased risk of death at 90 days (relative risk, 1.17; 95%-confidence interval (CI), 1.01–1.36; $P = 0.03$), increased use of renal replacement therapy (relative risk, 1.35; 95%-confidence interval, 1.01–1.80; $P = 0.04$) and more bleeding episodes (relative risk, 1.55; 95%-confidence interval, 1.16–2.08; $P = 0.003$). Overall study fluid volumes were relatively small and comparable between the two groups (cumulative dose during the whole study, 44 mL kg^{-1} vs 47 mL kg^{-1}; $P = 0.18$) 1, 2].

Discussion: The main points of critique of the 6S trial include its pragmatic design where resuscitation goals were at the discretion of the clinician, and that the circulatory parameters could indicate that some patients were already resuscitated prior to inclusion resulting in harmful hypervolemia in HES-treated patients [3–5]. However, post-hoc analyses did not support this hypothesis [6], and the complex diagnosis of hypovolemia made by experienced doctors cannot be questioned without being at the bedside. Instead, the 6S trial reflects how HES is used clinically, and there is no reason to believe that the incidence of HES-induced hypervolemia is higher in the 6S–trial than in the real clinical world. The results of the 6S trial are well in line with the results of systematic reviews by independent authors showing that HES impairs renal function and increase the risk of death compared with other fluids [7–9]. Interestingly, the trials in these reviews have highly consistent results (low statistical heterogeneity and no differences among subgroups) indicating toxic effects independent of patient category, type of HES and trial design. The recent CRISTAL trial does not itself support the use of HES due to several limitations [10, 11], and consequently, EMA and FDA have put regulatory restrictions on the use of HES [12, 13]. The clinical findings are supported by the well-described mechanisms for harm with HES. These include coagulopathy [14] and tissue storage, which is widespread in both healthy volunteers and surgical patients, resulting in reduced cell viability and organ failure [15–17].

Conclusion: In conclusion, the 6S trial is one of several trials showing that HES should not be used for resuscitation neither in patients with sepsis nor in any other patient. Instead, crystalloid is a life-saving alternative.

Learning objectives: This talk will take a critical look at the available evidence on the use of HES solutions after the publication of the 6S trial.

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Infusion fluids — current topics

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Isotonic saline issue: The use of isotonic saline for fluid resuscitation is much more widespread than clinically justified. More than 50% of the infusion fluids sold in 0.5- and 1.0-L fluid bags in Europe consist of isotonic saline [1] and the situation is the same in many Asian countries. Numerous studies show that balanced crystalloid fluids are to prefer with regard to the acid–base balance, kidney function and patient well-being. Vomiting probably remains the only indication for saline, as the low sodium content and the hypo-osmotic properties of the Ringer solutions has been solved with the composition in Plasma-Lyte. With regard to hypertonic saline, new studies show that hypertonic saline does not improve survival or neurological damage in prehospital care [2, 3].

Tips when infusing crystalloid fluids: With the use of colloid fluids being increasingly questioned, the following tips are useful if turning to crystalloid electrolyte fluids as the mainstay of fluid resuscitation: (A) Using arterial pressure as the target for the infusion easily results in overhydration. Drug-induced hypotension cannot be reversed by fluid. If one fluid bolus does not raise the pressure, lighten the anaesthesia and/or use a vasopressor [4]. (B) Evaporation during surgery is often overrated. An open abdominal wound with liberal exposure of the organs is associated with loss of only 30 mL per hour [5]. (C) Plasma volume expansion from crystalloid fluid is much greater than commonly believed as long as the infusion is continued. This is due to the fact that equilibration of infused fluid between the plasma and interstitial fluid space, in whole-body man, requires 30 minutes to be completed. The half-life of the distribution process is about 8 minutes [6]. This means that the infused fluid expands to plasma volume by about 60% of the infused amount during a standard operation [7]. (D) In anaesthesia-induced hypotension, crystalloid and colloid fluids are equally effective plasma volume expanders. With a reduction of the mean arterial pressure by 20% or more the distribution of fluid from the plasma to the interstitial fluid space becomes arrested [6]. All the infused fluid remains in the bloodstream until a new Starling equilibrium has developed. This may take 30 minutes and probably depends n the rate of infusion and the severity of the hypotension. (E) Anaesthesia and surgery greatly retard the rate of elimination of crystalloid fluid.

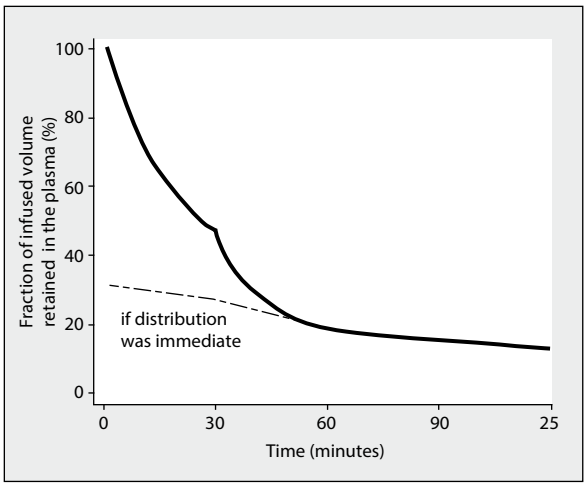

Figure 1. The plasma volume efficacy of a 30-min infusion of Ringer´s acetate illustrates the importance of distribution for the plasma volume expansion

Anaesthetists are happy if 50–100 mL is excreted as urine per hour after infusing 1.5–2 L of crystalloid, while a conscious volunteer would excrete > 1 L the first hour. Ringer´s acetate in a conscious volunteer has a half-life of 30 minutes while the half-life is 200–300 minutes during laparoscopy [6, 8]. In short, patients in this setting have very difficult to excrete fluid overload, and monitoring the urinary excretion can only provide information about the presence of marked hypovolaemia, not hypervolaemia. This slow elimination might account for the fact that crystalloids and colloids appear to have the same plasma volume expanding effect in intensive care [8].

Colloid fluids: In contrast to the crystalloids, colloid fluids have various degrees of allergic properties and their half-life in plasma is longer, usually 2–3 hours (compared to 8 minutes). Combining crystalloid and colloid fluid may have unforeseen effects. Recently it was shown that hydroxyethyl starch has a capacity to displace crystalloid fluid to the interstitium, thereby prolonging its half-life by withholding the crystalloid from renal excretion [9]. The current criticism of colloid fluids are mostly related to the risk of kidney injury associated with starch preparations in the intensive care setting. Meta-analyses have not supported the existence of such risks when used in the operating room [10, 11]. The recent CRISTAL study found no increased mortality after using colloids as the initial resuscitation fluid hypovolaemic shock treated in the intensive care unit [12]. At 90 days, the data rather showed a benefit. Other issues relate to problems in identifying advantages of choosing a colloid compared to a crystalloid.

Learning objectives: In the mind of this author, the use of colloid fluid should be restricted to the treatment of more apparent hypovolaemia while minor haemorrhage (up to 500 mL) can be safely treated with a balanced crystalloid. Thereafter, there is a „window" until the transfusion trigger is reached where further use of crystalloid fluid will result

in interstitial oedema and, in particular, is likely to have undesired effect on gastrointestinal function and wound healing. As a rule, crystalloid fluid administration should not exceed 3.5 L during abdominal surgery [13] and this target is easily exceeded if major haemorrhage is replaced by crystalloid fluid.

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Why crystalloids will do the job in the operating room

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Background: The current trend in anaesthesia is to choose crystalloid over colloid fluids for volume replacement in the operating room. Outcome–oriented studies and kinetic analyses have recently provided more insight into how crystalloid infusions should be managed.

Results: These fluids have a much better short-term effect on the plasma volume than previously believed. Their efficiency (i.e., the plasma volume expansion divided by the infused volume) is 50–80% as long as an infusion continues, while this fraction increases to 100% when the arterial pressure has dropped. Elimination is very slow during surgery, and amounts to only 10% of that recorded in conscious volunteers. Capillary refill further reduces the need for crystalloid fluid when bleeding occurs. These four factors limit the need for large volumes of crystalloid fluid during surgery. Adverse effects associated with crystalloid fluids mainly include prolonged gastrointestinal recovery time, which occurs when > 3 L has been infused. Clinicians who do not want to prolong the length of the hospital stay by 1–2 days due to such problems may use colloid fluid selectively, but calculations show that the therapeutic window for colloids is quite narrow. Inflammation is likely to decrease the fluid efficiency of colloid fluids, while its effect on crystalloids is unclear. However, some recent evidence suggests that inflammation accelerates the turnover of crystalloid fluid as well.

Conclusions: Several findings about how crystalloid fluid behaves during anaesthesia and surgery contribute to the fact that there are more effective plasma volume expanders than previously believed. There is no reason to use a colloid to compensate for vasodilatation when anaesthesia is induced, as the infused crystalloid is completely retained in the plasma in that setting. Rapid infusion of a crystalloid to compensate for surgical haemorrhage easily leads to hypervolaemia due to the distribution effect of the crystalloids. The recommended strategy is a smooth compensation, where 1/3 of the indicated volume is given immediately, the second 1/3 is infused more slowly, while 1/3 is saved for the end of surgery or the early postoperative period. Spontaneous capillary refill makes the last portion unnecessary if the volume compensation is started with the patient being in the conscious state, in particular if therapy initiated with a delay after the haemorrhage. Calculations show that the therapeutic window for colloid fluid is quite narrow before erythrocytes become indicated. Little is known about the impact of inflammation on the efficiency of infusion fluids, but some evidence suggests that it accelerates the turnover of both colloids and crystalloids.

Learning objectives: With the use of colloid fluids being increasingly questioned, the following tips are useful if turning to crystalloid electrolyte fluids as the mainstay of fluid resuscitation: Using arterial pressure as the target for the infusion easily results in over–hydration. Evaporation during surgery is often overrated. Plasma volume expansion from crystalloid fluid is much greater than commonly believed as long as the infusion is continued. In anaesthesia-induced hypotension, crystalloid and colloid fluids are equally effective plasma volume expanders. Anaesthesia and surgery greatly retard the rate of elimination of crystalloid fluid. Several findings about how crystalloid fluid behaves during anaesthesia and surgery contribute to the fact that they are more effective plasma volume expanders than previously believed. Rapid infusion of a crystalloid to compensate for surgical hemorrhage easily leads to hypervolaemia due to the distribution effect of the crystalloids.

Optimal administration of fluids can be achieved by targeting the microcirculation

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Learning objectives: 1) Understand the physiology of oxygen transport to tissue in relation to fluid therapy. 2) To appreciate the importance of targeting the microcirculation in this respect. 3) To understand the distinction between convective and diffusive oxygen transport and the way in which fluids affect these physiological variables responsible for oxygen transport to tissue. 4) To review methods for direct observation of the microcirculation. 5) To introduce the lates recently developed vital microscope (Cytocam) based on and a computer controlled image sensor able to automatically analyze images.

Background: The condition in shock and sepsis where despite correction of systemic oxygen delivery variables, signs of hypoxia regional dysoxia and a deficit in oxygen extraction persist represent the true challenge in the hemodynamic management of the critically ill patient today.

Results: Current evidence shows that the origin of circulatory failure in such patients is not found in alterations in systemic variables, rather in the failure of microcirculatory to transport and the mitochondria to utilize adequately oxygen [1]. These insights have gained clinical acceptance by our introduction of bedside microcirculatory observations using hand held microscopes, initially Orthogonal Polarized Spectral (OPS; commercialized by Cytometrics USA) and later Sidestream Dark Field (SDF commercialized by Microvision Netherlands and KK technologies UK) imaging [2, 3]. The latest generation of these hand held microscopes is and image sensor based computer–controlled device based on Incident Dark Field imaging (the Cytocam; Braedius Medical; [4, 5]). Fluid therapy is regarded as the corner stone of hemodynamic support of septic shock patients. However, optimal titration of fluid therapy has remained a challenge, where both composition of fluids and the hemodynamic target to be reached are a source of ongoing debate. Recently identifying hypovolemic patients responsive to fluid therapy by observation of slow perfusion in the sublingual microcirculation was found to be more sensitive than using clinical indicators of hypovolemia [6]. In a porcine study Xu et al recently showed that microcirculatory perfusion to be more effective as a resuscitation target than correction of systemic hemodynamic variables following shock [7]. From these studies it is clear that targeting the microcirculation in fluid therapy may be a much better hemodynamic target than targeting systemic variables such as stroke volume or blood pressure variables or changes therein which can lead to fluid overload. In this way we envisage, that as the study of Pranskunas shows that, patients with low convective flow identify themselves as being hypovolemic in need of fluid therapy. Fluid responsiveness would be defined as the observation that micrcocirculatory flow increases in response to the administration of fluids. Once maximum functional capillary density has been achieved with optimal convective flow, adequate optimal fluid administration would have been achieved. Too much fluid would be indicated by an excessive reduction of viscosity and loss of capillaries resulting in a reduction in functional capillary density with increased diffusion distances ans a reduction of the oxygen delivary capacity of the microcirculation [8, 9]. Such a theory for optimal fluid administration will have to be tested in clinical settings. However routine clinical use of hand held microscopes has not been realized and using the current first (OPS imaging) and second (SDF imaging) generation devices mainly due to their technical limitations and inability to automatically analyze images at the bedside needed for diagnosis and titrating therapy and they have mainly been used for research purposes [10]. Recently, however, a third generation hand held microscope based on Incident Dark Field imaging [5] has been introduced by Braedius Medical with a computer controlled high-resolution high--pixel density digital camera able to instantly analyze and quantify images [4]. This development opens the way for implementation of quantitative microcirculatory imaging for routine clinically use.

Conclusions: It is concluded that bedside microcirculatory diagnostics will form an important addition to functional hemodynamic monitoring bringing important missing physiology to the bedside of the critically ill patient [13].

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Acute circulatory failure and the FALLS protocol

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Background: A concept is holistic when each of its components must be understood for making able to understand the whole. The FALLS protocol (fluid administration limited by lung sonography) is a typical example since it allows a simplified use of cardiac sonography by considering lung ultrasound [1].

Discussion: With our universal microconvex probe and our simple material, the cause of a circulatory failure of obscure origin will be assessed sequentially, following Weil's terminology [2]. The simple cardiac sonography (a major simplification of traditional "Echo") will rapidly exclude substantial fluid surrounding heart (suggestive of pericardial tamponade), then right heart dilatation (suggestive of pulmonary embolism). Then some drops of BLUE protocol immediately exclude an A' profile (lung sliding abolished with exclusive A lines), suggestive of a tension pneumothorax. At this step, obstructive shock is ruled out. Then the BLUE protocol is used again for searching a B profile (multiple lung rockets with lung sliding), the usual signature of hemodynamic pulmonary edema. Its absence will here rule out a cardiogenic shock from left origin, i.e., most cases. Cardiogenic shock from right origin is rare and the low pulmonary artery occlusion pressure (PAOP) will generate an A profile, read below. Once obstructive and cardiogenic shock ruled out, the only remaining causes are hypovolemic and distributive shock. These patients have, usually, the A profile (or equivalents, A/B, C profile). The A profile (lung sliding with A lines) indicates a low PAOP [3] i.e., a pathophysiological clearance for fluid therapy in these patients, who are called FALLS responders. The therapeutic part of the FALLS protocol begins: a therapeutic test. Patient's improvement if there is no change of the A profile indicates hypovolemic shock. Such patients just needed fluids for improving their circulatory status, without initiating any fluid overload. The absence of clinical (or biological, etc) improvement under fluid therapy will result in resuming the fluid therapy up to a fluid overload which will be detected at the interstitial stage, i.e., early and infra clinical stage [4]. At this step, when the PAOP increases above 18 mm Hg, the A profile changes to a B profile [3]. This change is called the FALLS endpoint. The FALLS endpoint indicates that the diagnosis of hypovolemic shock can be ruled out. Such a dynamic profile indicates the only remaining mechanism, which is distributive shock, i.e., mainly, septic shock. The diagnosis of anaphyllactic shock is usually easy (and by the way also requires fluid therapy). Spinal shock is a rarity and occurs in suggestive settings. Time permitting, FALLS protocol can be associated with no drawback with any of the traditional hemodynamic tools (Swan Ganz catheterization, echocardiography, PICCO etc). Left heart hypocontractility (accessible using the simplified cardiac sonography) can yield needs for inotrope. The main limitation of the FALLS protocol is the B profile on admission due to a non cardiogenic pulmonary edema, i.e., mainly, lung sepsis displaying this B profile. In this case, more traditional tools should be used in a first step (we simplify this point). Said differently, FALLS protocol suggests that the change from A lines to B lines during fluid therapy can be considered as a direct marker of clinical volemia. It occurs at an early, infraclinical step of pulmonary edema [3]. It is independent from many constraints of usual methods. The answers to many questions are detailed in [5], such as: How about PAOP as a reference? How about right heart dysfunction? How about special settings (post surgery with open pericardium and others)? Can a patient be managed without control of its cardiac index? Are patients with septic shock plus ARDS a limitation? And several other questions, regarding a concept which advocates to be fully open to any criticism. Just, these remarks should address an indisputable gold standard for being efficiently considered.

Conclusions: The final aim of the FALLS protocol is to manage circulatory failure more easily, with less energy, less cost, using again the spirit of holistic ultrasound, since the same material with the same probe (previously used for whole body, veins, heart...) is used here, once again.

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Heart Lung ultrasound interactions

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Background: The two main vital organs (heart and lungs) live next each other, and permanently interact. Many tools are used for assessing these heart lung interactions. An interesting use of lung ultrasound is the case of elevated left heart pressures, which generate pulmonary edema, because it can be promptly detected, at an infraclinical

step. The FALLS protocol has a devoted abstract. It is based on a 25 year observation of lung artifacts using ultrasound. Only two main kinds of artifacts can be described, A lines and B lines (called lung rockets when multiple). We were not able to see intermediate artifacts, which means that the B line is generated all of a sudden. This also means that lung ultrasound is a dichotomous science. Lung rockets are labile, present during pulmonary edema and vanishing under therapy. It was shown that the B line indicates an enlargment of the subpleural interlobular septum, usually because of pulmonary edema [1]. Normal septa are unable to disturb the ultrasound beam, which is totally rejected by the pleural line, resulting in a repetition of this line: the A line. The absence of intermediate artifact between A lines and B lines indicate that when the septum begins to enlarge, the A line remains unchanged. At a certain degree of septal enlargment, the ultrasound beam can suddenly penetrate a minute portion of the septum. Since there is a maximal acoustic impedence gradient between gas and fluids, the ultrasound beam which meets simultaneously these two components becomes prisoner of this minute structure, resulting in a persistent to andfro movement generating multiple small horizontal lines called J lines at the speed of 1500 m s^{-1}. The B line is a vertical artifact shaped precisely by these small horizontal lines (roughly hundred in a slide of 15 cm depth). The difference between dry septa and wet septa is a volume of fluid coming from the vascular system, i.e., a representation of a part of volemia. The A lines and B lines are two opposite artifacts, either horizontal or vertical. **Conclusion:** This means that using the FALLS protocol, the physician benefits from an ON-OFF parameter measuring a variation in volemia. This change occurs in an organ supposedly free of fluid, and what more is, the most vital organ. These pathophysiological facts have initiated the FALLS protocol

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Lung ultrasound in the critically ill: The BLUE protocol

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Background: The BLUE protocol is a fast protocol (less than 3 minutes). It is part of lung ultrasound in the critically ill (LUCI), which is part of critical ultrasound, itself a kind of visual medicine. Critical ultrasound was defined in our 1993 publication as an approach associating one diagnosis with one immediate therapeutic decision. The inclusion of the lung, the main vital organ, is part of its definition. The integration of LUCI provides a new definition of the priorities. The BLUE protocol requires the mastery of no more than ten signs. Simple machines work better than up to date ones. We use a 1992, gray scale unit, without Doppler, and a 1–17 cm range microconvex probe. The BLUE protocol analyzes the bat sign (pleural line), lung sliding (yielding seashore sign), the A line (horizontal artifact), the quad sign and sinusoid sign indicating pleural effusion regardless its echogenicity, the tissue like sign and fractal sign indicating lung consolidation, the B line and lung rockets (numerous vertical comet tail artifacts indicating interstitial syndrome), abolished lung sliding with the stratosphere sign, suggesting pneumothorax, and the lung point, indicating pneumothorax. Some other signs are used for more sophisticated uses (distinguishing atelectasis from pneumonia for instance...). All these disorders were assessed using CT as gold standard with sensitivity and specificity ranging from 90 to 100%, allowing to consider ultrasound as a reasonable bedside gold standard in the critically ill. The BLUE protocol allows immediate diagnosis of acute respiratory failure among the main causes. It associates signs with locations, and includes a venous analysis (done in the case of normal anterior lung surface), different from traditional approaches, with particular emphasis at calf areas, and use of a nonvascular probe. Pulmonary edema, pulmonary embolism, COPD & asthma (considered together), pneumothorax and pneumonia yield quite specific profiles: respectively (at anterior chest wall), the B profile (lung sliding plus lung rockets) for pulmonary edema, the A profile (lung sliding plus A lines) with venous thrombosis for pulmonary embolism, the A profile plus free venous network for COPD or asthma, the A' profile (abolished lung sliding with A lines) for pneumothorax, and four profiles for pneumonia: the B' profile (abolished lung sliding plus lung rockets), the C profile (anterior lung consolidation), the A–B profile (one side lung rockets, one side half A profile), and the A-V-PLAPS profile, that is A profile, free venous network and postero-lateral alveolar and/or pleural syndrome (labelled PLAPS). The data of the BLUE-protocol are consecutive patients seen in our emergency room, all admitted to the ICU and benefiting from a final diagnosis in the hospitalization report. The sensitivity and specificity are, respectively, 97% and 95% for hemodynamic pulmonary edema, 81% and 99% for pulmonary embolism, 89% and 97% for COPD and asthma, 88% and 100% for pneumothorax, and 89% and 94% for the four profiles of pneumonia. The native article and several answers to letters to the Editor deal with several issues, such as the consideration of patients with unknown diagnosis, several diagnoses, rare diagnoses, the inclusion or not of many items (diaphragm e.g.), some issues such as the

diagnosis of pulmonary embolism when the venous thrombosis cannot be found, and many others. LUCI is also the use of lung artifacts in acute circulatory failure (read other abstracts), interventional ultrasound (mainly, here, thoracocenthesis), which provides maximal safety and can change patient management. Referrals to CT can be postponed (ARDS, trauma). Irradiation is decreased (LUCI-FLR project). The SESAME-protocol (ultrasound in cardiac arrest) begins with the lungs, for its ability to immediately rule out or suggest pneumothorax, mainly. Here, the one probe philosophy allows fast assessment of the lung (pneumothorax), then heart (tamponade), then calf veins (embolism), then abdomen (hemorrhage). All these applications can be performed in trauma, ICU, remote areas, neonates (the signs being the same as in the adult), and can be extrapolated to several other disciplines (pulmonology, cardiology and all those where the lung can be on focus). Several details are dealt with in our textbook.

Conclusion: The publication of an extended BLUE-protocol (including rare or double diagnoses) is foreseen, but the main advantage of the BLUE-protocol is its simplicity. The BLUE-protocol should then be considered as a preliminary work. Training is the least issue. CEURF makes since 1990 personalized training of intensivists at the bedside of the critically ill.

Learning objectives: To understand the basics of lung ultrasound. To explain how artifacts point towards specific diagnoses. To list the definitions included in the BLUE protocol

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Assessment of fluid status in critically ill patients

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Background: Is fluid overload a cosmetic issue or just bad medicine? Oedema and derailed cumulative fluid balances: are they just collateral damage or do they put the patient in additional danger? What is best: restrictive versus liberal fluid strategies? What is the Ebb and Flow phase of shock? Is anasarc oedema just of cosmetic concern or is it harmful for the organs and eventually the patient? Maybe we need to rethink the 2 hit ischemia-reperfusion model and replace it by a 3 hit model, where unresolved shock will lead to the third hit, the global increased permeability syndrome? We need to move our targets and adapt our goals. Is there an additional effect of early removal of fluids or should we go from early goal directed treatment to late conservative treatment, to late goal directed fluid removal. How should we guide our fluids, should we use barometric or volumetric preload indices? Is there a place for PAL in the de-resuscitation phase? How can we get the right answers to the 4 basic questions: 1) when do I start giving fluids (this about the safety of fluids), 2) when do I stop giving fluids (this is about the risks of fluids), 3) when do I start to empty the patient (this is about the safety of removing fluids), and finally 4) when do I stop emptying the patient (this is about the risks of removing to much fluids)? Old habits die hard but does the good old central venous and capillary wedge pressures still hold against the new volumetric armamentarium? When are barometric indices of preload not working? Why are static filling pressures useless as resuscitation endpoint since they may lead to under- or futile over-resuscitation? Why are volumetric indices better in conditions of increased intrathoracic pressure?

Conclusions: A positive cumulative FB is associated with worse outcomes. Interventions to limit a positive cumulative FB are associated with improved outcomes. A positive cumulative FB is associated with IAH.

Learning objectives: Traditional filling pressures are erroneously increased in situations of high intrathoracic pressures (related to IAP or PEEP). In this situation enddiastolic volumes are better preload indicators. Normal values of GEDVI and EVLWI in surgical and septic patients have been described in a recent meta-analysis. The PPV and SVV are not indicators of preload but rather markers of fluid responsiveness (in fully ventilated patients with a tidal volume above 6mL kg^{-1} and in regular sinus rhythm). Pay attention to the fact that increased IAP may increase baseline values of SVV and PPV, so higher thresholds may be needed in order to define fluid responsiveness. Therefore one can start to give fluids when GEDVI (and GEF-corrected GEDVI) is low and PPV and SVV are high. However, before giving any fluids one must always assess fluid responsiveness with the passive leg raising (PLR) test or the end-expiratory occlusion (EEO) test taking into account that IAP may also have an impact on the interpretation of these tests. Measurement of flow (CI) alone does not allow you to discriminate between over- and underfilling. One must stop filling when GEDVI (or GEF corrected GEDVI), SVV and PPV return to normal or when EVLWI starts to increase above 10 mL kg^{-1} PBW. After the initial resuscitation phase an even more important question that needs to be answered is: "when to stop filling?" EVLWI can guide you to get rid of the excess fluids by initiating diuresis with furosemide or starting CVVH with ultrafiltration as was recently shown. So I start emptying my patient when IAP or EVLWI increase and when the daily or cumulative fluid balance is positive. Finally one must stop emptying the patient when IAP and EVLWI normalise, when

cumulative fluid balance gets close to zero, or hen central venous oxygen saturation (ScvO2) decreases. Off course if hepatosplanchnic perfusion is compromised (as evidenced by a low plasma disappearance rate of indocyanine green) one must stop emptying the patient since a dry liver leads to a dead patient! The learning objectives are:

- To analyse the different methods to assess fluid status
- To list methods to assess capillary leak
- To understand the basic principles, mechanisms, indications and limitations of bio-electrical impedance analysis
- To review the available literature on fluid status assessment with an emphasis on BIA.

The death of early goal directed therapy (EGDT)

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Background: On the 8th November 2001 Emanuel Rivers and collaborators published a study entitled "Early Goal Directed Therapy (EGDT) in the treatment of severe sepsis and septic shock" in which they compared two protocols for the early resuscitation of patients with severe sepsis and septic shock.

Results: The study enrolled 288 patients (25 were excluded after the fact) and reported a 28 day mortality of 49.2% in the control group and 33.3% in the EGDT group ($P = 0.01$). Based on this small, unblinded, single center study, EGDT soon became regarded as the standard of care around the world, it was endorsed by major organizations and formed the basis of the 6-hour resuscitation bundle of the 2004, 2008 and 2012 recommendations of the Surviving Sepsis Campaign.

Discussion: However, a number of very serious concerns exist with regards to the scientific basis of the study (none of the elements were evidence based), the conduct of the study, the presence of undisclosed conflicts of interest as well concerns regarding data manipulation. This study was followed by over 54 observational before-and-after studies/cohort studies and meta-analyses of these studies demonstrating that EGDT reduced mortality. The Protocolized Care for Early Septic Shock (ProCESS) and the Australasian Resuscitation in Sepsis Evaluation (ARISE) trials are large multicenter randomized trials that have recently been completed. These two trials, which enrolled a total of 2941 patients, failed to demonstrate any benefits from EGDT. These and other studies have demonstrated that blood transfusion (in patients with a Hb > 7g dL^{-1}) and targeting a $ScvO_2$ > 70% are of no benefit in patients with sepsis. Furthermore, targeting a CVP > 8 mm Hg is likely to lead to severe fluid overload and in itself is likely to be a harmful intervention.

Conclusion: Hence, the major elements of EGDT lack scientific support and indeed may be harmful. These data suggest that EGDT should be abandoned immediately. Furthermore PROCESS and ARISE reinforce the concept that uncontrolled before-after studies lack scientific rigor and are likely to be plagued by publication bias, patient selection bias, investigator bias and data manipulation and should not be published in reputable journals.

Learning objectives:

- To give an overview of early goal directed therapy
- To understand the different outcomes from the different studies

Fluid Responsiveness

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Background: Current "wisdom" suggests that aggressive fluid resuscitation is the best initial approach to the patient with hemodynamic instability. Yet, multiple studies have demonstrated that only about 50% of hemodynamically unstable patients in the intensive care unit and operating room respond to a fluid challenge.

Results: While under-resuscitation results in inadequate organ perfusion accumulating data suggests that aggressive fluid resuscitation is associated with increased morbidity and mortality across a diverse group of patients. From an evolutionary point of view humans have evolved to deal with hypovolemia and not hypervolemia. The argument is no longer "wet or dry" but "just the right amount of fluid". This is not an easy determination and requires an evaluation of the patient's global hemodynamics, organ perfusion, cardiac function and an assessment of "fluid responsiveness" in addition to understanding the patients' clinical condition. Fundamentally, the only reason to give a patient a fluid challenge is to increase stroke volume (fluid responsiveness). If a fluid challenge does not increase stroke volume, volume loading serves the patient no useful benefit and is likely harmful. Cardiac filling pressures including the central venous pressure and pulmonary artery occlusion pressure have traditionally been used to guide fluid management. However, studies performed over the last 30 years have demonstrated that cardiac filling pressures are unable to predict fluid responsiveness.

Discussion: Over the last decade a number of dynamic tests of volume responsiveness have been reported. These tests

dynamically monitor the change in stroke volume following a maneuver that either increases or decreases venous return (preload) and challenge the patients' Frank-Starling curve. These dynamic tests use the change in stroke volume following a passive leg raising maneuver or fluid challenge to assess fluid responsiveness. In the operating room changes in stroke volume during mechanical ventilation can also be used as a guide to fluid responsiveness. These dynamic tests measure stroke volume continuously and in real-time by minimally invasive or non-invasive technologies which include Doppler ultrasound, pulse contour analysis and bioreactance.

Conclusion: Dynamic tests for fluid responsiveness should be used instead of static preload parameters before fluids should be administered.

Learning objectives:

- To understand the differences between barometric and volumetric preload indicators
- To understand the difference between static an dynamic parameters
- Low preload does not mean fluid responsiveness
- Fluid responsiveness does not mean that fluids need to be administered

Assessing fluid responsiveness by echocardiography

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Background: Predicting fluid responsiveness consists in predicting before to give a volume expansion, whether or not it will induce the expected increase in cardiac output. It is a major issue, especially in the intensive care unit. Indeed, on the one hand, many studies showed that fluid administration result in a significant increase in cardiac output in only half of the patients if fluid responsiveness is not predicted. On the other hand, evidence is accumulating that excessive fluid administration is deleterious, especially in patients with septic shock and/or acute respiratory distress syndrome [1].

Aims: Taking into account the most recent publications of the literature, we will attempt to describe the different methods that are today available in order to predict fluid responsiveness with echocardiography. We will describe the respective advantages and limitations of each of these tests. We will also discuss the place of echocardiography in the global fluid management of patients with acute circulatory failure.

Discussion: Echocardiography can be used to predict fluid responsiveness through four methods. First, fluid responsiveness is predicted by significant variations of the subaortic maximal velocity during the respiratory cycle [2]. Nevertheless, this surrogate of pulse pressure shares with it the same limitations. In particular, it cannot be used in patients with cardiac arrhythmias, spontaneous breathing and ARDS with low lung compliance and/or low tidal volume. Second, the hemodynamic response to a passive leg raising test can be assessed by echocardiography. Several studies actually showed that a significant increase in the velocity time integral in response to the postural maneuver is reliable in order to predict fluid responsiveness [3]. Even though echocardiography during a passive leg raising test is not easy-to-do, this method can be considered if no other tool is used to measure cardiac output, especially at the early phase of acute circulatory failure. Third, the increase in the velocity time integral during a "mini" fluid challenge, consisting in a 100-mL fluid bolus, has been proposed to predict fluid responsiveness [4]. This requires some additional investigation, especially because echocardiography may not be precise enough to measure changes in cardiac output induced by a so small fluid challenge. Fourth, the end-expiratory occlusion test consists in interrupting mechanical ventilation at end--expiration during 15 sec and to use the induced-increase in cardiac preload as a preload challenge. This test has been investigated with other measurements of cardiac output, but can likely be done with echocardiography. Finally, the respiratory variation of the diameter of the inferior [5] and superior [6] vena cavae during mechanical ventilation are associated with hypovolemia and were found to detect preload responsiveness. These methods are limited by the fact that they need that no spontaneous breathing is present and that tidal volume and lung compliance are not too low. Also, the collapsibility of the superior vena cava can only be assessed by transesophageal echocardiography.

Learning objectives:

- To recall the risk of excessive fluid administration in critically ill patients
- To recall the basic pathophysiology of cardiac preload, cardiac output and the cardiac function curve
- To list the tests that are today available to detect preload responsiveness by means of echocardiography, to detail and describe their respective advantages and limitations
- To describe the practical method to perform these tests at the bedside

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The therapeutic conflict: when each of your decisions may cause harm?

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Background: Critical illness is often associated with significant hemodynamic changes which have the potential to cause organ dysfunction and death. In such settings we often find ourselves in a 'Therapeutic Conflict'. A therapeutic conflict is a situation where each of the possible therapeutic decisions carries some potential harm. Such conflict is often encountered in patients who have more than one failing organ system or have significant co-morbidities. The 'classic' therapeutic conflict is encountered in a hemodynamically unstable septic patient who also has ARDS. On one hand, large amounts of fluids may be necessary to stabilize the hemodynamic status. On the other, further fluid administration may increase extra-vascular lung water (EVLW) and further deteriorate lung mechanics and function. Since all individual hemodynamic parameters have limitations and confounding factors, a multi-parametric approach increases the chance of a correct identification of the underlying pathophysiological disturbances. Such multi-parametric approach to hemodynamic monitoring should be able to provide a more accurate assessment of preload and fluid responsiveness, cardiac output and EVLW. In addition, therapeutic conflicts should be managed by adopting of decision-making strategy that includes a-priori assessment of the possible harm that each of the respective potential decisions may cause if found to be wrong.

Learning objectives: To understand that the presence of a therapeutic conflict presents a challenge to protocolized care as it necessitates individualized care at the highest professional level.

Continuous lactate and glucose monitoring: sense or nonsense?

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Background: Near-continuous monitoring appears as a must for the analysis of trends of physiological variables over time. Thanks to new technological advances, blood glucose and lactate near-continuous monitoring are now available and validated for clinical practice. Blood glucose monitoring will be very helpful to guide insulin therapy in order to maintain blood glucose within a narrow range, thereby preventing severe hyperglycaemia, hypoglycaemia and increased glucose variability, three conditions associated with a poor outcome. Blood lactate monitoring can serve as a guide for the initial resuscitation and treatment of circulatory disorders associated with tissue hypoxia and hyperlactatemia. Hence, these monitoring tools will likely be included in the standard equipment of modern ICUs in the near-future.

Learning objectives:

- To know the methods used to measure blood glucose and blood lactate
- To understand the evidence supporting continuous monitoring of blood glucose and blood lactate
- To appraise in which clinical situations these technologies could be useful
- To know the limitations of the different monitoring systems

Hydroxyethyl starch: to be banned or here to stay?

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Background: The call for the ban of hydroxyethyl starch (HES) is primarily based on the data of the VISEP [1], CHEST [2] and 6S studies [3]. The numerous methodological flaws of the VISEP study [1] have been addressed in countless letters and commentaries and are too numerous to be individually listed. The most important flaws are; (i) the trial was prematurely terminated. (ii) An unphysiologically hypertonic, unbalanced, hyperchloraemic 10% pentastarch solution 200/0.5 (i.e., average molecular weight 200 kDa, average molar substitution ratio 0.5) was compared with a balanced, normochloraemic crystalloid solution. Thus, this was not only a comparison between HES and crystalloid, but also between a hypertonic, unbalanced, hyperchloraemic and a balanced solution. (iii) The recommended daily dose of pentastarch was exceeded by ≥ 10% at least once in 38% of patients. Notably, in patients receiving no more than the maximum recommended dose of HES, mortality was significantly lower than in those receiving more than the recommended dose and tended to be even lower than in patients receiving Ringer's lactate. These findings strongly suggest that the adverse renal effects were (at least partly) caused by an overdose of pentastarch.

Discussion: The CHEST study [2] has also considerable methodological problems. One of them is the use of two unbalanced hyperchloraemic solutions for volume replacement in critically ill patients. It has been known for two decades that chloride is a potent renal vasoconstrictor [4]. Even in healthy individuals, the infusion of 2 L of 0.9% normal saline resulted in an immediate 40% decrease of renal blood flow velocity and renal cortical tissue perfusion [5]. Implementation of a chloride-restrictive intravenous fluid administration strategy decreased the incidence of acute kidney injury and renal replacement therapy (RRT) in critically ill patients [6]. The conclusion of the CHEST study that "more patients who received resuscitation with HES were treated with renal-replacement therapy" is wrong. It is "buried" in the electronic supplemental material that the renal outcome variables RRT and RIFLE-F (renal failure) were not statistically different between groups, and HES was even associated with better outcome of RIFLE-R (risk of renal dysfunction) and RIFLE I (renal injury). At the time of randomization, homeostatic values in the VISEP [1], CHEST [2] and 6S studies [3] had reached and, at times, even exceeded therapeutic target values recommended by the Guidelines of the Surviving Sepsis Campaign in the initial therapy of sepsis [7], indicating that the patients were already resuscitated and normovolaemic at that time. This is, in general, a contraindication to the administration of any type of colloid. Referring to the VISEP [1], CHEST [2] and 6S studies [3], a recent editorial stated [8]: "From a physiological point of view, this type of experimental design warrants significant skepticism […]. If one is to compare the respective effects of crystalloid solutions and starch solutions, particularly in the kidney, an organ that is extremely sensitive to the volume and composition of fluids, it is essential that a clear hemodynamic endpoint in the individual administration of these solutions is applied […] Although these trials are to be commended on their impressive undertaking and may indeed hold true under certain circumstances, from a physiological perspective, the results and conclusions of these trials may need to be taken with a pinch of salt." In non-septic patients, HES compared to other fluids was not associated with increased risk of RRT, renal dysfunction or renal failure, and was even associated with decreased risk of RIFLE-R and RIFLE-I [9].

Conclusion: Several recent meta-analyses (which included several investigations in cardiac surgery patients) did not find any association between HES containing solutions and renal dysfunction [10–12], increased blood loss [12] and allogeneic erythrocyte transfusion [12]. On the basis of existing data, starches might just be the right solution — sometimes [13].

Learning objectives: The titles of two recent commentaries succinctly make the point: "Hydroxyethyl starch — the importance of being earnest" [14], and "Twisting and ignoring facts on hydroxyethyl starch is not helpful" [15]. In general ICU patients HES can be used only within a short time frame after the onset of shock: the use is limited to acute volume resuscitation (< 24h) for hemodynamic instability in case of hypovolaemia and complying with maximum dose (50 mL kg^{-1} per day). HES should not be used in acute or chronic renal failure or oliguria not responsive to fluids (6h) and the best alternative is a balanced crystalloid. In postoperative hypovolemic patients there may still be a place for HES taking into account the considerations listed above. In sepsis and burn patients, HES should no longer be used, while saline is also to be avoided and as alternative balanced crystalloids form a good first choice.

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Suspecting ebola: when the dress code becomes life saving! Personal protective equipment — a practical demonstration

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Background: The CDC guidance contains the following key principles (http://www.cdc.gov/vhf/ebola/hcp/procedures-for-ppe.html): Prior to working with Ebola patients, all healthcare workers involved in the care of Ebola patients must have received repeated training and have demonstra-

ted competency in performing all Ebola-related infection control practices and procedures, and specifically in donning/doffing proper PPE. While working in PPE, healthcare workers caring for Ebola patients should have no skin exposed.The overall safe care of Ebola patients in a facility must be overseen by an onsite manager at all times, and each step of every PPE donning/doffing procedure must be supervised by a trained observer to ensure proper completion of established PPE protocols.

Learning obejectives: Healthcare workers must understand the following basic principles to ensure safe and effective PPE use, which include that no skin may be exposed while working in PPE:

Donning: PPE must be donned correctly in proper order before entry into the patient care area and not be later modified while in the patient care area. The donning activities must be directly observed by a trained observer.

During Patient Care: PPE must remain in place and be worn correctly for the duration of exposure to potentially contaminated areas. PPE should not be adjusted during patient care. Healthcare workers should perform frequent disinfection of gloved hands using an alcohol-based hand rub, particularly after handling body fluids. If during patient care a partial or total breach in PPE (e.g., gloves separate from sleeves leaving exposed skin, a tear develops in an outer glove, a needlestick) occurs, the healthcare worker must move immediately to the doffing area to assess the exposure. Implement the facility exposure plan, if indicated by assessment.

Doffing: The removal of used PPE is a high-risk process that requires a structured procedure, a trained observer, and a designated area for removal to ensure protection. PPE must be removed slowly and deliberately in the correct sequence to reduce the possibility of self-contamination or other exposure to Ebola virus. A stepwise process should be developed and used during training and daily practice.

Fix the leaky bucket to prevent fluid overload: How CytoSorb stops capillary leakage

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Background: Capillary leakage is one major cause of intravasal fluid deficiency. This may result in hypotension and cardiocirculatory shock necessitating fluid resuscitation. Administered fluid, however, may be lost into third space due to leaking capillaries leading to relative hypovolemia despite adequate volume administration. Massive tissue edema may result from pursuing to maintain adequate intravasal fluid level. Capillary leakage may be triggered by inflammatory conditions. Acute inflammatory disease is accompanied by stimulation of inflammatory mediators. This, primarily, intends to control the inflammatory stimulus. In some cases, however, cytokine response may be overwhelming and causes an overshooting release of cytokines. This is well known as "cytokine storm" and is known to lead to clinical consequences such as shock, vasoplegia, organ dysfunction and capillary leakage [1, 2].

Discussion: Therapeutic approaches of "blood purification strategies" using modified hemofilter technology and high volume filtration techniques failed to show a clear benefit to patients suffering from severe inflammatory diseases [3]. Since 2011 a new technology is available, which uses a different approach to get rid of uncontrolled cytokine release. CytoSorb is a so-called bead adsorber technology which is able to reduce elevated cytokine levels [4]. This approach was proven effective in animal models of sepsis and septic shock in terms of modulating immune response and controlling an overwhelming cytokine response and, thereby, improving short term survival in this experimental model [5, 6]. Case reports from the use of cytokine adsorption with CytoSorb also could demonstrate effectiveness in controlling cytokine overshoot during hyperinflammatory conditions [7]. Also, in other disease states which are well known to be associated with uncontrolled cytokine release and, as a consequence, may lead to clinically relevant decreased vascular tone and capillary leakage, treatment with cytokine adsorbers may be effective to control cytokine storm and reverse detrimental clinical effects [8]. We used CytoSorb hemadsorption therapy in patients suffering from severe inflammatory conditions as post cardiopulmonary bypass SIRS, septic shock due to endocarditis in a therapeutic as well as in a pre-emptive approach. Cytokine levels could be reduced in these patients and this was accompanied by reduced catecholamine needs and clinical stabilization.

Conclusion: The overproduction of cytokines by the immune system, often called "cytokine storm", is a hallmark of many life-threatening illnesses seen in the ICU such as severe sepsis and septic shock. A cytokine storm can be toxic, causing direct cell death, massive capillary leakage, severe inflammation, and a cascade of events that can ultimately lead to shock and multiple organ failure. At the heart of the Cytosorb® technology is a biocompatible, highly porous polymer designed to capture and adsorb cytokines in the ~10–50 kDa "cytokine sweet spot" where most cytokines reside. The goal is to reduce toxic cytokine levels to prevent or mitigate organ failure and immune suppression, and to seal the capillary leak, thereby improving clinical outcome. Thus, hemadsorption therapy with CytoSorb may offer a new therapeutic approach for patients suffering from

severe immune system hyperactivation by re-equalizing pro- and anti-inflammatory response.

Learning objectives:

- To recognize the role of uncontrolled immune response for clinical changes of vascular tone, hemodynamic changes, capillary permeability, organ dysfunction
- To recognize the parameters of proinflammatory cytokines and the course of their activation in the context of inflammatory diseases
- To review different approaches of blood purification for modulation of cytokine levels
- To learn the effects of bead adsorber technology for cytokine removal
- To recognize different indications for hemadsorption therapy

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Ultrasound in respiratory failure

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Respiratory failure may be associated with or without pulmonary oedema. In presence of pulmonary oedema in patient with respiratory failure the mail goal of the echocardiography is to make the difference between ARDS or bilateral pneumonia and hemodynamic pulmonary oedema (HPO). Using echocardiography we estimate pulmonary artery occlusive pressure (PAOP) by using the mitral flow E wave velocity and early diastolic velocity of mitral annulus E'. E/E' is closely related to PAOP. Diagnosis of ARDS or bilateral pneumonia is associated with low PAOP. As well echocardiography is useful to assess right ventricular function in ARDS patients to rule out acute cor pulmonale. With high PAOP, HPO is diagnosed and then using echocardiography the cause of this pulmonary oedema may be done. Without pulmonary oedema, echocardiography may be used to assess right ventricle to found arguments en favour of pulmonary oedema or acute or chronic pulmonary disease. Right ventricular dilation is easy to recognize from a 4-chamber view. Thrombus may be seen in less than 10% of cases in severe pulmonary embolism using transthoracic echocardiography. In patients with dilation of right ventricle right ventricular hypertrophy may help to do the difference between acute and chronic cor pulmonale. Intra pulmonary or intra cardiac shunt should be ruled out by performing a contrast echocardiography

Riddles in the dark — how can the Stewart approach assist the clinician?

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Learning objectives: The principles and practice of strong ion differences (SID), acid-base status and the Stewart's approach. According to the Stewart approach there are only three independent variables that determine the concentration of H+ and thus pH in any fluid, including plasma. At first glance, the Stewart approach may appear difficult, especially because it involves a number of equations. However, the Stewart approach is actually very easy to use and put into practice at the bedside. After providing clear explanations for situations that are rather unituitively explained by the traditional methodology, some complex acid-base cases will be solved using this technique

The future of fluids in critical care

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Fluid therapy: after HES, should we eliminate the others? Adequate fluid administration is one of the cornerstones in the effective management of critically ill patients. There are two main groups of fluid, the crystalloids and the colloids. Crystalloid solutions pass easily through the endothelial barrier, and have a short intravascular persistence; they are readily available, cheap and generally well-tolerated. Colloid solutions do not easily cross semi-permeable membranes, so they maintain plasma oncotic pressure better and remain longer in the intravascular space than crystalloid solutions; hence, ingeneral, more crystalloid than colloid is needed to achieve the same resuscitation end-points, with the potential increased risk of positive fluid balance when only crystalloid solutions are used. However, these differences

may be less marked in patients with altered membrane permeability, e.g., those with sepsis. In recent years, there has been intense interest in which fluid or combination of fluids should be used. Concerns were initially raised regarding potential harm of albumin solutions; more recently hydroxyethyl starch (HES) solutions have come into the spotlight and essentially been withdrawn, except for certain specific cases of acute hypovolaemia. Indeed, all fluids have specific drawbacks. Among the crystalloid solutions, the most frequently used is normal saline, but infusion of large amounts of saline solution results in hypernatraemia and hyperchloraemic acidosis, which may have detrimental effects on coagulation and on renal, cerebral, gastrointestinal, and respiratory functions. So-called "balanced" fluids, such as Ringer's lactate, which are closer in content to normal body fluids and thus carry less risk of causing iatrogenic electrolyte imbalance, may be preferable to normal saline. However, Ringer's lactate is slightly hypotonic, may interfere with interpretation of lactate levels, and has some calcium content. Other balanced solutions include various molecules, e.g., acetate, gluconate, malate, citrate, the metabolism of which is not clearly defined in critically ill patients. The most popular of these balanced normotonic solutions is Plasmalyte. Among the colloids, albumin is the natural colloid and has been shown to be safe in critically ill patients. Nevertheless, it is more expensive than other colloid solutions so that it should be reserved for specific groups of critically ill patients in whom it has been shown to improve outcomes, e.g., septic shock, patients with cirrhosis and infection and patients with cirrhosis and type 1 hepatorenal syndrome. Of the synthetic colloids, HES solutions are now restricted, dextrans can cause anaphylactic reactions and may increase the risk of renal failure, and gelatin solutions are of limited effectiveness and not available in all countries.

Learning objectives: Fluids are an essential part of patient management and clearly we cannot eliminate all fluid solutions. However, fluids should be prescribed with more care than in the past, taking into account the patient's diagnosis, the type of fluid that has been lost, the adverse effects of each intravenous fluid, local fluid availability and costs. If large quantities of fluid are required, it would seem reasonable to use several fluid types rather than excessive amounts of any one; crystalloids should form the basis for fluid resuscitation and maintenance, but colloids may be required in some patients, especially when large amounts of fluids are required.