Esophagus perforation complicating anterior cervical spine surgery

Xuhua Lu · Qunfeng Guo · Bin Ni

Received: 17 February 2011 / Revised: 2 August 2011 / Accepted: 14 August 2011 / Published online: 27 August 2011
© Springer-Verlag 2011

Abstract

Purpose To study the diagnosis and treatment strategy of esophagus perforation complicating anterior cervical spine surgery.

Methods From 2000 to 2010, we performed 1,045 cases of anterior cervical surgeries. One developed esophagus perforation. The diagnosis and treatment strategy of this case and the other five patients with esophagus perforation from other hospitals were retrospectively reviewed. For an intraoperative perforation, primary double layer suture was performed. Postoperatively, the patient took nutrition by a nasogastric tube instead of oral intake for one week. For three cases of perforations early in the post-operative period, oral intake was forbidden and nasogastric tube was conducted for nutrition support. The wound was debrided and open drainage was conducted postoperatively. Intravenous broad-spectrum antibiotic therapy was utilized. For perforations at postoperative year 3 and 7, prohibition of oral intake, intravenous broad-spectrum antibiotics therapy, and nasogastric tube nutrition support were all conducted and surgical debridement was performed. In operation, fixation plates and screws were removed, and the edges of the perforation were loosely approximated by synthetic absorbable sutures. Postoperatively, skin wound was kept open for drainage.

Results All the perforations healed evenly without secondary complications.

Conclusions When a perforation is suspected, imaging techniques should be employed. Surgical treatment facilitates the healing of esophagus perforation. Supportive treatments including prohibition of oral intake, intravenous broad-spectrum antibiotic therapy, feeding with a nasogastric tube were mandatory parts of treatments.

Keywords Esophagus perforation · Cervical spine · Complications · Revision spine surgery · Anterior cervical fusion

Introduction

Esophagus perforation is a rare but a life-threatening lesion which can lead to death in 6–34% of cases according to the status of the patients, the site and cause of the perforation, the time from perforation to treatment, the presence of underlying esophageal disease [1, 2]. Cervical esophagus perforations are considered to be less critical than intrathoracic and intra-abdominal ones due to slow formation of descending mediastinitis [3–5], but they may be still fatal in up to 16% of cases [3].

The esophagus perforation can be spontaneous, induced by a foreign body, caused by trauma and iatrogenic. Patients often present with nonspecific complaints and subtle physical findings. Therefore, diagnosis is difficult and the treatment often delayed, resulting in cervical abscess, mediastinitis, septic shock, and even death [4, 6–8]. If the treatment is instituted within 24 h the mortality rate is 20%, on the contrary it may be up to 50% if instituted later [9–11]. Currently, in addition, the treatment of esophageal tears remains controversial. Therefore,

X. Lu and Q. Guo contributed equally to this work.

X. Lu · Q. Guo · B. Ni (✉)
Department of Orthopedics, Changzheng Hospital,
The Second Military Medical University, 415 Fengyang Road,
Huangpu District, Shanghai 200003, People's Republic of China
e-mail: nibin99@sohu.com

X. Lu
e-mail: xuhualu@hotmail.com

in this paper, the diagnosis and treatment strategy is studied by retrospectively analyzing six cases of esophagus perforation related to anterior cervical surgery for cervical spine disorders. And the literature is reviewed.

Materials and methods

From 2000 to 2010, six patients (4 males and 2 females) who developed esophagus perforations associated with anterior cervical spine surgery were treated in our department. During this period, we performed 1,045 cases of anterior cervical surgeries. One developed esophagus perforation in operation. The other five patients with esophagus perforation were from other hospitals. The general information was presented in Table 1. The diagnoses and treatments of perforations were retrospectively reviewed.

The mean age of patients was 49.5 years (range 27–74). The reasons for anterior approach included cervical spine fracture and dislocation in two cases, cervical myelopathy in three, and implant failure after anterior decompression and fixation due to cervical myelopathy in one. The perforation was confirmed in operation in one case, at postoperative day 7–18 in three cases, at postoperative year 3 in one and at postoperative year 7 in one. Clinical presentation was versatile, including neck pain, dysphagia, odynophagia, aspiration, fever, localized neck tenderness, and hemoptysis. Food residue leaking from the incision was found in two postoperative cases. Contrast esophogram demonstrated perforation in other three postoperative perforations. Plain radiographs of the cervical spine revealed subcutaneous emphysema in three cases, widening of the retropharyngo-esophageal space in five, implant failure in two. The perforation sites were at C5/6 in four cases and at C6/7 in two cases.

For the intraoperative perforation, primary double layer suture (mucosal layer and muscular layer) was performed. Esophageal suture is made by absorbable interrupted stitches in a tension-free way to avoid secondary stricture of esophagus. Postoperatively, the patient took nutrition by a nasogastric tube instead of oral intake for 1 week and the perforation healed without secondary complication. For postoperative perforations, we discussed the cases with otolaryngologists and thoracic surgeons preoperatively. In addition, we performed the suturing with the help of an otolaryngologist or a thoracic surgeon. For three cases of perforations early in the post-operative period, oral intake was forbidden as soon as perforation was confirmed. A nasogastric tube was conducted in each patient for nutrition support. The wound was debrided and the perforations were loosely sutured by synthetic absorbable sutures. After operation, open drainage was conducted and intravenous broad-spectrum antibiotic therapy was utilized. At the

mean day 27.7 (range 21–39) after diagnosis, there was no secretion in the wound and contrast esophogram confirmed healing of the perforation (Fig. 1). For perforations at postoperative year 3 and 7, above mentioned measures including prohibition of oral intake, intravenous broad-spectrum antibiotics therapy, and nasogastric tube nutrition support were all conducted and surgical debridement was performed. In operation, fixation plates and screws were removed because bone fusions had been achieved, and the edges of the perforation were carefully freshened and loosely approximated by synthetic absorbable sutures. Postoperatively, skin wound was kept open for drainage. Finally, all the two perforations healed evenly.

The duration of antibiotics was 7–32 days in our cases, according to the condition of esophageal fistula and estimated healing time required. We did not stop the use of antibiotics until the patients had normal temperature, normal white blood cell and neutrophil counts, and had no leak from the incision.

Discussion

Esophagus injury is a rare complication with anterior cervical surgery, the rate of which was 0–1.62% in large clinical reports [11–16]. From 2000 to 2010, we performed 1,045 cases of anterior cervical surgeries. One developed esophagus perforation. The perforation rate was about 0.1%, similar to the study by Patel et al. [14]

Esophagus perforations mostly occur at the level of C5-6 or C6-7 [17]. Killian triangle, corresponding to C5-6, is the most vulnerable esophageal site to lesions. In this region, the esophagus lies directly on the cervical vertebra and only covered by fascia at the dorsal side [3]. Another area of weakness is the lateral wall of the pyriform sinus at the level of the thyrohyoid membrane [11]. Therefore, to avoid such injury, care must be taken to ensure that the esophagus is well protected with the retractor blades being seated below the longus colli muscles medially, so do it during use of the high-speed drill as well as during the instrumentation portion of the case [6, 18].

Clinical presentation of esophageal injury can be intraoperative with recognized injury, acute within 24 h, subacute after 24 h, or delayed up to a reported 10 years [14]. Early perforation is often related to direct iatrogenic maneuvers or acute spine trauma demanding the intervention, and delayed perforation is generally related to chronic compression, dislocation, or migration of the grafts or internal fixation materials [8, 10, 19–25]. In our study, one perforation was recognized intraoperatively and three perforations at early postoperative period. All of them might be attributed to inappropriate distraction except the one undergoing secondary surgery due to implant failure. In our

Table 1 General information of patients

No.	Sex	Age (year)	Surgery reason	Internal fixation failure	Symptoms	Time from operation to diagnosis	Injury level	Management	Time from diagnosis to cure (day)
1	M	74	Instrument failure	No	Neck pain, dysphagia, odynophagia, localized neck tenderness, food residue leaking from the incision	12 day	C5	Debridement, open drainage, supportive treatments	39
2	F	43	Cervical myelopathy	No	Dysphagia, odynophagia, fever, localized neck tenderness	18 day	C6/7	Debridement, open drainage, supportive treatments	23
3	F	61	Cervical myelopathy	No	Neck pain, dysphagia, odynophagia, aspiration, localized neck tenderness, hemoptysis, food residue leaking from the incision	7 day	C5/6	Debridement, open drainage, supportive treatments	21
4	M	27	Fracture and dislocation	Yes, screw migration	Dysphagia, odynophagia, localized neck tenderness	7 years	C5/6	Debridement, remove of internal fixation, loosely suture, open drainage, supportive treatments	35
5	M	47	Fracture and dislocation	Yes, one screw disappeared	Odynophagia	3 years	C5/6	Debridement, remove of internal fixation, loosely suture, open drainage, supportive treatments	42
6	M	45	Cervical myelopathy			In operation	C6/7	Primary double layer suture and supportive treatments	7

Fig. 1 **a** Radiograph showing instrument failure. **b** Radiograph after removing the failed instrument showing prevertebral air at C3-5. **c** Contrast esophagogram confirming healing of the esophagus perforation at day 39 after diagnosis

opinion, implant failure plays an important role in the development of perforation for the case undergoing secondary surgery. The other two perforations at many years after operation should be attributed to implant failure undoubtedly.

Patients with cervical esophagus perforation often present neck or pharyngeal pain, dysphagia, odynophagia, unexplained aspiration, choking, fever, localized neck tenderness, induration, hemoptysis, or subcutaneous emphysema [23, 26]. But some of them are easily overlooked or can lead to misdiagnosis. Therefore, when a perforation is suspected, imaging techniques should be employed. Plain neck X-ray may show indirect signs such as subcutaneous emphysema, presence of prevertebral air, widening of the retropharyngo-esophageal space due to edema or fluid collection and migration of implants. Contrast swallow studies may help in confirmation and localization of the perforation, showing an extravasation of fluid from the viscerum and/or an airfluid collection in deep neck spaces [3]. Esophagoscopy can provide a direct visualization of the perforation, but a missed perforation hidden in a mucosal fold and the potential to convert a small mucosal or submucosal tear into a large perforation during air insufflation argue against its use [27]. CT or MRI can delineate the extent of infection and reveal necrotic discitis, osteomyelitis, epidural abscess, or mediastinitis. However, imaging studies indicated esophagus injury in only 73% of perforations that were later confirmed [26]. Therefore, many perforations require surgical exploration for confirmation and treatment [26]. In our study, all the postoperative perforation were confirmed using contrast esophagogram except for two cases being confirmed by food residue leaking from the incision.

Currently, the treatment of esophageal perforation remains controversial. Conservative treatment has been advocated in case of small and early recognized perforations with well contained leak without signs of septicemia [4, 5, 28, 29]. It consists of total prohibition of oral intake for a minimum of 7 days, administration of combination of broad-spectrum antibiotics, use of prokinetic drugs (cisapride and metoclopramide), and feeding with a nasogastric tube or jejunostomy [4]. Unfortunately, about 20–25% of the patients treated conservatively developed an abscess and the mortality rate was 18% [11, 30]. Therefore, surgical treatment is considered to be the gold standard which can close the perforation, control or prevent infection and stabilize the cervical spine if indicated [30]. Double layer or imbricating sutures and reinforcement of suture with sternocleidomastoid muscle flap, pectoralis major muscle flap or longus colli muscle flap have been reported [8, 31–35].

In our opinions, treatment should be tailored in each case, depending on the time from perforation to diagnosis and the morphology of the perforation. For patients with recognized lacerations intraoperatively, primary suture may be treatment of choice. As to small injuries in the early postoperative period, surgical debridement and drainage is an effective method. While to perforation occurred many years after operation, surgical debridement, remove of the internal fixation, loosely suture of the esophagus and open drainage can achieve ideal prognosis. To be noted, for any of above-mentioned methods, supportive measures were one of the important parts of treatments. A nasogastric tube should be inserted for feeding purpose instead of oral intake for a minimum of 7 days. Patients not tolerating nasogastric feeding or requiring feeding for more than 2 weeks can be subjected to jejunostomy [4]. Empiric antibiotics should

cover anaerobes and, for established infections, should also be broadened to cover aerobic Gram-positive and Gram-negative organisms until the results of cultures are available [36]. For perforation related to early failure of internal fixation, the implant should be removed and the spine should be maintained by internal or external fixation. However, for late implant failure, it does not matter to remove the implant because bone fusion often has been achieved.

Reinforcement of primary suture with muscle flap including sternocleidomastoid muscle flap, pectoralis major muscle flap and longus colli muscle flap has been used by many authors [31–35, 37]. However, there are shortcomings with muscle flap harvesting. Sternocleidomastoideus harvesting can lead to functional loss of cervical motion, modest deformity in contour of the neck, and disruption of sensory nerves to the ear and ipsilateral neck [38]. Pectoralis major flap harvesting requires a longer surgical procedure and is related to both cosmetic and functional sequelae at the donor site. And a defect with longus colli muscle flap harvesting is the possibility to injure the cervical sympathetic trunk [17, 39]. Therefore, in our study, not all the patients with primary suture underwent muscle flap reinforcement. Fortunately, all of them achieved good results. However, it does not mean that muscle flap repair is not necessary. For large perforations, muscle flap repair, which can avoid secondary stricture of esophagus, may be mandatory.

In conclusion, when a perforation is suspected, imaging techniques should be employed. Surgical treatment facilitates the healing of esophagus perforation. Supportive treatments including prohibition of oral intake, intravenous broad-spectrum antibiotic therapy, feeding with a nasogastric tube were mandatory parts of treatments.

Conflict of interest The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References

1. Jones WG 2nd, Ginsberg RJ (1992) Esophageal perforation: a continuing challenge. *Ann Thorac Surg* 53:534–543
2. Jougon J, Cantini O, Delcambre F, Minniti A, Velly JF (2001) Esophageal perforation: life threatening complication of endotracheal intubation. *Eur J Cardiothorac Surg* 20:7–10
3. Brinster CJ, Singhal S, Lee L, Marshall MB, Kaiser LR, Kucharczuk JC (2004) Evolving options in the management of esophageal perforation. *Ann Thorac Surg* 77:1475–1483
4. Gupta NM, Kaman L (2004) Personal management of 57 consecutive patients with esophageal perforation. *Am J Surg* 187:58–63. pii: S0002961003004410
5. Brewer LA 3rd, Carter R, Mulder GA, Stiles QR (1986) Options in the management of perforations of the esophagus. *Am J Surg* 152:62–69. pii: 0002-9610(86)90144-3
6. Newhouse KE, Lindsey RW, Clark CR, Lieponis J, Murphy MJ (1989) Esophageal perforation following anterior cervical spine surgery. *Spine (Phila Pa 1976)* 14:1051–1053
7. Skinner DB, Little AG, DeMeester TR (1980) Management of esophageal perforation. *Am J Surg* 139:760–764
8. Smith MD, Bolesta MJ (1992) Esophageal perforation after anterior cervical plate fixation: a report of two cases. *J Spinal Disord* 5:357–362
9. Sharma RR, Sethu AU, Lad SD, Turel KE, Pawar SJ (2001) Pharyngeal perforation and spontaneous extrusion of the cervical graft with its fixation device: a late complication of C2–C3 fusion via anterior approach. *J Clin Neurosci* 8:464–468
10. Pompili A, Canitano S, Caroli F, Caterino M, Crecco M, Raus L, Occhipinti E (2002) Asymptomatic esophageal perforation caused by late screw migration after anterior cervical plating: report of a case and review of relevant literature. *Spine (Phila Pa 1976)* 27:E499–E502
11. Orlando ER, Caroli E, Ferrante L (2003) Management of the cervical esophagus and hypopharynx perforations complicating anterior cervical spine surgery. *Spine (Phila Pa 1976)* 28:E290–E295
12. Cloward RB (1971) Complications of anterior cervical disc operation and their treatment. *Surgery* 69:175–182. pii: 0039-6060(71)90145-0
13. Eleraky MA, Llanos C, Sonntag VK (1999) Cervical corpectomy: report of 185 cases and review of the literature. *J Neurosurg* 90:35–41
14. Patel NP, Wolcott WP, Johnson JP, Cambron H, Lewin M, McBride D, Batzdorf U (2008) Esophageal injury associated with anterior cervical spine surgery. *Surg Neurol* 69:20–24
15. van Berge Henegouwen DP, Roukema JA, de Nie JC, vd Werken C (1991) Esophageal perforation during surgery on the cervical spine. *Neurosurgery* 29:766–768
16. Capen DA, Garland DE, Waters RL (1985) Surgical stabilization of the cervical spine. A comparative analysis of anterior and posterior spine fusions. *Clin Orthop Relat Res* 196:229–237
17. Haku T, Okuda S, Kanematsu F, Oda T, Miyauchi A, Yamamoto T, Iwasaki M (2008) Repair of cervical esophageal perforation using longus colli muscle flap: a case report of a patient with cervical spinal cord injury. *Spine J* 8:831–835
18. Tew JM Jr, Mayfield FH (1976) Complications of surgery of the anterior cervical spine. *Clin Neurosurg* 23:424–434
19. Halligan M, Hubschmann OR (1993) Short-term and long-term failures of anterior polymethylmethacrylate construct with esophageal perforation. *Spine (Phila Pa 1976)* 18:759–761
20. Graham JJ (1989) Complications of cervical spine surgery. A five-year report on a survey of the membership of the Cervical Spine Research Society by the Morbidity and Mortality Committee. *Spine (Phila Pa 1976)* 14:1046–1050
21. Whitehill R, Sirna EC, Young DC, Cantrell RW (1985) Late esophageal perforation from an autogenous bone graft. Report of a case. *J Bone Joint Surg Am* 67:644–645
22. Hanci M, Toprak M, Sarioglu AC, Kaynar MY, Uzan M, Islak C (1995) Oesophageal perforation subsequent to anterior cervical spine screw/plate fixation. *Paraplegia* 33:606–609
23. Kelly MF, Spiegel J, Rizzo KA, Zwillenberg D (1991) Delayed pharyngoesophageal perforation: a complication of anterior spine surgery. *Ann Otol Rhinol Laryngol* 100:201–205
24. Lowery GL, McDonough RF (1998) The significance of hardware failure in anterior cervical plate fixation. Patients with 2- to 7-year follow-up. *Spine (Phila Pa 1976)* 23:181–186
25. Riew KD, Sethi NS, Devney J, Goette K, Choi K (1999) Complications of buttress plate stabilization of cervical corpectomy. *Spine (Phila Pa 1976)* 24:2404–2410

26. Gaudinez RF, English GM, Gebhard JS, Brugman JL, Donaldson DH, Brown CW (2000) Esophageal perforations after anterior cervical surgery. *J Spinal Disord* 13:77–84
27. Pasricha PJ, Fleischer DE, Kalloo AN (1994) Endoscopic perforations of the upper digestive tract: a review of their pathogenesis, prevention, and management. *Gastroenterology* 106:787–802
28. Shockley WW, Tate JL, Stucker FJ (1985) Management of perforations of the hypopharynx and cervical esophagus. *Laryngoscope* 95:939–941
29. Kim YJ, Glazer PA (2002) Delayed esophageal perforation and abscess formation after cervical vertebrectomy and fusion. *Orthopedics* 25:1091–1093
30. Navarro R, Javahery R, Eismont F, Arnold DJ, Bhatia NN, Vanni S, Levi AD (2005) The role of the sternocleidomastoid muscle flap for esophageal fistula repair in anterior cervical spine surgery. *Spine (Phila Pa 1976)* 30:E617–E622. pii: 00007632-200510150-00026
31. Rubin JS (1989) Repair of post-laryngectomy pharyngeal fistulae. *J Laryngol Otol* 103:302–305
32. Reeder LB, DeFilippi VJ, Ferguson MK (1995) Current results of therapy for esophageal perforation. *Am J Surg* 169:615–617. pii: S0002961099802323
33. Lindhorst E, Encke A (1999) Esophageal perforation. A rare complication after operation of degenerative and traumatic pathology of the cervical spine. *Zentralbl Chir* 124:562–567
34. Fuji T, Kuratsu S, Shirasaki N, Harada T, Tatsumi Y, Satani M, Kubo M, Hamada H (1991) Esophagocutaneous fistula after anterior cervical spine surgery and successful treatment using a sternocleidomastoid muscle flap. A case report. *Clin Orthop Relat Res* 267:8–13
35. Reid RR, Dutra J, Conley DB, Ondra SL, Dumanian GA (2004) Improved repair of cervical esophageal fistula complicating anterior spinal fusion: free omental flap compared with pectoralis major flap. Report of four cases. *J Neurosurg* 100:66–70
36. Lew TW, Darby J, Marion DW (1995) Candida mediastinitis and septic shock following occult esophageal perforation in a patient with posttraumatic quadriplegia. *J Trauma* 39:805–808
37. Collins SL (1997) The longus colli muscle flap for reconstruction of the lateral pharyngeal wall. *Head Neck* 19:297–308
38. Losken A, Rozycki GS, Feliciano DV (2000) The use of the sternocleidomastoid muscle flap in combined injuries to the esophagus and carotid artery or trachea. *J Trauma* 49:815–817
39. George B, Gauthier N, Lot G (1999) Multisegmental cervical spondylotic myelopathy and radiculopathy treated by multilevel oblique corpectomies without fusion. *Neurosurgery* 44:81–90