Aberrant Right Subclavian Artery-Esophageal Fistula in 20-Year-Old with VATER Association

Satoru Kudose¹ Jose Pineda² Jacqueline M. Saito³ Louis P. Dehner¹

¹Department of Pathology and Immunology, Washington University School of Medicine, St. Louis, Missouri, United States

²Department of Pediatrics, Washington University School of Medicine, St. Louis, Missouri, United States

³Division of Pediatric Surgery, Department of Surgery, Washington University School of Medicine, St. Louis, Missouri, United States

Address for correspondence Satoru Kudose, MD, Department of Pathology and Immunology, Washington University School of Medicine, Campus Box 8118, 660 S. Euclid Avenue, St. Louis, Missouri 63110, United States (e-mail: skudose@path.wustl.edu).

J Pediatr Intensive Care 2017;6:127–131.

Abstract

Aberrant right subclavian artery (ARSA), the most common aortic arch abnormality, occurs in approximately 0.5 to 1.8% of the general population, with prevalence of up to 25% in those with esophageal atresia. Although ARSA is often asymptomatic, a fistulous tract into esophagus may develop with prolonged nasogastric tube placement or endotracheal intubation and lead to potentially fatal hematemesis. We present a first case of ARSA-esophageal fistula in a 20-year-old woman with VATER association in the absence of an esophageal anomaly and review 28 cases of ARSA-esophageal fistula reported in the literature to date. Requiring nasogastric and endotracheal tube placement for approximately 4 months, the patient had a prolonged hospital course and died after sudden hematemesis. An autopsy demonstrated an ARSA-esophageal fistula and no other source of upper gastrointestinal bleeding. In patients with esophageal atresia requiring prolonged placement of an endotracheal or nasogastric tube, a screening imaging study and corrective surgery may be indicated. Although the mortality rate is still high, timely recognition and repair of ARSA-esophageal fistula appear to be improving. Given the potentially prolonged latency for its development with occasional presence of heralding symptoms, increased awareness may facilitate surgical intervention to prevent a catastrophic exsanguination.

Keywords

- aberrant right subclavian artery
- esophageal fistula
- VATER association

Introduction

Aberrant right subclavian artery (ARSA), the most common aortic arch abnormality, occurs in approximately 0.5 to 1.8% of the general population, with a prevalence of up to 25% in those with esophageal atresia (EA).^{1,2} Although ARSA is often asymptomatic, a fistulous tract into esophagus may form with prolonged nasogastric tube placement or endotracheal intubation, leading to potentially fatal hematemesis.³ We present the first case to the best of our knowledge of ARSA-esophageal fistula in a patient with the VATER association but without an esophageal anomaly. A total of 28 cases of ARSA-esophageal fistula have been reported in the literature.^{3–28}

A Case Report

A 20-year-old woman, with VATER association and primary pulmonary hypertension status post two prior lung transplants complicated by bronchiolitis obliterans, was admitted to the hospital for her third lung transplantation. The past medical history included atrial septal defect, solitary left kidney, hemi-vertebrae, diabetes mellitus, gastric tube placement, and supra- and subglottic laryngeal webs with previous tracheal reconstruction, tracheostomy placement, and removal. The patient did not have any esophageal, radial limb, or anorectal anomaly.

Shortly after the third lung transplantation, she developed cardiorespiratory and renal failure, requiring

received

February 18, 2016

accepted after revision

April 2, 2016

published online

June 29, 2016

Copyright © 2017 by Georg Thieme
Verlag KG, Stuttgart · New York

DOI <http://dx.doi.org/10.1055/s-0036-1584812>.
ISSN 2146-4618.

vasopressors and continuous venovenous hemodiafiltration. The hospital course was further complicated by ischemic colonic perforation for which she underwent colectomy and ileostomy. She became ventilator dependent and a tracheostomy was performed. Superior vena cava thrombus developed and was treated with chronic anticoagulation with heparin.

While still in the intensive care unit and after 3 hours of hemodialysis, the patient suddenly developed abdominal pain; she attempted to lie back and became pale, vomited copious amounts of bright red blood from her nose and mouth (~200–300 mL), and became unresponsive. After 17 minutes of cardiopulmonary resuscitation, spontaneous circulation was reestablished with resolution of the bleeding. Subsequent computed tomography (CT) scan of the chest, abdomen, and pelvis with intravenous contrast as well as upper airway endoscopy and esophagogastroduodenoscopy, failed to reveal a source of the bleeding, although contrast material was noted in stomach on the CT study (►Fig. 1). At this point, she was already known to have an ARSA from a prior imaging study. Shortly after the esophagogastroduodenoscopy, the patient again developed massive bleeding and hemorrhagic shock. Although multiple transfusions and vasopressors were given, she continued to decline and the decision to redirect therapy toward comfort care was made. It was determined shortly after death that the hemorrhagic shock possibly secondary to an ARSA-esophageal fistula was the clinical cause of death.

The post mortem examination revealed a fistulous connection from the ARSA into the posterior mid-esophagus (►Fig. 2A) and a copious amount of blood was found in the stomach and beyond. Histologic examination of the fistula showed intimal thickening, attenuation of the media, and esophageal ulceration with extensive dystrophic calcification, suggesting previous tissue injury in this site (►Fig. 2B).

Fig. 1 Computed tomography with contrast. ARSA is present.

Fig. 2 (A) Gross image of the fistula. The esophagus (above) and aorta (below) from the posterior aspect. ARSA is seen behind the esophagus with a probe at the fistula. (B) Histologic section of the fistula (hematoxylin and eosin, $2\times$). Note the adhesion between adventitia of the ARSA and esophagus, intimal thickening of ARSA, and extensive dystrophic calcifications. No significant inflammation is seen.

Discussion

It is known that ARSA is more common in patients with EA, with estimated prevalence of 25% in patients with long-gap EA and in 12% of patients with any type of EA.^{1,2} Although typically asymptomatic, ARSA can produce symptoms by compression of adjacent structures resulting in dysphagia or respiratory symptoms. In the pediatric population, respiratory symptoms are thought to be more common, presumably due to the malleability of the trachea.²⁹ The present case of ARSA-esophageal fistula represents a fatal clinical juxtaposition in a young woman with VATER association who did not have a history of tracheoesophageal fistula (TEF) or EA.³⁰

An ARSA-esophageal fistula is rare, with a total of 28 cases identified in the English literature since 1969.^{3–28} The age in these cases ranged from 5 months to 82 years (median age, 36 years) (►Table 1). No gender predilection was noted in our review, but others have reported a female predilection.⁴ Instrumentation within the adjacent trachea or esophagus

Table 1 Cases of ARSA-esophageal fistula

Authors (year of publication)	Age (y)	Sex	History	Symptoms at presentation	ET (duration)	NG (duration)	Diagnostic modality	Treatment	Outcome (follow-up length)
Lynn (1969) ²⁵	57	M	Atherosclerosis	UGIB	N	N	CXR; angio	S	N
Buades Reynes et al (1976) ¹⁰	72	F		Seasick, blurry vision, dizziness	N	N	CXR; angio	N	N
Merchant et al (1977) ¹⁸	17	F	Endometritis, pelvic abscess after pregnancy	UGIB after removal of nasogastric tube	N	Y (9 d)		N	N
Livesay et al (1982) ²⁶	25	M	Trauma	UGIB	Y	Y (13 d)	Endo; angio	B;S	N (14 d)
Belkin et al (1984) ⁹	27	M	Neck SCC	UGIB after deflation of balloon tamponade	N	Y (60d)	Endo; angio	B;S	N (10 d)
Gossot et al (1985) ²⁷	72	F			Y	Y (30 d)			N
Kullnig (1989) ²⁸	66	M		Chest pain, dysphagia, UGIB	N	N	CXR; CTWC		N
Stone et al (1990) ²²	72	M		Dysphagia (1 y), UGIB	Y		CXR; angio	S	N (14 d)
Ikeda et al (1991) ⁸	9	M			Y	"Long"			N
Edwards et al (1984) ⁷	79	M		Dysphagia, melena, UGIB	N	N		S	N
Miller et al (1996) ⁶	36 ^a	F	SAH and cerebral aneurysm	UGIB	Y (27 d)	Y (27 d)	Angio; endo	N	N (27 d)
Singha et al (1998) ⁵	11	F	IVH	UGIB	Y (14 d)	Y (17 d)	Endo; angio	B;S	Y (2 y)
Feugier et al (2002) ¹²	82	M		UGIB	N	N	Endo; CTWC	N	N
Lehmann et al (2006) ⁴	24	M	Trauma	UGIB	Y (31 d)	Y (31 d)	CTWC; angio	S	Y
Millar et al (2007) ³	78	M		UGIB	N	N	Endo; angio	B	N
Magagna et al (2008) ¹⁷	57	M	Esophageal carcinoma	UGIB	N	Y	CTWC; angio	S	N (18 d)
Fuentes et al (2010) ¹³	73	F	Laryngeal carcinoma	UGIB	Y	N	Endo; CTWC	B;V	Y (6 mo)
Chapman et al (2010) ¹¹	3	F	TEF	UGIB			Endo	B;V;S	Y (28 d)
Situma et al (2011) ²¹	34	F	Trauma	UGIB	Y (45 d)	Y (45 d)	Endo	B;S	N
Jain et al (2012) ¹⁵	5 mo	F	TEF; colonic interposition	UGIB			Endo	S	Y (6 mo)
Pop et al (2012) ²⁰	57	F	Scimitar syndrome	UGIB	Y (10 d)	Y (18 d)	Endo	B;S	Y (21 d)
Takahashi et al (2013) ²³	67	M	Esophageal carcinoma	UGIB		N	Endo; angio	B;V	N
Morisaki et al (2014) ¹⁹	63	M		Dysphagia (4 mo), UGIB	N	N	CTWC	V;S	Y (4 mo)
	74	F	Repair of ARSA	UGIB			CTWC	B;V;S	N

(Continued)

Table 1 (Continued)

Authors (year of publication)	Age (y)	Sex	History	Symptoms at presentation	ET (duration)	NG (duration)	Diagnostic modality	Treatment	Outcome (follow-up length)
Lo et al (2013) ²⁴	16 mo		TEF	UGIB	N	Y (30 d)	CTWC	B;V	N
	15 mo		EA; DA	UGIB	N	Y (14 d)	Endo; angio	S	Y (7 d)
Hosn et al (2014) ¹⁴	29	F	Sleeve gastrectomy	UGIB	N	Y (42 d)	None	S	Y (3 mo)
Joynt and Grifka (2015) ¹⁶	17 mo			UGIB	N	N	Endo; barium	V;S	Y

Abbreviations: Angio, angiography; B, balloon tamponade; CTWC, CT with contrast; CXR, chest X-ray; DA, duodenal atresia; EA, esophageal atresia; ET, endotracheal tube; F, female; IVH, intraventricular hemorrhage; M, male; N, no; NG, nasogastric tube; S, surgical repair; SAH, subarachnoid hemorrhage; SCC, squamous cell carcinoma; TEF, tracheoesophageal fistula; UGIB, upper gastrointestinal bleeding; V, endovascular repair; Y, yes.

^aAberrant left subclavian artery with right aortic arch.

is a suspected risk factor; 16 cases reported various forms of instrumentations such as endotracheal intubation, tracheostomy, or placement of a nasogastric tube. Although cases of so-called spontaneous fistula have been reported, pressure from these devices or even an ingested foreign body may result in necrosis of adjacent tissue leading to fistula formation.¹⁶

Due to association of EA and ARSA, perhaps it is not surprising that ARSA-esophageal fistula is seen in the pediatric and young adult population. There are eight reported cases in patients younger than 20 years, with four having either EA or TEF. To our knowledge, in patients with VATER association, no case of fistulous connection has been reported, although one case of ARSA steal syndrome is found in the literature.³¹ However, given the high frequency of ARSA in patients with EA, many cases may be underreported or unrecognized, particularly since ARSA-esophageal fistula often results in sudden death without time for any diagnostic studies, and these patients often have other substantial comorbidities.

Although the most common initial presentation of ARSA-esophageal fistula is sudden and massive hematemesis, so-called sentinel symptoms of dysphagia, dyspnea, or sublethal hematemesis sometimes years prior to fatal hematemesis are reported in some cases.^{3,7,10,18,22} Furthermore, massive hematemesis following withdrawal of nasogastric tube or deflation of the esophageal balloon during an endoscopic procedure has also been reported.^{9,18} In a stable patient, esophagogastroduodenoscopy and CT with intravenous contrast are seemingly the diagnostic procedures of choice, with contrast material in the stomach on CT scan being highly suggestive of the presence of a fistula when this condition is considered. Diagnosis can be further confirmed by angiography. Chest X-rays often are nondiagnostic or show a superior mediastinal mass.^{10,22,25,28} In an unstable patient, balloon tamponade can temporarily stop bleeding, and surgical or endovascular repair can be attempted. Endovascular procedures such as embolization or stenting may be successful in stable patients, although in one case recurrent hematemesis was reported.^{17,19}

Although initially reported as almost uniformly fatal with survival rate of only 9.1% (1/11) in 1996, survival has improved with a survival rate of 58.8% (10/17) from those cases reported after 1996. Currently, overall survival rate is 35.7% (10/28), although follow-up periods from these studies are variable and often of short duration. Importantly, mortality after massive bleeding in unstable patients remains much higher (74%).^{4-12,14,17,18,20-22,24-27} Pathologic findings when described show attenuation and necrosis of the arterial and esophageal wall with a variable inflammatory response. In two cases, the presence of neutrophils was accompanied by "polymicrobial bacterial overgrowth" and gram-positive cocci and *Candida* were identified, suggesting a potential role for infectious organisms.^{6,7} Two other reports noted presence of atherosclerosis, not unexpected in older individuals.^{5,7} The presence of dystrophic calcifications suggests that these fistulas form gradually, potentially allowing for intervention before the onset of fatal bleeding.

Conclusion

In summary, we report a first case of ARSA-esophageal fistula in a patient with VATER association in the absence of TEF and EA. Given the high prevalence of ARSA in patients with EA, a screening imaging test and corrective surgery may be indicated if prolonged intubation or nasogastric tube placement is required. Although average mortality rate is still high, diagnosis and treatment of ARSA-esophageal fistula appear to be improving. Given the potentially prolonged latency for its development with occasional presence of heralding symptoms, increased awareness of this condition is critical. While the incidence of ARSA and ARSA-esophageal fistula in patients with VATER association is not known, this report suggests the need for clinical suspicion in this patient population.

Acknowledgment

The authors thank Linda Hankins for editing the manuscript.

References

- Berthet S, Tenisch E, Miron MC, et al. Vascular anomalies associated with esophageal atresia and tracheoesophageal fistula. *J Pediatr* 2015;166(5):1140–1144.e2
- Canty TG Jr, Boyle EM Jr, Linden B, et al. Aortic arch anomalies associated with long gap esophageal atresia and tracheoesophageal fistula. *J Pediatr Surg* 1997;32(11):1587–1591
- Millar A, Rostom A, Rasuli P, Saloojee N. Upper gastrointestinal bleeding secondary to an aberrant right subclavian artery-esophageal fistula: a case report and review of the literature. *Can J Gastroenterol* 2007;21(6):389–392
- Lehmann B, Clemetson I, Fantin AC, et al. Arterioesophageal fistula secondary to rupture of an aberrant right subclavian artery aneurysm: a rare differential diagnosis in upper gastrointestinal bleeding. *Endoscopy* 2006;38(7):762. Doi: 10.1055/s-2006-925172
- Singha NK, Hale SJ, Kuhlman JE. Arterio-esophageal communication from a ruptured aberrant right subclavian artery aneurysm. CT diagnosis. *Clin Imaging* 1998;22(2):117–121
- Miller RG, Robie DK, Davis SL, et al. Survival after aberrant right subclavian artery-esophageal fistula: case report and literature review. *J Vasc Surg* 1996;24(2):271–275
- Edwards BS, Edwards WD, Connolly DC, Edwards JE. Arterio-esophageal fistulae developing in patients with anomalies of the aortic arch system. *Chest* 1984;86(5):732–735
- Ikeda T, Yokota Y, Ando F, et al. A case of an aberrant subclavian artery-esophageal fistula due to prolonged nasogastric intubation [in Japanese]. *Kyobu Geka* 1991;44(12):1045–1047
- Belkin RI, Keller FS, Everts EC, Rösch J. Aberrant right subclavian artery—esophageal fistula: a cause of overwhelming upper gastrointestinal hemorrhage. *Cardiovasc Intervent Radiol* 1984;7(2):87–89
- Buades Reynes J, Aguirre Errasti C, Bilbao Ercoreca FJ, Oñate Landa A. Letter: Aneurysm of aberrant right subclavian artery with esophageal perforation. *Chest* 1976;70(1):105a. Doi: 10.1378/chest.70.1.105a
- Chapman JR, Sedghi S, Christie BD, Nakayama DK, Wynne JL. Aberrant right subclavian artery-esophageal fistula. *Am Surg* 2010;76(12):1430–1432
- Feugier P, Lemoine L, Beaudoin N, Chevalier JM. Aberrant right subclavian arterioesophageal fistula: endovascular occlusion via a transbrachial approach. *Eur J Vasc Endovasc Surg* 2002;23(1):77–78
- Fuentes S, Cano I, López M, et al. Arterial-esophageal fistula: a severe complication in children with cardiovascular abnormalities. *Pediatr Surg Int* 2010;26(3):335–337
- Hosn MA, Haddad F, El-Merhi F, Safadi B, Hallal A. Repair of an aberrant subclavian arterioesophageal fistula following esophageal stent placement. *World J Gastrointest Surg* 2014;6(6):117–121
- Jain KK, Braze AJ, Shapiro MA, Perez-Tamayo RA. Aberrant right subclavian artery-esophageal fistula and severe gastrointestinal bleeding after surgical correction of scimitar syndrome. *Tex Heart Inst J* 2012;39(4):571–574
- Joynt MR, Grifka RG. Spontaneous aberrant right subclavian arterio-oesophageal fistula in a previously healthy child. *Cardiol Young* 2015;25(7):1425–1427
- Magagna P, Abbiate N, Mansi G, et al. Endovascular treatment of aberrant right subclavian (lusorian) artery to oesophagus fistula: a case report. *Vasc Endovascular Surg* 2008;42(4):394–396
- Merchant FJ, Nichols RL, Bombeck CT. Unusual complication of nasogastric esophageal intubation-erosion into an aberrant right subclavian artery. *J Cardiovasc Surg (Torino)* 1977;18(2):147–150
- Morisaki A, Hirai H, Sasaki Y, Hige K, Bito Y, Suehiro S. Aortoesophageal fistula after endovascular repair for aberrant right subclavian artery aneurysm. *Ann Thorac Cardiovasc Surg* 2014;20(Suppl):790–793
- Pop D, Venissac N, Nadeemy AS, Schneck AS, Aze O, Mouroux J. Lesson to be learned: beware of lusoria artery during transhiatal esophagectomy. *Ann Thorac Surg* 2012;94(3):1010–1011
- Situma M, Kubiak R, Numanoglu A, Wood R, Brooks A, Millar AJ. Near-fatal bleeding from an aberrant subclavian artery following colonic interposition for oesophageal atresia. *Pediatr Surg Int* 2011;27(10):1131–1133
- Stone WM, Brewster DC, Moncure AC, Franklin DP, Cambria RP, Abbott WM. Aberrant right subclavian artery: varied presentations and management options. *J Vasc Surg* 1990;11(6):812–817
- Takahashi S, Okada K, Orihashi K, Sueda T. Arterio-oesophageal fistula caused by aberrant right subclavian artery aneurysm. *Interact Cardiovasc Thorac Surg* 2013;16(6):920–922
- Lo A, Baird R, De Angelis P, et al. Arterioesophageal fistula after stenting for esophageal atresia. *J Pediatr Gastroenterol Nutr* 2013;56(5):e30–e31
- Lynn RB. Kommerell's diverticulum with esophago-arterial fistula. *Can J Surg* 1969;12(3):331–333
- Livesay JJ, Michals AA, Dainko EC. Anomalous right subclavian arterial esophageal fistula: an unusual complication of tracheostomy. *Tex Heart Inst J* 1982;9(1):105–108
- Gossot D, Nussaume O, Kitzis M, Cohen G, Chalaux G, Andreassian B. Fatal hematemesis due to erosion of a retro-esophageal right subclavian artery by an esophagogastric tube [in French]. *Presse Med* 1985;14(31):1655–1656
- Kullnig P. Aneurysm of an aberrant right subclavian artery with bleeding into the esophageal wall. *Semin Roentgenol* 1989;24(2):75–76
- Bakker DA, Berger RM, Witsenburg M, Bogers AJ. Vascular rings: a rare cause of common respiratory symptoms. *Acta Paediatr* 1999;88(9):947–952
- Braddock SR. A new recessive syndrome with VATER-like defects, pulmonary hypertension, abnormal ears, blue sclera, laryngeal webs, and persistent growth deficiency. *Am J Med Genet A* 2003;123A(1):95–99
- Budincevic H, Starcevic K, Bielen I, Demarin V. An aberrant subclavian artery exhibiting the partial steal phenomenon in a patient with VACTERL association. *Intern Med* 2014;53(16):1859–1861