Original article

HDR brachytherapy (HDR-BT) combined with stent placement in palliative treatment of esophageal cancer

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Abstract

Purpose: In the study we present the initial results of palliative treatment using combined methods of HDR-BT and stent insertion in patients with advanced esophagus cancer.

Material and methods: Fifty patients were treated in the Great Poland Cancer Center using HDR-BT between June 2001 and December 2005 and they were enrolled into the study. All patients underwent endoscopic insertion of self-expanding, metal, endoesophageal stents owing to blockages in the lumen of the esophagus which excluded brachytherapy. The group included 41 men and 9 women, aged between 44 and 79 years (average 59.3 years). 36 of patients received 3 fractions of HDR once a week of 7.5 Gy, up to total dose of 22.5 Gy, 14 patients received 2 fractions of 7.5 Gy (15 Gy).

Results: The average patient observation period was 5.4 months. Complete remission (CR) was observed after 4 weeks in 2 cases (4%), partial remission (PR) in 31 (62%), no remission (NR) was seen in 6 patients (12%) and progression was noted in 11 cases (22%). Complications of brachytherapy for esophageal cancer were observed in 11 patients (22%), ulceration in 1 patient (2%), haemorrhage in 1 patient (2%) and bronchotracheal fistulas in 9 (18%) patients. The average observation period for patients with bronchotracheal fistulas was notably shorter than in remaining patients and amounted 3.5 months.

Conclusions: 1. Endoscopic implantation of stents to the lumen of the esophagus provides access to esophagus and, in many cases, allows application of HDR-BT. 2. HDR-BT for advanced esophageal cancer brought relief from dysphagia in most of patients. 3. The combination of the two methods of treatment represents an effective choice for palliative care of this group of patients, with a complication rate similar to observed one in the instance of brachytherapy alone.

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Key words: esophageal cancer, HDR brachytherapy, stents, palliative treatment.

Purpose

Cancer of the esophagus has been known and described for nearly two thousand years [1] and dysphagia is the most common complaint within the earliest reported symptoms (Fig. 1). The first form of palliative therapy for this neoplasm was described at the end of 19th century. This therapy was centered on the formation of an artificial feeding tube which bypassed the tumor and at the same time narrowed the lumen of the esophagus. In 20th century some number of other surgical procedures were developed which allowed radical excision of portions in the esophagus, along with the tumor, and using the replacement of prosthetic parts [2].

Unfortunately only 10-20% of patients with a diagnosis of esophageal neoplasm is qualified for surgical treatment. In the majority of cases the tumor is in advanced stage and already involves in the esophageal wall. Infiltrates surrounding organs [3] what, along with the frequent involvement of the mediastinal lymphatic system, leads to disqualification from radical surgical treatment. Usually palliative radiotherapy and/or chemotherapy is offered to such patients as they belong to a group with a poor prognosis. In spite of previously applied treatments, patients with advanced stage of esophagus tumors die as a result of metastases as well as involvement of neighboring organs and – quite often – from internal bleeding. Other cause of death is the formation of broncho-

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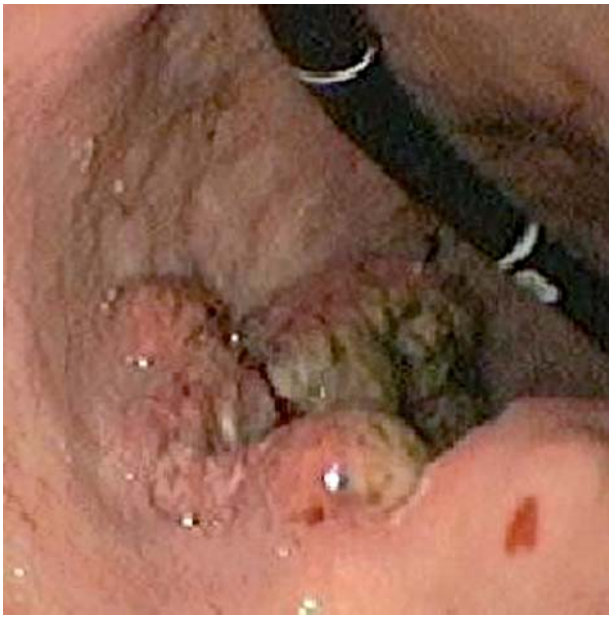

Fig. 1. Esophageal cancer with fiberogastroscop inside

esophageal fistulas resulting from the effects of radiotherapy and disintegration of the tumor, which in turn leads to inflammation of the mediastinum and lungs, causing direct threat to a patient life.

A number of methods of palliation have been used in attempt to improve patients quality of life and to provide normal swallowing till death of a patient resulting from progress of systemic disease. These methods include: thermal ablation, photodynamic therapy, radiotherapy (external beam or brachytherapy), chemotherapy, injected chemotherapy, argon beam or bipolar electrocoagulation therapy, internal feeding (nasal-gastric intubation/ percutaneous endoscopic gastrostomy), and intubation

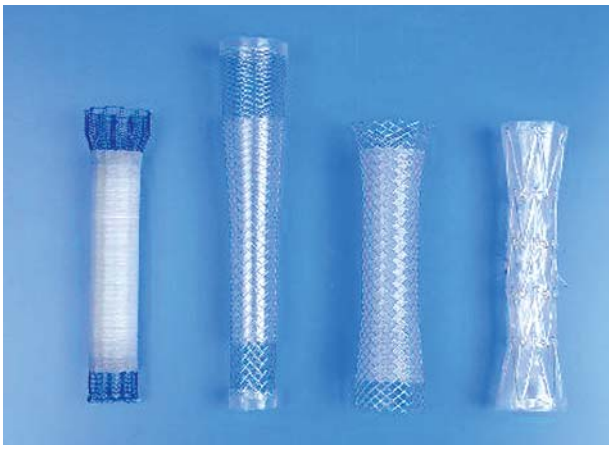

Fig. 2. Esophageal stents. Four types of esophageal stents (from left to right): Ultraflex (Microvasive, Boston Scientific, Natick, Massachusetts, USA), Wallstent (Microvasive, Boston Scientific), EsophaCoil (Instent, Minneapolis, Minnesota, USA), Z-stent (Wilson Cook, Winston Salem, North Carolina, USA)

(self-expanding metal stents SEMS or semi-rigid prosthetic tubes) with varying success and complications rates.

Endoesophageal brachytherapy allows to apply high doses of radiation to the tumor itself with concurrent protection of adjoining healthy tissues thanks to the rapid fall of the dose by the square of distance from the center of the applicator. The above treatment is also associated with a smaller proportion of late radiation complications. In the treatment of esophageal cancers, occasionally brachytherapy is used along with external beam radiation therapy (ERBT) in doses of 10-40 Gy, which may extend the palliative effects of improved swallowing among patients. Brachytherapy used alone as a individual way of treatment, in comparison to EBRT, gives lower percentage of complications [4, 5], out of which the most common problems are ulcerations and bleeding and bronchoesophageal fistulas. The aims of palliative brachytherapy are: maintenance of oral intake, minimization of hospital stay, relief of pain, elimination of reflux and regurgitation, prevention of aspiration and improvement of the patient's well-being. The results of HDR-BT as a palliative treatment are well known [6, 7]. In spite of all this facts, the access to this procedure on a national scale is limited due to the need for oncology centers to possess highly specialized equipment and appropriately qualified medical staff. In other centers, the use of other means for palliative treatment of the esophagus – such as endoscopic insertion of self-expanding metal stents (SEMS) [8, 9] – is not available. However theoretically, this type of procedure may be carried out in any regional center every single day whenever there is no need for more invasive methods, that may lead to problems associated with control of bleeding. Previous studies have confirmed that up to 95% of patients with stents application reported reduced dysphagia that resulted in improved swallowing and body mass increasing [10, 11]. Complications after implantation procedures are infrequent but include perforation of the esophageal wall, chest pain, bleeding and migration of the stent to the stomach or fistulas [12]. Blockage of the stent plates by growth of the tumor mass occurs in 27% of cases [13] and requires renewed endoscopic intervention. Complications after insertion of the stent are also connected to the location of its implantation. In the proximal portion of the esophagus, a patient may initially experience some breathing difficulties, while in the distal and intra-diaphragmatic portions, gastro-esophageal reflux may require pharmacological treatment [14]. Figure 2 shows the most commonly used variations of stents, while summarized indications and contraindications for the application of esophageal stents [15] are presented in Table 1.

HDR-BT is often proceeded with stent implantation which, apart from providing the insertion of the applicator itself, improves patient's swallowing. In the presented work, the clinical data and results were obtained from stent/HDR-BT palliative treatment of patients with inoperable advanced cancers of the esophagus. Effects of the treatment on patient survival in association of selected prognostic factors are presented.

Table 1. Indications and contraindications for stents [15]

Indications	Relative contraindications
1. Malignant esophageal obstruction. 2. Tracheo-esophageal fistula. 3. Primary or secondary tumors within the mediastinum causing extrinsic esophageal compression. 4. Esophageal perforation, usually iatrogenic, from direct endoscopic trauma or following factor of dilatation. 5. Treatment of symptomatic malignant gastro-esophageal anastomotic leaks. 6. Anastomotic tumor recurrence follow by surgery. 7. Benign esophageal strictures refractory to balloon dilatation and not suitable for surgery.	1. Uncorrect coagulation. It is suggested to have a normal coagulation profile with an international normalized ratio which is less than 1.5 and platelet count less than 50 000. 2. Recent large dose of chemotherapy or radiotherapy (3 to 6 weeks) because of reported increase of rates of hemorrhage and perforation. 3. Severe tracheal compression that could become worse by esophageal intubation. 4. Extremely high stenosis close to the vocal cords. 5. Severely ill patients with limited life expectancy. 6. Obstructive lesions of the stomach and/or small bowel.

Material and methods

Fifty patients with inoperable advanced esophageal cancer were treated with the use of HDR-BT and endoesophageal stent implantation at the Greater Poland Cancer Center between June 2001 and December 2005. These patients were not qualified for surgical treatment or radical external beam radiotherapy because of poor general condition, clinical stage and tumor location. Palliative HDR-BT was the treatment, of choice due to limited possibility of external beam therapy and, in most of the cases, the patient's advanced clinical stage. A rapid improvement in dysphagia was expected after brachytherapy which was performed on outpatient basis. The combined stent/HDR-BT palliative treatment was proposed to patients in order to rapidly improve their quality of life, in relation of treating each patient by both methods separately. In all patients, gastroscopy, X-ray, and CT scan were performed as well as a histological diagnosis in order to evaluate the extent of the tumor.

The group consisted of 41 (82%) men and 9 women (18%), aged between 44 and 79 years (average 59.3 years). Pathologically, the most frequently diagnosed cancers were squamous cell carcinoma (40 cases – 80%) and adenocarcinoma (7 cases – 14%). In majority of patients (61.2%) qualified for palliative treatment, the location of the tumor was in the mid (one third) portion of the mediastinal esophagus. Positions in the upper and lower thirds represented 5 (10.2%) and 14 (28.6%) of patients respectively. The most recurrent infiltrations were observed during gastroscopy at 5-10 cm (59.2%) in length, while smaller than 5 cm or greater than 10 cm were noted in 10 cases (20.4%). Patients for palliative treatment were eligible on the grounds of swallowing difficulties (dysphagia), generally grade I (26 patients – 55.3%) and grade II (15 patients – 31.9%). Grades were qualified as follows: 0 – no dysphagia, I – dysphagia for solids, II – dysphagia for semisolids, III – dysphagia for liquids and IV – total dysphagia. During treatment, distant liver and brain metastases were discovered in 2 patients (4%), whereas malignant neoplasm's were identified in other locations in 4 cases (8%). Clinical data for patients are presented in Table 2.

In all patients, gastroscopy, X-rays, and CT were performed as well as a histological diagnosis to evaluate the extent of the tumor. In most of the cases HDR-BT was

Table 2. Clinical data

Clinical data	Number of patients
Sex:	
male	41 (82%)
female	9 (18%)
total	50 (100%)
Age:	
range	44-79 years
median	59.3 years
Histopathology:	
adenocarcinoma	7 (14%)
squamous cell carcinoma	40 (80%)
other	3 (6%)
Tumor location:	
upper thoracic	5 (10.2%)
mid-thoracic	30 (61.2%)
lower thoracic	14 (28.6%)
other	1
Length of infiltration:	
< 5 cm	10 (20.4%)
5-10 cm	29 (59.2%)
> 10 cm	10 (20.4%)
no data	1
HDR-BT schema:	
3 × 7.5 Gy	36 (72%)
2 × 7.5 Gy	14 (28%)
Treatment:	
combined (with EBRT and chemotherapy)	10 (20%)
sole	40 (80%)
Grade of dysphagia:	
0	2 (4.3%)
I	26 (55.3%)
II	15 (31.9%)
III	3 (6.4%)
IV	1 (2.1%)
no data	3
Weight lost:	
no	5 (10.9%)
< 5%	28 (60.9%)
5-10%	13 (28.2%)
no data	4
Zubrod score:	
I	20 (41.7%)
II	27 (56.3%)
III	1 (2.1%)
no data	2

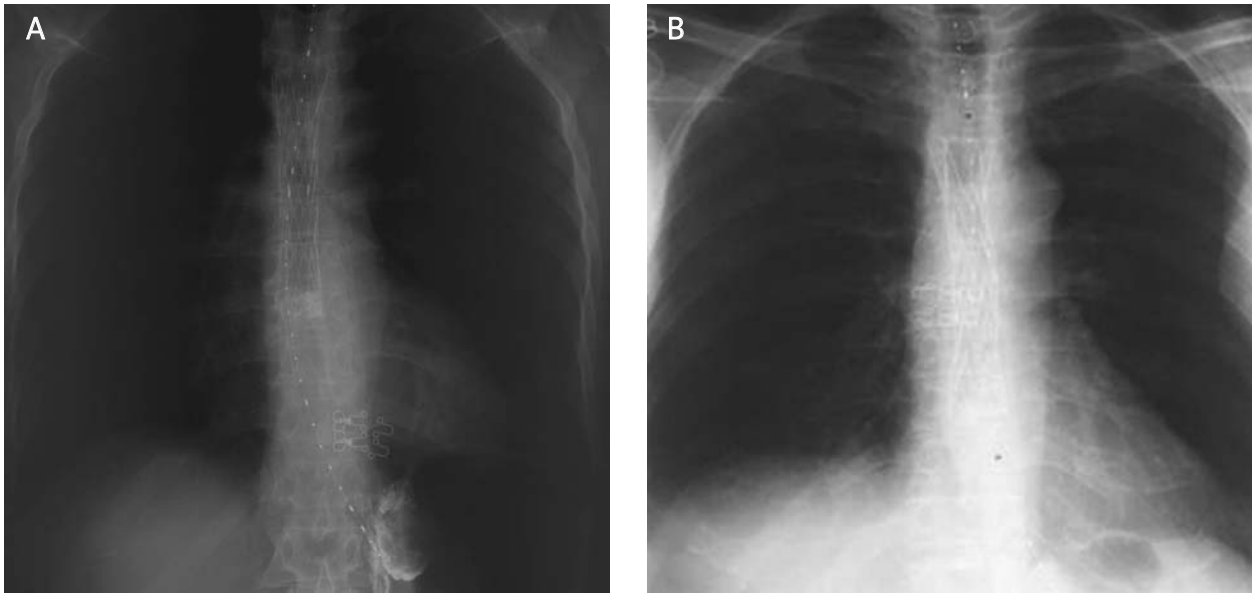

Fig. 3. X-ray of stents inside esophagus – brachytherapy applicator with metal marker visible

applied within two weeks of the implantation of the stent. After initial medication, the applicator was inserted, via the oral cavity, into the esophageal lumen. Following the placement of a catheter with specific marker, an X-ray was taken which was later used in preparation of the treatment plan and to define volume of the tumor. In all treatment plans optimization procedures were performed. This was necessary for full coverage of the defined tumor volume (Fig. 3A-B). The dose was prescribed at distance of 10 mm from the surface of the source. The target volume included visualization of residues of the tumor, which has been previously evaluated during gastroscopy and 2 cm safety margin in the cranial and caudal directions. 192-Ir with 10 Ci nominal activity and HDR-GammaMed 12i unit (Mick Radio-Nuclear Instruments, Inc., Mt. Vernon, NY) and Microselectron HDR (Nucletron®) subsequently were used. Dose distribution was calculated using ABACUS (until 2001) and PLATO software. 80% of patients were given HDR-BT monotherapy and 20% were additionally treated with EBRT and chemotherapy. 36 of patients (72%) received total dose of 22.5 Gy given in three weekly fractions of 7.5 Gy per week. Fourteen patients (28%) received total dose of 15 Gy (2 × 7.5 Gy).

Endoesophageal self-expanding metal stents (SEMS) were inserted via working channel during gastroscopy on short term intravenous anesthesia in the Gastroenterology Clinics in Łódź, Poznań and Wrocław (Fig. 4A-B). Implantation of the stent often required earlier mechanical widening of the area of infiltration, because of implant's

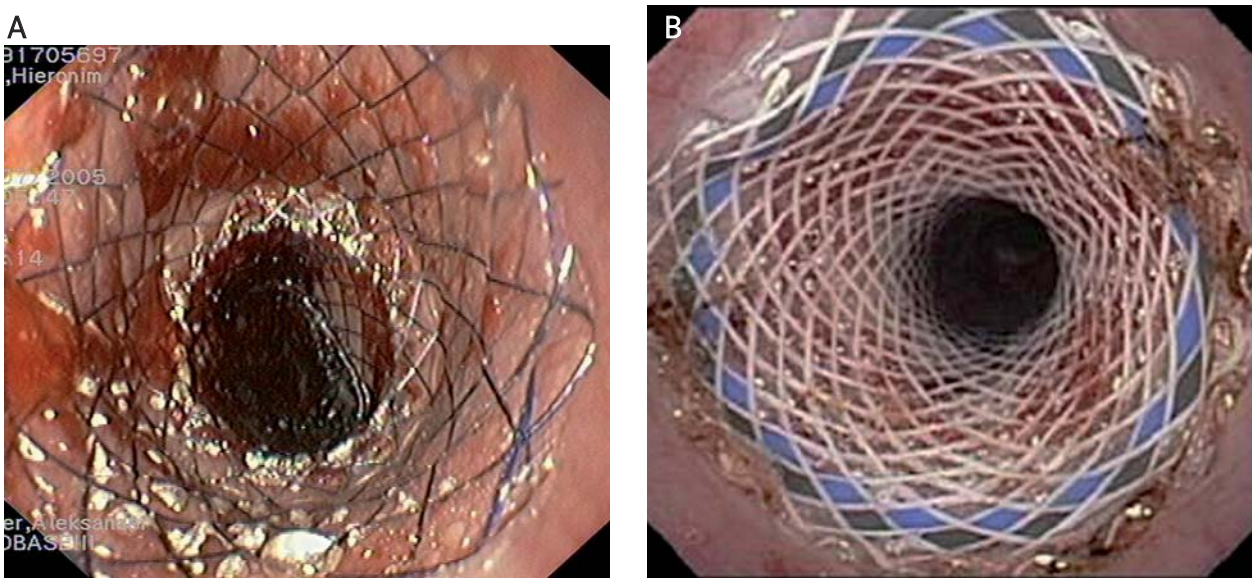

Fig. 4. Visible stents during gastroscopy

diameter limitation (15-20 mm). This procedure is usually performed with the use of a balloon and in rare cases with the help of neodymium laser (Nd YAG).

Degree of dysphagia, remission and complications arising from combined stent/BRT treatment were evaluated 4 weeks after the completion of the treatment. The degree of remission was verified on the basis of subjective tests, an interview and imaging techniques (X-rays of the gastrointestinal tract, computerized tomography and gastroscopy).

The patients' survival was compared with selected clinical factors such as: the grade of evaluated remission (radiological and during gastroscopy) in the first month after treatment, age, sex, histopathology, the Zubrod score, clinical stage, grade of dysphagia, location and size of tumor. The patients data was gathered in order to investigate statistically significant correlations. The respective survival periods were ascertained for particular groups in relation to treatment (remission, partial remission, no remission, progression).

In order to statistically assess the effects of prognostic factors on survival, the Mann-Whitney test was used (for groups included 2 patients) and the Kruskal-Wallis test for groups included 3 or more patients. In turn to evaluate the relationships within the above factors, the Spearman test was applied.

Results

Local reaction to the combined brachytherapy HDR and stent implantation treatment was estimated after 4 weeks. Complete remission (CR) was confirmed by imaging techniques and was observed in 2 cases (4%), partial remission (PR) in 31 patients (62%), no remission (NR) in 6 cases (12%) and in 11 (22%) patients progression was determined (Fig. 5). The average survival period among the observed group of patients amounted 5.4 months. Patients with bronchoesophageal fistulas did not achieve average survival (3.5 months). Longer survival periods were noted in patients with infiltrations shorter than 5 cm (6.1 months) rather than in patients with infiltrations longer than 10 cm (4.9 months).

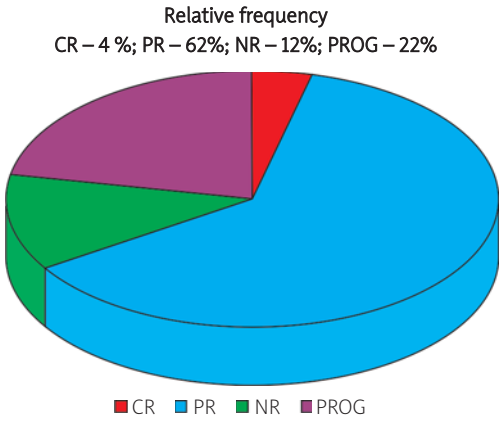

Fig. 5. Remission after 4 weeks during first check-up: CR – complete remission, PR – partial remission, NR – no remission, PROG – progression

The statistical analysis revealed the effects of prognostic factors of the patients clinical stage. The Kruskal-Wallis test analyzed certain aspects such as: the effects

Table 3. Spearman statistical correlation between prognostic factors

Variables	Response	Sex	Age	Location	Tumor length	Zubrod	Dysphagy	Pain	Weight loss	Histopathology	EBRT	Complication	Fractionation
Response	1	0.000	–0.218	–0.186	–0.139	–0.008	0.036	**0.334**	0.220	0.017	0.275	0.205	0.207
Sex	0.000	1	0.267	–0.139	–0.167	0.096	0.061	–0.026	–0.005	–0.142	0.075	–0.111	0.049
Age	–0.218	0.267	1	0.106	–0.200	0.080	–0.169	–0.141	–0.185	–0.024	–0.013	–0.178	–0.063
Location	–0.186	–0.139	0.106	1	–0.218	**–0.305**	–0.004	**–0.385**	**–0.451**	0.158	–0.158	–0.221	**–0.490**
Tumor length	–0.139	–0.167	–0.200	–0.218	1	–0.129	0.157	0.200	0.148	–0.166	–0.151	0.167	0.221
Zubrod	–0.008	0.096	0.080	**–0.305**	–0.129	1	0.264	**0.436**	**0.485**	–0.027	0.115	**–0.336**	0.208
Dysphagy	0.036	0.061	–0.169	–0.004	0.157	0.264	1	0.232	0.241	0.163	–0.044	0.061	0.218
Pain	**0.334**	–0.026	–0.141	**–0.385**	0.200	**0.436**	0.232	1	**0.655**	0.171	–0.031	–0.026	0.261
Weight loss	0.220	–0.005	–0.185	**–0.451**	0.148	**0.485**	0.241	**0.655**	1	0.011	–0.068	0.042	0.167
Histopathology	0.017	–0.142	–0.024	0.158	–0.166	–0.027	0.163	0.171	0.011	1	0.043	–0.018	–0.010
EBRT	0.275	0.075	–0.013	–0.158	–0.151	0.115	–0.044	–0.031	–0.068	0.043	1	–0.050	**0.392**
Complication	0.205	–0.111	–0.178	–0.221	0.167	**–0.336**	0.061	–0.026	0.042	–0.018	–0.050	1	0.049
Fractionation	0.207	0.049	–0.063	**–0.490**	0.221	0.208	0.218	0.261	0.167	–0.010	**0.392**	0.049	1

Values in bold are statistically different from 0 with a significance level alpha = 0.05

of infiltration localization (p = 0.428), histopathology results (p = 0.408), loss of body weight (p = 0.363), length of the infiltration (p = 0.605), the Zubrod score (p = 0.830), grade of dysphagia (p = 0.695) and pain level (p = 0.059). No correlation was determined between these prognostic factors and the reduction of infiltration size. The maximum clinical response after treatment was presented by the pain factor (according to the Kruskal-Wallis test this aspect was not significant, though the pain relationship was shown by this test for correlation). Similarly, using the Mann-Whitney test, correlations were investigated within: treatment scheme (p = 0.288), number of brachytherapy fractions (p = 0.580), the occurrence of complications (p = 0.165), age (p = 0.604), sex (p = 0.988) and clinical response. None of these prognostic factors had any statistical effect on results of treatment obtained (Table 3.).

Furthermore, using the Spearman test, we attempted to find relationships among the above mentioned prognostic factors (correlation testing). Statistically significant correlations that are worth mentioning are: reported pain levels/response to treatment (p = 0.025) and pain level/localization of the infiltration (p = 0.009), localization of the infiltration/body weight loss (p = 0.002), general condition according to the Zubrod score/occurrence of complications (p = 0.025), pain level/loss of body weight (p = 0.000). The remaining correlations discovered by use of the Spearman test are presented in Table 4.

Complications were diagnosed in 11 patients (22%). Necrosis was seen in 1 patient (2%), serious hemorrhage was observed in 1 patient. Bronchoesophageal fistulas were found in 9 patients (18%) estimated in follow-up X-ray examinations or bronchoscopy. As highlighted above, the statistically significant correlation was found between the frequency of complication occurring after combined therapy and the general state of a patient, according to the Zubrod score.

Discussion

The prognosis for patients with inoperable advanced esophageal cancer is still very bad despite the introduction of improved treatment modalities such as surgery, radiotherapy and chemotherapy. The reported 2 and 5 year survival rates range from 30-40% and 10-25%, respectively, regardless of the tumor stage or treatment options [16, 17]. Moreover, the prognosis is worse for patients with tumor stage IV and for patients with inoperable advanced cancer. The frequency of esophageal cancer in Western societies is steadily rising, particularly in lower, sub-cardiac locations on the basis of Barrett's metaplasia. Unfortunately, at the time of diagnosis only few patients qualify for radical treatment as a result of general condition of their health, advanced stage of disease, metastases to distant locations or cardiac and respiratory difficulties. 30-40% of patients may potentially be treated with radical surgery; however, 5 year survival in this group amounts to only 20% [18-20]. The prognosis for inoperable cases is always poor and such treatment is targeted at reducing suffering of patients in addition to improve their quality of life. In our institution we apply a combined therapy that integrates chemotherapy, radiotherapy, as well as restorative laser and endo-esophageal stents.

Table 4. Statistically significant correlations between prognostic factors (Spearman test)

Associations	R^2	p-value
Response-Pain	0.334	0.025
Location-Zubrod	–0.305	0.042
Location-Pain	–0.385	0.009
Location-Weight	–0.451	0.002
Location-Fraction	–0.490	0.001
Zubrod-Pain	0.436	0.003
Zubrod-Weight	0.485	0.001
Zubrod-Complication	–0.336	0.025
Pain-Weight	0.655	0.000
EBRT – Fraction	0.392	0.008

Dysphagia is the most frequent problem among patients with advanced esophagus cancer and is described in almost 90% of cases. In correlation to this symptoms, procedure must be as noninvasive as possible and should quickly lead to palliative effects with minimal risk of complications. The above criteria are well fulfilled in combined method of implantation of a stent into the lumen of the esophagus during endoscopy procedure, followed by endoesophageal irradiation of high dose brachytherapy. After mechanical widening of the narrowed area and positioning of the metal stent, the immediate palliative effects are usually visible. The aim of instant application of brachytherapy is to prolong the effects acquired through prevention of renewed stenosis within the stent. This way of treatment is quite comfortable for patients, since it does not require an extensive hospital stay and can be applied in ambulatory condition.

HDR brachytherapy is used in palliative treatment relatively often. This gets out of giving an endoesophageal dose of ionizing radiation to the portion of the esophageal wall with great precision. The authors have no found publications on the subject of HDR brachytherapy combined with stent placement. Physical parameters such as treated volume, specific point of dosage and the diameter of applicators are the frequent topic of scientific publications [21, 22]. A number of findings are available on the subject of brachytherapy results as applied as a single therapeutic method. In March 2003, Homs and co-workers published treatment results for 149 patients treated with HDR brachytherapy of average dose 15 Gy, delivered in two or three fractions [23]. After 6 weeks of therapy 51% of treated patients significantly reduced dysphagia. The average survival time of patients in the group mentioned above was 160 days, with annual survival of 15%. The most regular amount of observed complications after brachytherapy were bleeding and the formation of tracheoesophageal fistulas (7%), chest pain (8%) and perioperative morbidity (2%). According to the authors of the work, the treatment was considered to be effective in spite of the fact that symptoms of dysphagia

returned in 37% of patients after a short post-treatment time. The frequency of complication occurrence was described as very low but often required additional treatment [23].

In the year 2002 Sur and colleagues, from the University of Johannesburg, compared two brachytherapy schemes for advanced cancer of the esophagus [6]. 232 patients were divided into two groups, depending on the dose and number of fractions used (A-3 x 6 Gy i B-2 x 8 Gy). Patients were excluded from the study if their neoplasm involved large mediastinal vessels, was localized in the portion in the neck, the distance from the infiltration to the cardia was less than 1 cm or in the instance of bronchoesophageal fistulas. Survival time for the whole studied group was 7,9 months (groups A and B – 9.1 and 6.9 months respectively). The coefficient for survival without dysphagia complications were reported as 7.8 and 6.3 months respectively [6]. The authors of the study sought a relationship between prognostic factors and the palliative effects of treatment. A clear statistical correlation was found between the initial body weight of the patient, their general state, their initial degree of dysphagia, histopathologic differentiation and the coefficient for survival without dysphagia. The age of the patients had a statistically significant effect on the survival of the whole study group. Palliative brachytherapy was shown to be a safe treatment modality with small number of complications (fistulas – 22 cases, narrowing of the lumen of the esophagus – 25 cases). HDR brachytherapy treatment in 3 fractions of 6 Gy was barely more effective and the frequency of complications in both groups were comparable [6].

The next center published its scientific results of the treatment of esophageal cancer was the Tata Memorial Hospital in Mumbai, India [24]. Between 1994 and 2000 the procedure was used in therapy of 58 patients, out of which 21 cases with recurrence of neoplasm's treated earlier. Brachytherapy as a single way of treatment was used in 38 cases (65%), while the remaining number of patients received radiation treatments with the use of external sources. All patients received doses of 2 × 6 Gy by HDR brachytherapy. The results published by Indian institution were not very different from those described above. A significant improvement in swallowing was seen in 22 cases (48%). Furthermore, higher than formerly noted (10 months) coefficient of survival without dysphagia was reported. The occurrence of complications was seen more frequently in patients with recurrence after previous radiation (27%). The observed complications were narrowing (15%), ulceration (10%) and fistula formation (5%). The average survival time for the whole group amounted to 7 months and was marginally higher for patients not previously treated by radiotherapy (7.8 yrs 6 months) [24].

At this point, results of palliative treatment for cancer of the esophagus with the use of stent implantation should be taken into consideration. Most authors that published their data on this subject noted high effectiveness of this method (reduction of dysphagia symptoms in 95-100% of patients) [25-29]. The average period of efficiency after palliative procedure sustained for up to 20 months. The survival period in the majority of studies was dependent on the additional treatments used among the patients. The average ratio of patients treated with chemotherapy and radiotherapy was 318 days [30] while patients without additional treatment survived between 77 and 168 days [31]. Among early complications, chest pain occurred in nearly 100% of cases after the procedure, even though only 13% of patients suffered for more than a week [32]. An additional post therapy difficulties in 10-20% of patients was bleeding, perforation of the wall, choking inflammation of the lungs and fistula formation [33]. Morbidity associated with implantation of the stent was 7% [34].

Migration of the stent to the lumen of the stomach is an occasional complication of the procedure and has been observed in 3-6% of cases [35]. The occurrence of complications after implantation is largely affected by earlier treatment, particularly mechanical widening, laser therapy, radiotherapy and brachytherapy. Repeated intervention as a result of the tumor recurrence or infiltration of the lumen of the stent is more common and occurs in 8-35% of cases, renewed dysphagia is seen in close to 60% of these patients [36]. It is worth to emphasize that complications, especially life threatening conditions (fistula formation, massive bleeding, perforations, tracheal compression), occur more frequently with stent localized in one third of the proximal portion, as indicated by Wang and colleagues [37].

The treatment results for patients with advanced cancer of the esophagus presented in our work are not different in general from papers published globally. The advantage of HDR brachytherapy in combination with stent implantation was the immediate improvement of swallowing which is so greatly desired in this disease. Most patients, after stent implantation, return to usual diet (75-90%). The role of endoesophageal brachytherapy treatment appears to be significant in prolonging the palliative effects of stent implantation, despite its lack of effect in the extension of survival. From our studies we know that some patients experience a recurrence of dysphagia symptoms owing to infiltration of the lumen of the implant [13, 36]. That requires invasive procedures which pose a direct threat to a patient's life, since they are extremely difficult and complex. In case of patient's good general condition, the use of HDR brachytherapy provides satisfactory reduction of post-treatment complications and perioperative morbidity. In order to extend the survival time of patients it is necessary to apply additional treatments such as chemotherapy and higher dosage radiotherapy.

The cost of endoesophageal implants is high, however health care centers are able to provide and apply treatment method during a single day of hospital stay.

This kind of arrangement allows important reduction of operating cost and represents serious grounds for combined therapies [38]. However, in many cases, the choice of treatment method is based on the experience of medical staff and the availability of therapeutic equipment. Further comparative studies are required in order to determine whether the type of stent used in palliative treatments in combination with HDR-BT is directly connected to minimum post-treatment complications. Nevertheless, in such type of scientific analysis, the extension of patients' survival periods is least apparent.

Conclusions

1. In many cases implantation of a stent enabled application of HDR brachytherapy.
2. HDR brachytherapy for advanced esophageal cancer allowed the improvement of dysphagia in most of the patients.
3. The palliative effects that were obtained from the therapy did not influence the increase of complications, in particular bronchoesophageal fistulas.

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