REVIEW PAPER

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Primary aortoenteric fistula: is endovascular repair the prime option? A review of the literature

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Abstract

Primary aortoenteric fistula (PAEF) is a rare entity that demands high clinical suspicion and efficient management in a limited time. The evolution of interventional radiology established endovascular repair (EVAR) as an attractive option. The English literature was searched using the PubMed database with the terms "primary aortoenteric fistula", "primary aortoduodenal fistula" or "aortoduodenal fistula", and "endovascular repair" in different combinations. Studies and original articles that described the role and the outcomes of EVAR for primary aortoenteric fistula were included. Fourteen articles with a total of 15 patients with primary aortoenteric fistula who were managed with EVAR were included in our literature review. PAEF is a rare and lethal entity that everyone should be aware of. EVAR is a salvage option and a valuable weapon in our armamentarium. Is EVAR really a "bridge to surgery" or is it the birth pangs of a minimally invasive definite treatment of PAEF?

Key words: critically ill patient, percutaneous endovascular repair, primary aortoenteric fistula.

Introduction

Aortoenteric fistula is defined as an abnormal communication between the aorta and the intestinal lumen and it represents a rare and challenging entity for the surgeon. When the aortoenteric fistula is a result of an abdominal aortic aneurysm repair, it is considered secondary. On the other hand, when no interventions in the aorta have preceded it, it is called a primary aortoenteric fistula [1]. Primary aortoenteric fistula (PAEF) is even rarer and the basic mechanism is the erosion of the intestinal lumen from the continuous pressure of an abdominal aortic aneurysm. The most common location of PAEF, at a rate of 83%, concerns the third portion of the duodenum and the celiac aorta [2]. PAEF was described for the first time in 1829 by Sir Astley Cooper, whereas the first repair was performed in 1954 by Zenker [3]. Since their discovery, there are increasing cases of PAEF described in the literature, but they still remain extremely rare with a reported incidence of 0.04–0.07% [4]. Aortoenteric fistulae are characterized by high mortality and morbidity with a total rate of 30–40% and the immediate diagnosis and treatment remain crucial in order to increase the overall survival of the patient [5]. Initially, the traditional open approach for the treatment of PAEFs was considered as the gold standard, but the evolution of interventional radiology managed to establish endovascular repair (EVAR) as a quite promising and minimally invasive option [6]. The first case of endovascular repair of PAEF was reported in 1997 and it steadily emerged as a promising option, because not only is it a minimally invasive approach avoiding the morbidity of open surgery but also it achieves superior short-term outcomes when compared to open surgery, especially in critically ill patients with a low survival rate [3, 7].

Aim

The aim of this study is to provide a comprehensive review regarding the primary aortoenteric fistula and the key role of EVAR with its short and long-term outcomes.

Material and methods

An extensive electronic search of the literature was performed in the PubMed database using the terms "primary aortoenteric fistula", "primary aortoduodenal fistula", "aortoduodenal fistula" and "endovascular repair" in different combinations. Inclusion criteria were: (1) English language, (2) original articles, case reports, and case series, (3) aortoenteric fistulae only between duodenum and aorta, (4) no recurrences or secondary aortoenteric fistulae. All the included articles were thoroughly examined and ana-

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lyzed concerning especially the key role of endovascular repair as the first method of treatment for primary aortoenteric fistula. Regarding the "short-term outcomes" section, hemodynamic stabilization, rate of re-bleeding, and discharge of the patient were evaluated. In the "long-term outcomes" section, the overall survival rate, the rate of re-bleeding or re-infection, and the need for definite open surgery were evaluated.

Results

Articles and patient characteristics

From the review of the literature, using the terms above, fourteen articles were found to meet the criteria and a total of fifteen patients with PAEF, who were managed initially with EVAR (Table I). Thirteen articles were case reports and one article a case series and they were reported from 2001 to 2021. The majority of patients were men (10 of 15 patients – 66.6%) and the mean age was 64.2 (range: 35–89) years.

Clinical presentation of PAEF

The typical symptom that led patients to the emergency department was upper gastrointestinal bleeding (14 of 15 patients – 93%) and its clinical manifestations, hematemesis, hematochezia, and melena.

Hemodynamic instability was the second most common finding (11 of 15 patients – 73%), which presented with tachycardia and hypotension. Less common symptoms were syncope (5 of 15 patients – 33%), abdominal pain (3 of 15 patients – 20%), and fever (1 of 15 patients – 6%). The combination of upper gastrointestinal bleeding and hemodynamic instability was the most frequent pattern of symptoms (11 of 15 patients – 73%). Furthermore, 1 patient was admitted to the emergency department only with syncope.

Diagnosis and causes of PAEF

The first procedure to be performed was esophagogastroduodenoscopy (EGD) (12 of 15 patients – 80%), aiming to exclude other causes of upper gastrointestinal bleeding. Nevertheless, EGD did not manage in any case to detect the aortoenteric fistula. By contrast, computed tomography angiography was performed on 13 of 15 patients (86%) and was able to identify the aortoenteric fistula in all patients, either with extravasation of the intravenous contrast to the intestinal lumen or with the presence of free air in the aorta and the aneurysm sac. Moreover, 3 of 15 patients (20%) were investigated immediately with angiography from the interventional radiologists, without performing EGD due to hemodynamic instability. The leading cause of PAEFs was the abdominal aortic aneurysm (10 of 15 patients – 67%). Other less common causes were metastatic cancers, retroperitoneal fibrosis, radiation, and foreign bodies such as eroding duodenal stents.

Techniques in endovascular repair

Closing the fistulous connection and controlling the bleeding with an aortic stent in the celiac aorta is the main aspect of endovascular repair. However, there are also alternative techniques described, such as the placement of two aortic stents or embolization with coils or ballooning in the proximal and distal ends for better stent expansion. Moreover, the use of a rifampin-soaked stent is described.

Short-term outcomes (hemodynamic stabilization, re-bleeding, discharge)

Regarding the short-term outcomes after EVAR, 13 of 15 (86%) patients were hemodynamically stable without requiring any early re-intervention. In 1 (6.6%) patient re-bleeding on the third postoperative day was noted and a new aortic stent was placed. In the other patient (6.6%), on the 5th postoperative day, a definite open surgical repair was decided because of deterioration with more free air in the aneurysm sac in the CT scan. Of the 15 patients, two died on the 10th and 33rd postoperative days from sepsis and pulmonary infection respectively. In 1 patient it was decided to perform definite treatment with an open surgical approach on the 20th postoperative day, although without any complications of the endovascular repair. The remaining 12 (80%) patients managed to be discharged with the aortic stent. The precise length of hospital stay is not mentioned in all cases and it is reported as "early discharge" or "prolonged stay", so it cannot be accurately determined. In 5 cases where the hospital length stay is reported, the mean time is 25.2 days (7 to 48 days) (Table I) [5–28].

Long-term outcomes (overall survival, re-bleeding, re-infection, need for definite surgery)

The long-term outcomes were evaluated for the 12 patients who managed to be discharged with the aortic stent. Five out of 12 patients (41.6%) presented with re-bleeding or recurrent infections. The mean postoperative time that these symptoms presented was 13.3 months (1 month to 48 months follow-up). Three out of 25 (25%) died during the follow-up. Two deaths were related to recurrent infections and one to an irrelevant cause (myocardial infarction). Four out of 12 patients (33.3%) were finally managed with open surgical repair, 50% (2 of 4 patients) due to recurrent infections, 25% (1 of 4 patients) due to re-bleeding, and 25% (1 of 4 patients) for achieving definite repair. Five patients out of 12 (41.6%) managed to remain with the aortic stent without having any signs of re-bleeding or recurrent infections with a mean follow-up of 31.4 months (6 months to 67 months). The overall survival rate for the patients who were discharged with an aortic stent was 75% (9 of 12 patients).

Discussion

PAEF is one of the most challenging and lethal entities that requires high clinical suspicion and immediate reaction from the surgeon. Traditionally the basic targets to be accomplished were control of the bleeding, control of infection, and preservation of distal perfusion [8]. In the past,

Table I. Characteristics of the fifteen patients with PAEF, who were managed initially with EVAR

Author	Type of article	Year	Number of patients with PAEF and sex	Age	Clinical presentation	Diagnosis	Causes	Method of endovascular repair	Short-term outcomes after endovascular repair	Long-term outcomes after endovascular repair
Ramanujam *et al.* [18]	Case report	2004	1 (male)	75	Hematemesis Hematochezia Abdominal pain Hypotension Syncope	Endoscopy (–) CT angiography (extravasation)	Metastatic renal cancer	Two aortic stents	Hemodynamic stabilization and discharge (one week)	Recurrence after one month with hematemesis and infection. Died
Petrunić *et al.* [21]	Case report	2020	1 (male)	62	Hematemesis, Abdominal pain Hypotension	Endoscopy (–) CT angiography (extravasation)	Abdominal aortic aneurysm	Aortoiliac stent	Hemodynamic stabilization and discharge (early discharge)	Recurrent fevers and antibiotics during the first year. Endograft infection and open surgical repair
Lakhani *et al.* [22]	Case report	2021	1 (male)	52	Syncope	CT angiograph (no extravasation, air in the aneurysm sac)	Abdominal aortic aneurysm	Aortoiliac stent	More free air in the aneurysm sac, no signs of bleeding. Surgical repair eventually after 5 days	Not reported
Jayarajan *et al.* [5]	Case report	2009	1 (male)	35	Hematochezia Hematemesis Hypotension	Endoscopy (–) Aortography (no signs of bleeding)	Retroperitoneal fibrosis, lymph nodes and radiation due to germ cell cancer	Aortic stent (two grafts because of recurrence of bleeding)	Rebleeding after 3 days and endovascular repair with graft (prolonged hospital stay)	3 years after with no signs of infection or rebleeding
Keunen *et al.* [23]	Case report	2016	1 (female)	79	Melena Hematemesis Syncope	CT angiography (extravasation and air in the sac) Endoscopy (–)	Abdominal aortic aneurysm and polymyalgia rheumatica	Aortic graft	Hemodynamic stabilization and discharge (2 weeks)	4 months after recurrence with infection and definite surgical repair with removal of the graft
Burks Jr *et al.* [9]	Case series	2001	2 (male)	48 and 82	Hematemesis Hypotension – Hematemesis	Endoscopy (–) CT angiography – Endoscopy (–) CT angiography	Abdominal aortic aneurysm	Coils Aortoiliac stent	Immediate cessation of bleeding and early discharge	At 67 months follow-up without signs of recurrence or infection At 13 months died of MI, but no signs of recurrence or infection
Verhey *et al.* [16]	Case report	2006	1 (female)	66	Hypotension Hematemesis	Aortography	Eroding duodenal stent	Aortic stent	Hemodynamic stabilization with no signs of rebleeding or infection and was discharged (early discharge)	6 months after with no signs of infection or rebleeding, long-term oral antibiotics
Georgeades *et al.* [14]	Case report	2021	1 (male)	64	Melena Hypotension	CT angiography Endoscopy (–)	Abdominal aortic aneurysm	Rifampin-soaked aortic stent graft	Cessation of bleeding and hemodynamic stabilization	20 days after the endovascular repair, open surgical repair was performed

Table I. Cont.

Author	Type of article	Year	Number of patients with PAEF and sex	Age	Clinical presentation	Diagnosis	Causes	Method of endovascular repair	Short-term outcomes after endovascular repair	Long-term outcomes after endovascular repair
Thomson *et al.* [24]	Case report	2009	1 (female)	70	Hematemesis Melena Hypotension Fever	Endoscopy (–) CT angiography (no extravasation but air in the aneurysm sac)	Abdominal aortic aneurysm	Two aortic stents	Hemodynamic stabilization and no rebleeding Discharged at 6 weeks	Antibiotics for 4 weeks, was discharged at 6 weeks and died probably because of sepsis
Miura *et al.* [25]	Case report	2020	1 (male)	73	Hematemesis Syncope Hypotension	Endoscopy (–) CT angiography	Abdominal aortic aneurysm	Aortic stent	Hemodynamic stabilization Discharged at 48 days	3 years after no signs of reinfection of rebleeding but shortly after endovascular repair open duodenal fistula repair was performed
Arima *et al.* [26]	Case report	2020	1 (male)	71	Hematemesis, syncope Hemodynamic unstable	Endoscopy (–) CT angiography	Abdominal aortic aneurysm	Aortic stent	Hemodynamic stabilization and early discharge	No infections, antibiotics for more than one year but rebleeding after 4 years and definite open surgery
De Smet *et al.* [27]	Case report	2018	1 (female)	89	Hematemesis	Endoscopy (–) CT angiography (air in the sac)	Abdominal aortic aneurysm	Aortic stent	Hemodynamic stabilization, somatostatin, antibiotics and TPN, discharged on the 15th postoperative day	One year after no signs of reinfection or rebleeding
Morikawa *et al.* [28]	Case report	2017	1 (male)	56	Hematemesis Hypotension Abdominal pain	Endoscopy (–) CT angiography and aortography	Radiation of paraaortic lymph node metastasis	Aortic stent and ballooning of the proximal and distal ends	Hemodynamic stabilization with no signs of rebleeding (no discharge)	Died 33 days after due to pneumonia
Krosin *et al.* [17]	Case report	2017	1 (female)	42	Hematemesis Hematochezia Hypotension	CT angiography Aortography	Necrotic retroperitoneal metastases	Aortic stent	Hemodynamic stabilization Died 10 days after because of developing sepsis	Died

these were achieved with an open approach, with bypass grafting and aortic ligation, procedures with high mortality (25–90%), a high rate of amputation (5–25%), and aortic stump rupture in 10–50% [9]. Another option was the reconstruction of the aorta, with a respectively high rate of mortality, 27–30% [10]. Nevertheless, throughout the years EVAR emerged as a quite promising option, especially for patients in extremis with massive bleeding and instability, decreasing the rate of mortality and increasing the overall survival [3].

The cornerstone for PAEF diagnosis is high clinical suspicion. The usual presenting symptoms of PAEF are abdominal pain, upper gastrointestinal bleeding, and a palpable pulsating abdominal mass. However, the simultaneous presence of this triad is found only in 11–23%, according to the literature [3, 11]. Upper gastrointestinal bleeding manifesting with hematemesis, hematochezia, or melena accounts for the most common and initial symptom at a rate of 70%. Another finding is "herald bleeding", where an intermittent hemorrhage with spontaneous closure of the aortoenteric fistula by a thrombus is followed by a massive hemorrhage with the collapse of the patient. This herald bleeding usually presents 6–24 hours before the hemodynamic instability of the patient and it should always raise suspicions for the presence of PAEF [12]. Other less common symptoms are fever and septic emboli to the lower extremities due to microbiota translocation [3]. In our literature review, 93% of patients presented with upper GI bleeding and the most common pattern of symptoms (73%) were upper GI bleeding and hemodynamic instability.

However, PAEF requires not only high clinical suspicion but also the necessary examinations in order to confirm the diagnosis. Firstly, the EGD will exclude other causes of upper GI bleeding, but it will confirm the diagnosis at a rate lower than 50%. Suspicious findings during EGD are active bleeding in the third portion of the duodenum, external pressure of the duodenum, or the observation of an aortic stent which will also confirm the diagnosis. Therefore, a negative EGD does not exclude the presence of PAEF [13].

Computed tomography angiography is far more superior when compared to EGD, because not only is it a non-invasive method, but also it has a higher detection rate of 61%, sensitivity of 50-94%, and specificity of 85% [14]. Baril *et al.* in their series with aortoenteric fistulae from 1997 to 2006 report a CT angiography sensitivity of 85.7% (12 of 14 patients) [8]. In the present literature review, the CT angiography managed to confirm the diagnosis of PAEF in 86% (13 of 15 patients).

Moreover, CT angiography is a non-invasive method, with lower chances of dislodging the thrombus and re-bleeding [15]. Indirect signs of an aortoenteric fistula are the presence of air inside the aorta or the aneurysm sac, the elimination of the fat plane between aorta and duodenum, and bowel thickening, whereas the pathognomonic sign of PAEF is the extravasation of intravenous contrast to the intestinal lumen [14]. Another diagnostic tool is arteriography, even though it tends to be abandoned as a diagnostic process because the flow of the intravenous contrast is weak and the extravasation might not be identified [13]. Despite this, arteriography still remains a valuable tool for critically ill patients, because diagnosis and EVAR can be performed simultaneously and any pointless delay is avoided, something which is crucial for the patient in extremis [16, 17]. The exact mechanism that leads to the creation of PAEF still remains poorly understood but it seems that the continuous pressure and erosion of the intestinal wall, combined with infection, is the main mechanism. PAEFs in 73% of cases is a consequence of an abdominal aortic aneurysm and in 26% a result of trauma or mycotic aneurysms [15]. Other rare causes that are reported in the literature are radiation, metastatic cancers, peptic ulcers, idiopathic inflammatory bowel disease, and foreign bodies such as duodenal stents [5, 16, 18]. In addition, some authors consider the creation of an aortoenteric fistula after endoleak type II as a primary aortoenteric fistula, because they declare that this is a result of erosion from the aneurysm sac [19].

The evolution of interventional radiology and its application in the treatment of PAEFs managed to reduce the mortality and the complications of the open surgical approach. As a result, nowadays the traditional surgical approach for PAEFs is considered obsolete and it is not applied as the first option. Especially patients in extremis, patients with a hostile abdomen due to previous operations, and patients with advanced malignancy seem to benefit from a minimally invasive procedure such as the endovascular repair. This is also confirmed in our review where 86.6% (13 of 15 patients) were stabilized hemodynamically after the endovascular approach and all of these findings advocate the beginning of a new era in treating PAEFs. Nevertheless, EVAR for PAEFs is not a panacea, and according to the literature it is related to re-bleeding and recurrence of infections in the postoperative period. Leonhardt *et al*. report a bleeding control rate of 80% using the endovascular approach but also an increased rate of re-bleeding and re-intervention [20]. A lot of skepticism also exists regarding the placement of foreign material in a contaminated field, as this leads to recurrent infections and persistent sepsis. Antoniou *et al*. reported, in a systematic review of aortoenteric fistulae which were treated with EVAR, that 44% of patients presented with recurrent infections and re-bleeding, leading to deterioration of the overall survival. Especially in patients with pre-existing signs of sepsis, EVAR is associated with an increased rate of re-infection [1]. On the other hand, many authors believe that the aortic stent placement might be related to spontaneous closure of the aortoenteric fistula and containment of the infection by remodeling of the aorta and decreasing the aortic angulation. However, this mechanism remains poorly studied and not clearly elucidated [21]. The administration of somatostatin and parenteral nutrition is also suggested in order to accelerate the closure of the fistula and contain the infection of the stent, but there are limited cases and inconclusive results [22]. Furthermore, patients who are treated with EVAR are recommended to take life-long antibiotics for prophylaxis and suppression of the infection,

although more studies are required [15]. Therefore, EVAR should be considered as a primary option for certain cases of patients. Critical illness with hemodynamic instability, a hostile abdomen due to previous operations, and limited life expectancy are the main reasons to select endovascular repair. Only if the patients manage to stabilize will they receive a definite surgery with an open approach, as according to the literature so far, EVAR should be considered as a "bridge to surgery" [15]. Nevertheless, there are cases of PAEF which were treated only with EVAR without signs of re-infection or re-bleeding for a long-term follow-up. The exact mechanisms are still not clarified and more studies are needed to solve this enigma [5, 9, 23].

Conclusions

The therapeutic approach of PAEF is quite challenging and it requires high clinical suspicion and immediate identification, in order to increase the chances of surviving. EVAR is considered as a "bridge" to surgery by ensuring time for a definite repair when the patient stabilizes. However, certain patients benefit from the use of EVAR as a primary option. More data and studies are required in order to understand the mechanisms and establish a gold standard approach for the treatment of PAEFs.

Disclosure

The authors report no conflict of interest.

References

1. Antoniou GA, Koutsias S, Antoniou SA, Georgiakakis A, Lazarides MK, Giannoukas AD. Outcome after endovascular stent graft repair of aortoenteric fistula: a systematic review. J Vasc Surg 2009; 49: 782-789.
2. Busuttil SJ, Goldstone J. Diagnosis and management of aortoenteric fistulas. Semin Vasc Surg 2001; 14: 302-311.
3. Spanos K, Kouvelos G, Karathanos C, Matsagkas M, Giannoukas AD. Current status of endovascular treatment of aortoenteric fistula. Semin Vasc Surg 2017; 30: 80-84.
4. Saers SJ, Scheltinga MR. Primary aortoenteric fistula. Br J Surg 2005; 92: 143-152.
5. Jayarajan S, Napolitano LM, Rectenwald JE, Upchurch GR Jr. Primary aortoenteric fistula and endovascular repair. Vasc Endovascular Surg 2009; 43: 592-596.
6. Ricotta JJ, Faggioli GL, Stella A, Curl GR, Peer R, Upson J, D'Addato M, Anain J, Gutierrez I. Total excision and extra-anatomic bypass for aortic graft infection. Am J Surg 1991; 162: 145-149.
7. Oliva VL, Bui BT, Leclerc G, Gravel D, Normandin D, Prenovault J, Guimond JG. Aortoesophageal fistula: repair with transluminal placement of a thoracic aortic stent-graft. J Vasc Interv Radiol 1997; 8: 35-38.
8. Baril DT, Palchik E, Carroccio A, Olin JW, Ellozy SH, Jacobs TS, Ponzio MM, Teodorescu VJ, Marin ML. Experience with endovascular abdominal aortic aneurysm repair in nonagenarians. J Endovasc Ther 2006; 13: 330-337.
9. Burks JA Jr, Faries PL, Gravereaux EC, Hollier LH, Marin ML. Endovascular repair of bleeding aortoenteric fistulas: a 5-year experience. J Vasc Surg 2001; 34: 1055-1059.
10. Peck JJ, Eidemiller LR. Aortoenteric fistulas. Arch Surg 1992; 127: 1191-1193.
11. Guner A, Mentese U, Kece C, Kucuktulu U. A rare and forgotten diagnosis of gastrointestinal bleeding: primary aortoduodenal fistula. BMJ Case Rep 2013; 2013: bcr2013008712.
12. Tareen AH, Schroeder TV. Primary aortoenteric fistula: two new case reports and a review of 44 previously reported cases. Eur J Vasc Endovasc Surg 1996; 12: 5-10.
13. Ranasinghe W, Loa J, Allaf N, Lewis K, Sebastian MG. Primary aortoenteric fistulae: the challenges in diagnosis and review of treatment. Ann Vasc Surg 2011; 25: 386.e1-5.
14. Georgeades C, Zarb R, Lake Z, Wood J, Lewis B. Primary aortoduodenal fistula: a case report and current literature review. Ann Vasc Surg 2021; 74: 518.e13-518.e23.
15. Xiromeritis K, Dalainas I, Stamatakos M, Filis K. Aortoenteric fistulae: present-day management. Int Surg 2011; 96: 266-273.
16. Verhey P, Best A, Lakin P, Nachiondo J, Petersen B. Successful endovascular treatment of aortoenteric fistula secondary to eroding duodenal stent. J Vasc Interv Radiol 2006; 17: 1345-1348.
17. Krosin M, Pinter J, McCluskey K, Varma R. Endograft for palliation of aortoenteric fistula. J Vasc Interv Radiol 2017; 28: 1454.
18. Ramanujam S, Shiels A, Zuckerman G, Prakash C. Unusual presentations of aorto-enteric fistula. Gastrointest Endosc 2004; 59: 300-304.
19. Lind BB, Jacobs CE. Primary aortoduodenal fistula supplied by type II endoleak. Ann Vasc Surg 2012; 26: 1012.e13-5.
20. Leonhardt H, Mellander S, Snygg J, Lönn L. Endovascular management of acute bleeding arterioenteric fistulas. Cardiovasc Intervent Radiol 2008; 31: 542-549.
21. Petrunić M, Meštrović T, Halužan D, Perkov D, Golemović M, Golubić-Ćepulić B. Recurrent aortic infections due to unrecognized aorto-enteric fistula. Ann Vasc Surg 2020; 63: 455.e11-455.e15.
22. Lakhani DA, Sharma SA, Kutayni H, Balar AB, Marano G, Martin D. Primary aortoenteric fistula: a case report and brief review of the literature. Radiol Case Rep 2021; 14: 3549-3553.
23. Keunen B, Houthoofd S, Daenens K, Hendriks J, Fourneau I. a case of primary aortoenteric fistula: review of therapeutic challenges. Ann Vasc Surg 2016; 33: 230-235.
24. Thomson VS, Gopinath KG, Joseph E, Joseph G. Primary aorto-enteric fistula: a rare complication of abdominal aortic aneurysm. J Postgrad Med 2009; 55: 267-269.
25. Miura S, Kurimoto Y, Ujihira K, et al. emergency endovascular aneurysm repair coupled with staged omentopexy for primary aorto-duodenal fistula. Ann Vasc Dis 2020; 25: 183-186.
26. Arima D, Suematsu Y, Kurahashi K, Shimizu T, Nishi S, Yoshimoto A. recurrence of aortoenteric fistula after endovascular aortic repair. Ann Vasc Dis 2020; 25: 90-92.
27. De Smet A, van den Eynde W, Peeters P, Verbist J. Endovascular treatment of a primary aortoduodenal fistula. J Cardiovasc Surg 2018; 59: 844-845.
28. Morikawa K, Ashida H, Nozawa Y, et al. Endovascular repair with a stent graft in a patient with aortoduodenal fistula after radiation therapy. Case Rep Radiol 2017; 2017; 2087142.