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Palliative embolization of hemorrhages in extensive head and neck tumors

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Summary

Background:

A lot has changed in terms of intervention technique, indications and embolic agents since Duggan introduced embolization to management of postraumatic epistaxis in 1970.

Embolization is used in treatment of spontaneous and traumatic epistaxis, palliative tumors and vascular defects, as well as vascularized tumors and juvenile nasopharyngeal angiofibromas. The possibility of simultaneous visualization of pathology and implementation of therapy is one of its greatest advantages.

Material/Methods:

Authors analyzed the efficacy of selective embolization treatment of haemorrhage in advanced head and neck tumors. Seventy-six patients with such tumors treated at the Department of Otolaryngology in Białystok between 1999 and 2011 were examined.

Results:

Embolization of bleeding vessel within the tumor was effective (hemorrhage was stopped) in 65 patients (86%). Although the method is highly efficient, it is still associated with complications. Fourteen patients suffered from headaches that lasted for several days and six from face edema. Rebleeding was rare. Unfortunately, there was one case of hemiparesis.

Conclusions:

We conclude that superselective endovascular treatment deserves to be considered alongside standard options for the palliative or preoperative management of acute hemorrhage from advanced head and neck cancers.

Key words:

bleeding • head and neck tumor • embolization

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Background

Head and neck tumors pose an important and complex diagnostic and therapeutic problem. They constitute about 2–3% of all tumors and are responsible for 1–2% of oncological deaths. Head and neck cancers occupy the fifth place in the group of malignant tumors, most common being laryngeal cancers, which constitute 48% of all cases. As much as 55–68% of patients with laryngeal tumors report to the doctor with highly advanced tumor (T3 and T4), which influences treatment options and postoperative therapeutic failures. In some cases local recurrences of head and neck tumors result in dangerous hemorrhages caused by damage to blood vessels in the infiltrated region. Under such

circumstances access to the bleeding vessels and possibility of surgical intervention is limited or even impossible. Therefore, diagnostic imaging allowing for localization of pathology (angiography) with simultaneous embolization of the bleeding vessel appears to be an effective therapeutic option [1–3].

Embolization involves closing of the vessel that supplies the tumor by introducing an embolic agent into its lumen. A number of modifications were introduced into the technique during the past years, indications for it were broadened and new, effective embolization materials were invented [4,5]. Selection of proper material depends on the character of embolization, predicted artery closing time as

well as location and vessel diameter. Agents that close vessels permanently include embolization coils, latex balloons, polyvinyl alcohol, tissue glue and ethylene-vinyl alcohol. For temporary vessel closure we may use e.g. fibrin sponge or spongostan.

There are several types of embolization: preoperative, therapeutic and palliative. We may also distinguish temporary or permanent embolizations. The majority of embolizations are not associated with complications. The most common complications of the procedure include: prolonged (over 10 hours) bleeding at the puncture site, soft tissue hematomas at the puncture site, intima dissection of the involved artery, allergic reaction to the contrast medium. The most serious complication involves unintentional closure of a different vessel as a result of technical error or reflux of embolization material [6].

In otolaryngology, embolization is applied in treatment of spontaneous or posttraumatic epistaxis [7–10], but also in order to treat hemorrhages from inoperable head and neck tumors [11], vascular malformations, juvenile fibromas [12–14] as well as intracranial complications of ear and maxillary sinus diseases. Other specialties use this method for treatment of uterine myomas, meningiomas and vascularized kidney tumors.

Embolization is a minimally invasive procedure. Following premedication, in local anesthesia, the femoral artery is punctured using Seldinger method. Contrast medium is administered under x-ray control through a catheter introduced into the vessel of interest (chosen for embolization). When the source of bleeding is identified, temporary or permanent vessel closure is performed using appropriate embolic agents.

Goal

Authors analyzed the effectiveness of selective embolization in controlling hemorrhage in advanced, inoperable head and neck tumors.

Material and Methods

Material

Study included 76 patients treated at the Department of Otolaryngology of the Medical University of Białystok

between 1999 and 2011 due to advanced, inoperable head and neck tumors. All patients suffered from life-threatening, massive hemorrhages from necrotic tumor tissue. In many cases bleeding prevented continuation of therapy (radio- and chemotherapy). Angiography and embolization procedures were performed at the Department of Radiology of the Medical University of Białystok.

Methods

Every procedure was preceded by angiographic studies. During the study we identified the bleeding site and the damaged vessel intended for repair. Headhunter 4F or 5F catheters and, in some cases, microcatheters were used. Catheter was placed under angiographic control before application of embolic agent. Embolization material consisted of metal coils produced by BALT and polyvinyl alcohol (PVA) available as granulate particles 250–750 microns in size or histoacryl with lipiodol.

Results

In our study group, hemorrhages occurred in the course of extensive, inoperable tumors: 35 cases of laryngeal cancers (46%), including 17 that had previously undergone combination treatment (total laryngeal resection + adjunctive Co 60 radiotherapy), another 10 had undergone chemotherapy. Four patients were subjected to surgical treatment + Co 60 radiotherapy + chemotherapy. Four other patients had local recurrences following ineffective Co 60 radiotherapy. Another 17 cases (22%) consisted of patients with cancer of the pyriform recess after total laryngectomy and Co 60 radiotherapy (11 patients) or surgery + Co 60 + chemotherapy (6 patients).

In 15 patients operated on due to oral cancer with tongue involvement (20%) hemorrhages occurred during adjunctive Co 60 therapy or chemotherapy. In 5 patients bleeding occurred as a complication of combination therapy (surgery + Co 60 radiotherapy), while another 10 patients underwent surgery + Co 60 + chemotherapy. In 9 patients (12%) bleeding occurred during treatment of palate cancer including 7 cases treated with surgery with adjunctive radio- and chemotherapy and 2 cases of surgical resection with adjunctive radiotherapy (Table 1).

In all cases therapeutic failure (local tumor recurrence) was caused mainly by high degree of primary tumor

Table 1. Cases of selective embolization due to hemorrhage.

Treatment	Laryngeal carcinoma	Carcinoma of the pyriform recess	Carcinoma of the tongue	Carcinoma of the palate
Surgery + Co 60	17	11	5	2
Surgery + Co 60 + chemotherapy	4	6	10	7
Co 60	4			
Chemotherapy	10			
Total (%)	35 (46)	17 (22)	15 (20)	9 (12)

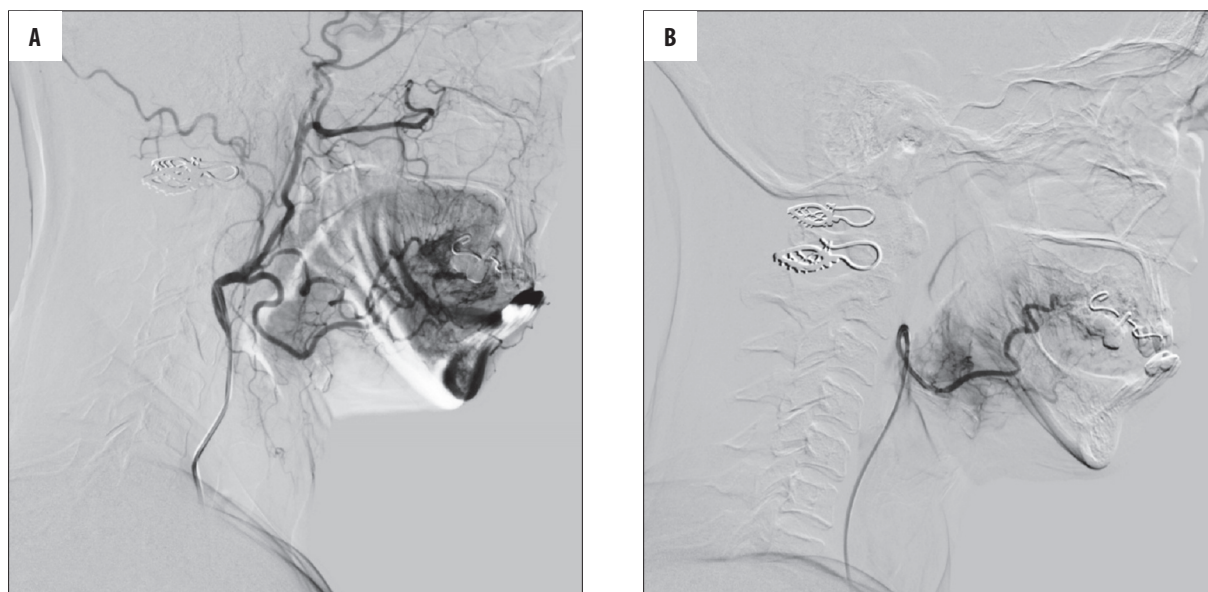


Figure 1. Cancer of the tongue (carcinoma linguae) – (A) pre-embolization state, (B) post-embolization state.

advancement at the time of diagnosis or lack of consent to surgical treatment.

Good therapeutic result (cessation of hemorrhage) of embolization of the bleeding tumor vessel was observed in 65 patients, which constituted 86% of all cases (Figure 1A, B).

In four cases (5%) hemorrhage recurred after several hours of reduced bleeding and required application of other methods (in two patients – surgical ligation of external carotid artery). Clinical improvement – radical reduction of bleeding – was observed in another 7 cases (9%). However, bleeding recurred after about 2 days, although it was less massive. Another embolization procedure, effective this time, was performed on the 3rd day in all of those patients.

Unfortunately, despite the highest care, extensive experience and proper laboratory equipment, postoperative complications could not be avoided. They were observed in 21 patients, which constituted 27.6% of all cases. Fortunately, in 14 cases (18.4%) they involved headaches lasting up to 3 days after the procedure. In another 6 patients (7.8%) we observed facial edema of varying intensity with transient facial nerve dysfunction. Unfortunately, one patient (1.3%) suffered from permanent hemiparesis directly after embolization (Table 2).

Discussion

A lot has changed in the technique since Duggan first used embolization as a method of selective control of bleeding in 1970 – indications were broadened and new embolization agents were introduced [15]. Development of imaging techniques and minimally invasive procedures in interventional radiology influenced the change of algorithms in diagnostics and treatment of hemorrhages. Difficult topography and uncertain outcome of surgical treatment in case of extensive head and neck tumors compels the necessity of considering all available therapeutic methods.

Table 2. Complications observed following embolization.

Character of complication	n	%
Headaches	14	18.4
Facial edema	6	7.8
Hemiparesis	1	1.3
Total	21	27.6

One of the great advantages of embolization is the possibility of simultaneous angiography, which localizes the pathology, and the actual closing of the damaged, bleeding artery [12]. It is particularly useful in case of difficult surgical access to the bleeding vessel (extensive, necrotic tumor mass) or lack of patient consent to surgical treatment (ligation of external carotid artery or its branch) [16–18]. As opposed to the surgical method, it allows for selective closure of the bleeding vessel. Some authors believe that direct application of embolic agent (onyx or tissue glue) into the tumor gives better results than the transarterial method [19,20].

Embolization procedure involves transcatheter closing of a specified area of vascularization. It is performed by introducing a catheter into the vessel lumen and applying the embolization agent. It causes mechanical vessel occlusion and, sometimes, inflammatory reaction, which promotes clot formation. The tumor devoid of arterial supply becomes necrotic and more susceptible to surgical removal. Embolization performed before proper surgery significantly reduces intraoperative blood loss. In case of some benign tumors (juvenile fibroma, paraganglioma, etc.) results of embolization may be permanent.

Most commonly mentioned advantages of embolization are the following: possibility of closing surgically inaccessible

arteries, reduction of intraoperative blood loss, shortening of the time of surgery, increasing the chance of total tumor resection, reducing the risk of damage to healthy tissues, reduction of tumor mass, attenuation of pain and lowering the number of postoperative recurrences.

Embolization, due to its documented effectiveness [21–27], reduced the number of surgical ligations, which are associated with rapid development of collateral circulation. Because of the level of vascular occlusion (microcirculation) embolization gives more durable effects. The extent and effectiveness of the procedure depends on many factors such as: vascular network, blood flow rate, type of pathology (tumor, hemorrhage) and type of embolic agent.

History of embolization in head and neck area goes as far back as the 30's of the twentieth century. Brooks was the first to describe a case of carotid-cavernous fistula treated by injecting a muscle fragment connected with a silver clip into the internal carotid artery [28]. In 1960 Lussenhop and Spence applied, via surgically exposed internal carotid artery, methyl methacrylate particles to a patient with vascular malformation supplied by the middle cerebral artery [29].

Evolution of embolization techniques took place in the 70's of last century together with the progress in production of catheter and embolization agents. Introduction of specifically shaped catheters, microcatheters and coaxial catheters allowed for superselective vascular catheterization and therefore, more precise application of embolization agents into the vessels.

In 1972 Zanetti and Sherman introduced tissue glue (isobutyl 2-cyanoacrylate) to experimental treatment of aneurysms and arterio-venous malformations [30]. In 1974 Lin published a method that utilized minute silicone cylinders for embolization of hemangioma of craniofacial bone structures [31], while Carey and Grace described intraarterial application of spongostan [32]. A year later, in *Journal of Neurosurgery*, Sebrinienko presented results of detachable balloon application [33]. Intravascular use of polyvinyl alcohol (PVA) was described in 1975 [34] and this agent proved to be the most widely used material to date. In 1975 Gianturco reported the first application of coils for vascular embolization [35]. Soon thereafter, in 1992, Guglielmi began using microcoils for embolization of aneurysms [36]. Further technological advances in particulate (e.g. embosphere) and liquid (e.g. Onyx) embolization materials took place at the turn of the century.

Embolization procedures in the head and neck region demand that the interventional radiologists possess precise knowledge of functional anatomy of the vessels, specifically with regard to the anastomoses between the extra- and intracranial arteries. Therefore, each patient requires careful assessment of vascular topography due to the possibility of atypical vessel course or atypical arterial connections. There is a risk of undesirable embolization

of cerebral vessels. In centers performing embolizations in the craniofacial area angiography was the only imaging modality for vascular evaluation. Multislice computed tomography imaging introduced during the past few years became an important diagnostic feature that enables planning of embolization procedures. Precise assessment of topography, the angle of artery branching as well as vessel diameter allows for proper selection of a catheter and embolic agent. In case of extensive craniofacial tumors it is also extremely important to assess multiple sources of vascular supply.

In the presented material, out of 76 cases of embolization we acquired high therapeutic efficacy, which amounted to 86%. In the available literature it ranges between 80% and 95% [37]. Complications of the procedure, which were relatively rare, in the vast majority of patients turned out to be minor and transient. In those cases embolization allowed to effectively control the bleeding and continue Co 60 radiotherapy or chemotherapy. No unwanted systemic or local reactions were observed during postembolization therapy.

Literature reports postembolization complications such as: ischemic stroke, cranial nerve paresis or blindness. Preoperative assessment of blood flow in cranial arteries is necessary to eliminate those dangerous complications. These studies are supposed to show possible additional connections between branches of external and internal carotid artery that could cause unwanted intracranial embolization [14,38]. Control superselective angiography directly from the site of intended embolization is indicated in order to minimize the risk of complications. The choice of embolization agent should be also carefully considered because liquid agents (polyvinyl alcohol, cyanoacrylate glue) or small particles (less than 250 microns) may migrate uncontrollably (through anastomoses between external and internal carotid artery) and pose a risk of complications [39–41]. In patients with advanced atherosclerosis and persistent hypertension embolization increases the risk of ischemic stroke, muscle weakness, hemiparesis, coma or even death. They may be caused by existing anastomoses between the vascular beds of external and internal carotid artery. With special caution and considerable operator experience embolization procedures are associated with 0.03% mortality and 1.73% morbidity [42]. Statistically, the number of complications and health threats decreases in proportion to the number of performed procedures.

Conclusions

1. Embolization appears to be an effective and minimally invasive method of controlling hemorrhages in advanced head and neck tumors, although not devoid of risk of complications.
2. Control of bleeding through embolization allows for continuation of oncological or palliative treatment.
3. In comparison to surgical methods, it allows for selective closure of damaged arteries.

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