

Cervical oesophageal and hypopharyngeal perforations after anterior cervical spine surgery salvaged with regional and free flaps

Perforacje przełyku i gardła dolnego po operacjach szyjnego odcinka kręgosłupa z dostępu przedniego – rekonstrukcja z wykorzystaniem płatów regionalnych i odległych

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Abstract

Background and purpose: The object of the study was to present our own experience in the management of cervical oesophageal and hypopharyngeal perforations after anterior cervical spine surgery.

Material and methods: The study group consists of 5 patients treated in Department of Otolaryngology Poznan University of Medical Sciences in 2009-2011. Different materials and techniques were used to repair the perforations: infrahyoid flap, primary sutures supported by sternocleidomastoid muscle flap, thigh flap and forearm flap in two cases.

Results: Four out of 5 patients were referred to our department in a poor general condition, with infected neck fistulas, three patients after prolonged conservative treatment, and three patients after initial attempts to repair the perforation outside our institution. One-stage reconstructive surgery was successful in three cases, while in two others secondary interventions were necessary. Total hospital stay ranged in the analysed group from 23 to 191 days, hospital stay in our department from 1 to 62 days, hospital stay from the final procedure from 18 to 26 days. Swallowing function was within normal limits in all cases 12-14 days after the surgery.

Conclusions: The authors' experience shows that in long-lasting and infected cervical oesophageal and hypopharyngeal perforations following anterior cervical spine surgery distant flaps should be primarily used as a source of a well-vascularized and unchanged tissue. It seems to be crucial to repair

Streszczenie

Wstęp i cel pracy: Przedmiotem pracy było zaprezentowanie własnych doświadczeń w leczeniu perforacji przełyku i gardła dolnego stanowiących powikłanie po zabiegach stabilizacji szyjnego odcinka kręgosłupa z dostępu przedniego.

Materiał i metody: Materiał obejmuje 5 pacjentów leczonych operacyjnie w Klinice Otolaryngologii i Onkologii Laryngologicznej Uniwersytetu Medycznego w Poznaniu w latach 2009-2011. Do rekonstrukcji ubytków zastosowano z powodzeniem kolejno płat podgnykowy, mięsień mostkowo-obojęczykowo-sutkowy, płat udowy i, w dwóch przypadkach, uszyłowany płat z przedramienia.

Wyniki: Spośród 5 pacjentów, 4 zostało przekazanych do ośrodka autorów w ciężkim stanie ogólnym, z zakażoną przetoką na szyi, 3 – po długotrwałym leczeniu zachowawczym, 3 – po próbach pierwotnego zaopatrzenia ubytków przełyku i gardła dolnego poza kliniką autorów. Jednoetapowe leczenie rekonstrukcyjne zastosowano z powodzeniem u 3 pacjentów, u 2 kolejnych istniała konieczność wtórnych interwencji na szyi. Całkowity czas hospitalizacji wahał się w badanej grupie od 23 do 191 dni, okres pobytu w ośrodku autorów – od 1 do 62 dni, czas hospitalizacji od finalnej procedury – od 18 do 26 dni. Funkcja połykania była we wszystkich przypadkach w granicach normy po 12-14 dniach po zabiegu.

Wnioski: Doświadczenia autorów pokazują, że w długotrwałych i zakażonych perforacjach przełyku i gardła dolnego, stanowiących powikłanie po operacjach stabilizacji szyj-

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the perforations immediately after the first symptoms appear – such an approach significantly reduces total hospital stay and improves the prognosis.

Key words: Cervical oesophageal perforation, hypopharyngeal perforation, anterior cervical spine surgery, cervical spine stabilization.

Introduction

Oesophageal or hypopharyngeal perforations constitute occasional complications of anterior cervical spine (ACS) surgery. Most perforations occur at the levels C5/6 and C6/7 [1]. The cricopharyngeal region where the oesophagus lies directly on the spine and the oesophagus is covered only by fascia at the dorsal side is especially at risk [2]. Neck oedema or wound leak with saliva discharge are the most pronounced clinical signs of that probably underreported adverse event of spine surgery. Although initial diagnosis supported by X-Ray tomography (XRT) and computed tomography (CT) imaging is not in doubt, the treatment is still extremely problematic. The first treatment strategy for the interdisciplinary management of hypopharyngeal and oesophageal perforations due to penetrating osteo-synthesis material was discussed by von Rahden *et al.* [3] in 2005. The authors addressed three major problems: 1) the patients' general condition, 2) the stability of the spine, and 3) morphological features of perforation. There is common agreement that if the perforation occurs intra-operatively, simple suturing is sufficient. For delayed perforations, there is no consensus as yet: conservative measures and several surgical approaches ranging from primary repair to reconstruction with local, regional or distant flaps were discussed in the literature but based on small case series or case reports. Conservative treatment may be effective when the perforation is small, diagnosed early, without signs of septicemia [4]. Some authors recommend aggressive treatment because a conservative approach increases the rate of abscesses and risk of mediastinitis and sepsis [5,6]. Wu *et al.* [7] presented in 2007 an algorithm of surgical therapy and non-operative treatment. Nevertheless, no treatment protocol has been standardized yet.

We aimed to present a series of patients with oesophageal or hypopharyngeal leaks after ACS surgery, all but one with long-lasting extensive multimodal treatment

nego odcinka kręgosłupa z dostępu przedniego, w zabiegach naprawczych zastosowanie powinny znaleźć płaty odległe jako źródło dobrze unaczynionej i niezmiętej tkanki. Kluczowe wydaje się podjęcie leczenia chirurgicznego niezwłocznie po wystąpieniu pierwszych objawów perforacji – takie postępowanie istotnie skraca czas hospitalizacji i poprawia rokowanie.

Słowa kluczowe: perforacja przełyku, perforacja gardła dolnego, dostęp przedni, stabilizacja szyjnego odcinka kręgosłupa.

prior to final surgical closure and in a poor general condition. The issue of time schedule for diagnostic and therapeutic management is crucial; thus we analysed the first-line treatment conducted outside our institution. We discussed the reasons of failures of the conservative or mini-invasive approach in the group and advocated the usefulness of free flaps in final closure of the perforations.

Material and methods

The analysis included five cases treated in a tertiary referral centre. Patients with oesophageal and hypopharyngeal external iatrogenic perforations after ACS surgery who were admitted to Department of Otolaryngology Poznan University of Medical Sciences between 2009 and 2011 were analysed. The study focused on patients who presented with neck leakage, all but one with extensive multimodal treatment prior to transfer to our department and in a poor general condition. We collected information on the original procedure, management, complications and time prior to referral to our institution.

Results

Patient No. 1, male, aged 19, was directed to our unit from the intensive care department. The perforation aetiology sequel was trauma complicated by quadriplegia requiring ACS surgery. The first sign of the perforation was neck leakage. On the fifth day of conservative treatment primary sutures and tracheotomy were done. After the next two weeks mediastinal drainage was performed but the leakage persisted. Time to referral to our department was 73 days. Complications prior to referral were as follows: pneumonia (3 times), mediastinitis and sepsis. The time from admission to the first surgery was two days and to the second, the final one, 42 days; the delay was due to the bad gen-

eral condition of the patient. The patient was fed by a nasogastric tube. Weight at presentation was 55 kg (10 kg loss). Contrast oesophagogram demonstrated perforation on the right side of the neck. CT confirmed the upper oesophagus fistula and the spinal hardware crossing the posterior wall mucosa. Intraoperative findings confirmed that the anterior plate was fixed through the posterior wall of the upper part of the oesophagus (C4-C6); it had to be removed during the first procedure and subsequently 5 cm oesophageal rupture edges were primarily sutured and supported with a local sternocleidomastoid (SCM) muscle flap interposed between the prevertebral plane and oesophagus. The leakage persisted, probably because of poor condition of neck soft tissues and intensive infection. The wound microbiology showed: *Staphylococcus epidermidis*, methicillin-resistant *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. The second procedure with the use of an infrahyoid flap allowed for definite leak closure. Oral intake was started after 14 days. After it, the recovery was uneventful. Time of hospital stay included 73 days before the referral to our department, 2 days and 42 days to prepare the patient for the first and second surgery in our department, respectively, and 18 days after the definitive surgery (total hospital stay: 135 days).

The shortest time of hospital stay was in **patient No. 2**, female, aged 42, quadriparetic after trauma, in whom neck oedema was noticed on the second day after ACS surgery. Plain radiographs of the neck revealed subcutaneous emphysema and enabled the suspicion of oesophageal perforation to be confirmed. She was operated on 48 hours after the adverse event. The tissues were of very good quality, with no inflammatory features. The 2-cm oesophagus fistula was primarily sutured with a local SCM flap interposed between the prevertebral plane and oesophagus to protect its wall. The wound was clean and oesophageal mucosa around the perforation unchanged. Single closure procedure was sufficient. Oral intake was started after 10 days and was undisturbed. Time of the total hospital stay was 23 days.

Patient No. 3, 22-year-old woman after trauma, quadriparetic, was referred to our unit from the thoracic surgery ward. The time from original surgery to oesophageal leak diagnosis was 21 days. Complications (two episodes of pneumonia, mediastinitis, bilateral pleural effusion, sepsis) were managed in neurosurgery, thoracic surgery and intensive therapy wards for 140 days. Prior to referral, she was operated on numerous times: on the 25th and 65th day the oesophageal fistula was sutured; on the 40th day pleurodesis and mediastinal

drainage were performed. In our department, the time from admission to the surgical procedure depended on the patient's general status, microbiology findings, need for neck imaging and indispensable multidisciplinary consultations. This patient was septic from the oesophageal perforation, malnourished and in a very poor general condition (for over 4 months only parenteral feeding was administered). Actual weight was 42 kg. Weight loss exceeded 15 kg. CT showed the canal of the oesophageal fistula from the region of the cricoid cartilage edge to the supraclavicular region. The neck wound and deep tissues were inflamed. Saliva and purulent discharge were drained from the fistula. Skin was reddened. Wound microbiology was taken: *Acinetobacter baumannii* and *Escherichia coli* were cultured. Intraoperative findings revealed inflammation, hyalinization and scarring of the tissues. The anatomical landmarks were difficult to recognize. Two perforations were found: on the right lateral wall and posterior wall of the upper oesophagus (C5-C6). Debridement of necrosis was performed and oesophagus fistulas were primarily sutured with a local SCM flap interposed between the prevertebral plane and oesophagus to protect its wall. The spinal fusion had to be maintained. The failure of that procedure was probably caused by bad condition of local tissues, with pronounced scarring, hyalinization and infection. A donor with a good blood supply was indispensable but there was no possibility to take the forearm radial flap (negative Allen's test on both hands). Thus a free thigh flap was taken with an excellent result of immediate leakage closure. Total time of hospital stay was 191 days: 140 days before the referral to our department, 10 days to prepare the patient for the first surgery, a further 21 days for the second surgery and 20 days after the definitive surgery. The first liquids were administered after 12 days and contrast oesophagogram excluded fistula. Normal oral feeding was started in the next 3 days.

Patient No. 4, a 56-year-old man, was referred to our unit from the intensive care department. He had a discectomy for radicular pain. Neck leakage occurred on the second day after the procedure; there was saliva and fresh blood in the discharge. Three urgent interventions on the neck on the third, fifth and eighth day were necessary because of massive bleeding from the neck fistula. The patient developed fulminant sepsis on the third day after primary surgery and needed intensive care treatment. Wound microbiology revealed *Staphylococcus haemolyticus*. The decision of very quick final fistula closure after 10 days was forced due to massive bleeding episodes of unclear origin. We aimed at

a single closure procedure but the neck wound and deep tissues were inflamed and local flaps were not applicable. Thus, we decided to use a good quality tissue from a radial forearm flap. Intraoperatively, erosion of the external carotid artery above the upper thyroid artery and vast perforation of the hypopharynx were observed. A flap of 4 cm × 5 cm was sufficient and successful primary closure of the huge, 6-cm long hypopharyngeal fistula was achieved. Resolution of the leakage was observed immediately after that definitive procedure. Time of hospital stay before referral to our department (3 days), time for preparing the patient for surgery in our department (10 days), and time after the definitive surgery (26 days) made up 39 days of total hospital stay. In this case after the initial, 10 kg weight loss (to 70 kg) and deterioration of general condition, in the further days of uneventful recovery the patient gained weight up to 75 kg and obtained excellent laboratory scores.

Patient No. 5 was a 60-year-old man, quadriplegic after trauma, directed to our unit from the intensive care department. The first sign of oesophagus rupture was the neck leakage, noticed on the third day after ACS surgery. He underwent unsuccessful procedures of primary suturing in outside institutions immediately after the leakage had occurred, followed by tracheotomy and gastrostomy and long 84-day conservative treatment. Pericarditis and mediastinitis were the complications prior to referral. At the moment of presentation, the general condition was good and the surgical management in our institution was undertaken in 12 hours. Although neck muscles and mucosal edges of the perforation were only moderately altered, we did not decide on primary sutures and local flap closure. Intraoperatively, a 4-cm posterior mediastinal abscess was found and drained. The spinal hardware had to be maintained. Successful primary closure was achieved by means of a radial forearm flap. Resolution of perforation was observed the next day after this definitive procedure. The recovery was uneventful. Oral intake was started after 12 days. Total time of hospital stay was 107 days: 90 days before referral to our department, one day for preparing the patient for surgery in our department and 16 days after the definitive surgery.

Discussion

Our study focused on surgical salvage in the group of patients admitted to our department due to oesophageal or hypopharyngeal leakage after ACS surgery, all but one with extensive multimodal treatment prior to

transfer and in a poor general condition. The treatment schedule in such a group has not been standardized yet. If the perforation is recognized in the post-operative period, treatment depends on the size, general status of the patient, complications and treatment duration [4]. Early surgical intervention and repair may decrease prolonged morbidity but the border size of the perforation is controversial. Hinojar *et al.* [8] reviewed the indications for the conservative versus surgical approach. They concluded that advances in antibiotic and nutrition therapies allowed conservative treatment to be used more and more successfully; surgery should be undertaken if the perforation is greater than 0.5-1 cm, and in the case of abundant extravasation of contrast into the mediastinum or pleural space, pneumothorax, pleural effusion, sepsis and failure of conservative treatment. Woolley *et al.* [4] stated that lacerations smaller than 2 cm should be treated conservatively. According to Lu *et al.* [9] treatment should be tailored in each case: for laceration recognized intraoperatively primary sutures are the treatment of choice, for small perforations noticed in the early postoperative period surgical debridement and drainage, and in late perforations debridement, removal of the hardware, loose suturing and open drainage provide ideal prognosis. Vrouenraets *et al.* [10] advise limiting the procedure to simple drainage in long-lasting perforations. We do not agree with that option. In none of the cases presented here was this line of treatment effective. In our opinion, surgery should be the method of choice in every patient without strong contraindications.

Local flaps

The pedicled SCM flap is interposed medially, rotated superiorly between the prevertebral plane and oesophagus to protect its wall and to increase antibiotic delivery to the site. Dakwar *et al.* [5] successfully used SCM in 4 out of 5 patients and concluded that this muscle is a great candidate for this procedure because it is pliable, easy to harvest, has a great blood supply and low donor-site morbidity. The longus colli muscle was used to repair the lateral pharyngeal wall and pyriform sinus by Collins *et al.* [11] and Haku *et al.* [12] in 16 and 3 patients, respectively. The pedicled intercostal muscle flap is preferred by Wu *et al.* [7]. Primary sutures seem to be a good solution only for viable tissues in early perforations [5,13]. We agree with this statement, having bad experience in two patients with a long history, in whom primary double suturing in macroscopically

unchanged oesophageal mucosa supported by a local SCM flap did not effectively close the leakage. In our group that technique was successful only in one patient, operated on three days after primary ACS surgery. The closure may also be achieved with pedicled flaps: infrahyoid muscle flap, submental island flap and pectoralis major (PM) flap interposed between the closure and the residual hardware [14-16]. The first of our patients was effectively cured with the help of an infrahyoid muscle flap but the method can be effectively used only in case of good anterior neck skin and deep tissue condition.

Vascularized flaps

The technique enables one to harvest unchanged, sound skin with muscle and subcutaneous layer and is especially useful in patients with a long lasting history, previous surgery failures, intensive scarring, heavy inflammation and poor blood supply in the perforated oesophageal wall. Supporting the defect with a vascularized flap was advocated by Phommachanh *et al.* [17]. According to Reid *et al.* [18] application of the free omental flap was superior to the PM flap. Von Rahden *et al.* [3] presented one case of cervical oesophagus resection with free jejunal loop end-to-end anastomosis. It is of paramount significance to eliminate the obstruction distally to the site of the repair [7], but this statement is true not only in strictures and achalasia but also in long-lasting, encapsulated mediastinal abscesses after ACS surgery. Thus, in the last two patients – No. 4 with wound bleeding and sepsis and No. 5 with deep mediastinal abscess – we preferred to use unchanged skin islands although it was the first closure procedure; we harvested the distal vascularized radial forearm flaps and succeeded in final one step closure.

Time of hospital stay

Oesophageal fistula with neck leak is a severe complication demanding long and multidisciplinary treatment. In the experience of Gaudinez *et al.* [19], 42 out of 44 patients required surgical repair and the length of hospital stay averaged 253 days. In the series of Benazzo *et al.* [20], mean time from discovery of perforation to definitive surgical treatment was 44.3 days, mean time to oral feeding resumption was 17.6 days and mean hospitalization time was 19 days. In the group presented by Lu *et al.* [9], time from ACS surgery to diagnosis of the perforation ranged from 7 to 18 days except for one

patient with a late complication (3 years); time from diagnosis to cure took 7-42 days and the longest was in this last case. In the group presented by the authors, there was a strong correlation between the time of oesophageal or hypopharyngeal injury, undertaking the surgery and recovery. Patient No. 2, and 4, operated on early in the post-operative period, were discharged between the 20th and 26th day. The total time of hospitalization was also short: 23 and 39 days, respectively. Patients No. 1 and 3 with a long history (73-140 days) also had a long total hospital stay (125 and 191 days) and experienced more severe complications before the final closure. Patient No. 5 had long hospitalization before the referral (90 days) but thanks to his good general condition and reliable reconstruction of the defect by means of a free flap, the recovery and hospital stay after the definitive surgery was short (16 days).

Conclusions

Based on personal experience we conclude that in our single case in which early surgical intervention and repair was possible, prolonged morbidity was decreased and the hospital stay was short. Closure of the defect supported by the vascularized flap is more reliable in long-lasting perforations and an infected operating field than primary sutures reinforced by a local muscle flap. The procedures that support well-vascularized tissue to the perforation region eliminate the risk of late oesophageal stenosis.

Disclosure

Authors report no conflict of interest.

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