Hepatic artery aneurysm causing gastrointestinal haemorrhage – Case report and literature review

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ARTICLE INFO

Article history:
Received 8 June 2017
Received in revised form 29 August 2017
Accepted 29 August 2017
Available online 4 October 2017

Keywords:
Case-report
Endovascular treatment
Gastrointestinal haemorrhage
Hepatic artery aneurysm
Radiological detection

ABSTRACT

INTRODUCTION: True hepatic artery aneurysms (HAAs) are rare, and when complicated by gastrointestinal haemorrhage, it becomes an even rarer disease entity. The mortality is high and imaging may fail to provide the diagnosis. We present a case of a true hepatic artery aneurysm complicated by a fistula to the duodenum which was first recognised during surgery.

PRESENTATION OF CASE: A 77-year-old man presented with upper gastrointestinal haemorrhage. Upper endoscopy revealed an ulceration in the duodenal bulb, which was refractory to endoscopic treatment. Computed tomography and angiography did not reveal the source of haemorrhage and as such, the diagnosis was delayed, until laparotomy was performed. Resection of the HAA and graft placement resulted in complete haemostasis.

DISCUSSION: True hepatic aneurysms communicating with the gastrointestinal tract have only been presented in case reports and short case series. Arteriosclerosis is a relatively common risk factor, but the underlying pathology is unknown. Meanwhile, gastrointestinal haemorrhage is a symptom of other, more common diseases in the gastrointestinal tract, and these factors, complicate the diagnostic workup.

CONCLUSION: In the case of treatment refractory duodenal haemorrhage, a visceral aneurysm should be considered. Even though angiography is performed, a HAA may remain undetected due to bleeding cessation. Improved computed tomography modalities could aid in the detection of gastrointestinal haemorrhage from HAAs, and ensure timely treatment by endovascular methods or surgery if the diagnosis is kept in mind in the initial evaluation.

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1. Introduction

Hepatic artery aneurysms (HAAs) are rare, with an estimated incidence of 0.002–0.4% [1,2]. HAAs are thought to account for 20% of visceral aneurysms, making it the second most common after splenic artery aneurysms [2]. However, increased use of abdominal CT scans and therapeutic biliary procedures have increased the detection of at least pseudo HAAs [3]. Symptoms of a HAA range from abdominal pain (55%) to total lack of symptoms (2%). The number of asymptomatic cases may however be underestimated [3].

True HAA’s communicating with the GI tract are only described in few case-reports. The Medline database was searched for potential articles using the MESH terms “hepatic artery”, “aneurysm”, and "gastrointestinal haemorrhage". A total of 187 articles were published from 1964 until 2014. Eighty-eight articles described pseudo-aneurysms or aneurysms arising from other arteries in the upper abdomen. The articles [4–34] on HAAs described the GI tract or the biliary system are presented in Table 1.

Fistulas from HAAs usually communicate with the biliary system. According to our literature search, a HAA with a fistula to the duodenum, has only been presented in seven previous studies/case reports. HAA present a diagnostic challenge due to the rarity of the disease with a variety of treatment options.

We present a case of a HAA complicated by a duodenal fistula. The case-presentation is made in full accordance with the current guidelines for surgical case reports (SCARE) [35].

2. Case presentation

A 77-year-old male with known hypertension (treated with bendroflumethiazid, amlodipine, and losartan), moderate daily alcohol consumption, and massive tobacco consumption, was admitted with hematemesis. Initial upper endoscopy did not reveal the bleeding source, and he was therefore managed conservatively. On the third day of admission, he developed a circulatory collapse.
Table 1

| Reference                         | Article type | No. of cases | Patient age | Location of fistula | Diagnostics | Treatment | Cause |
|-----------------------------------|--------------|--------------|-------------|---------------------|-------------|-----------|-------|
| Mortimer and Gresham [6]          | Case report  | 1            | 77          | NA                  | Autopsy     | Laparotomy| NA    |
| Graham et al. [5]                 | Case report  | 1            | 61          | Portal vein         | Angiography | Surgical resection | Heriditary telangiectasia |
| Macdonald et al. [7]              | Case report  | 1            | 52          | Gallbladder         | Laparotomy  | Surgical resection | Cholecystitis |
| Gryboski and Clemett [8]          | Case report  | 1            | 18 weeks    | NA                  | Autopsy     | NA        | Congenital |
| Sandblom [9]                      | Case report  | 1            | 73          | Pancreatic duct     | Angiography | NA        | NA    |
| Gupta and Cope [10]               | Case report  | 1            | 30          | Common bile duct    | Angiography | Surgical ligation | Endocarditis |
| Santiago-Delpin et al. [11]       | Case report  | 1            | 48          | Common bile duct    | Laparotomy  | Surgical resection partial Marfan syndrome |
| Croom et al. [12]                 | Case report  | 1            | 73          | Common bile duct    | Angiography | Surgical resection | NA    |
| Balthazar [13]                    | Case report  | 1            | 74          | Common bile duct    | Angiography | Surgical ligationa | NA    |
| Harlaftis and Akin [14]           | Case report  | 48           | 62a         | Gallbladder Cystic duct Peritoneal cavity Hepatic ducts Duodenum Gastro-duodenal Haemorrhage | Angiography | Surgical ligationb | NA    |
| Cranston and Smith [15]           | Case report  | 1            | 83          | Intestinal tract not otherwise specified Duodenal bulb Pancreatic duct | Angiography | Surgical resection | NA    |
| Hugel et al. [16]                 | Case report  | 1            | 56          | Duodenal bulb       | Angiography | Surgical resection | NA Giant cavernous hemangioma |
| Stierl et al. [17]                | Case report  | 1            | 51          | Common bile duct    | NA          | Surgical resection | NA Giant cavernous hemangioma |
| Psathakis et al. [18]             | Case report  | 2            | 64–70       | Abdominal cavity Gallbladder and cholecystic fistula | Laparotomy | Surgical resection | NA    |
| Werner and Bonnevie [4]           | Case report  | 1            | 73          | Pancreatic duct     | Angiography | Surgical resection, bypass grafting Surgical resection | Acromegaly |
| Hubloue et al. [19]               | Case report  | 1            | 74          | Duodenal bulb       | Angiography | Surgical resection | NA |
| Sarkar et al. [20]                | Case report  | 1            | 65          | Common bile duct    | Angiography | Embolisation Surgical ligation | NA Intrahepatic artery chemotherapy |
| Pross et al. [22]                 | Case report  | 1            | 56          | Duodenal bulb       | Angiography | Embolisation metal coils Surgical ligation | NA |
| O’Driscoll et al. [21]            | Literature review | 1          | 35          | Common bile duct    | Angiography | Embolisation metal coils Surgical ligation | NA |
| Cho et al. [23]                   | Case report  | 1            | 49          | Duodenal bulb       | NA          | Surgical resection | NA |
| Maralcan et al. [24]              | Case report  | 1            | 65          | Bile system not otherwise specified Duodenal bulb | Angiography | Surgical ligation | NA    |
| Shuster et al. [25]               | Case report  | 1            | 21          | Duodenal bulb       | Angiography | Surgical resection, and venous grafting Polyarteritis nodosa | |
| Narula et al. [26]                | Case report  | 1            | 85          | Unknown Common bile duct | Angiography | No treatment Embolisation metal coils | NA |
| Traversa et al. [27]              | Case report  | 1            | 49          | Common bile duct    | Angiography | Embolisation metal coils Surgical ligation | NA |
| Morisawa et al. [28]              | Case report  | 1            | 83          | Common bile duct    | Angiography | Embolisation metal coils and gelatin sponge Surgical suture laparotomy + Stent placement Endocarditis | |
| Soon et al. [29]                  | Case report  | 1            | 43          | Gall bladder        | CT          | Embolisation metal coils | NA Fibromuscular dysplasia |
| Papafragkou et al. [30]           | Case report  | 1            | 74          | Stomach             | CT          | Surgical resection Embolisation metal coils and N-butyl cyanoacrylate | NA |
| Wu et al. [31]                    | Case report  | 1            | 50          | Common bile duct    | CT          | Surgical suture laparotomy + Stent placement Stent placement | NA Marfan syndrome |
| Huisman et al. [32]               | Case report  | 1            | 48          | Duodenum            | CT          | Surgical resection | NA Marfan syndrome |
| Kobayashi et al. [33]             | Case report  | 1            | 77          | Duodenum            | CT          | No direct fistula could be found | |
| Komatsu et al. [34]               | Case report  | 1            | 53          | Duodenum            | CT          | Surgical resection | Marfan syndrome |

Note:Unless otherwise specified, the aneurysm was from the common hepatic artery. NA = Not available. CT = Computed Tomography.

a Data on the one patient from the case report. Ages from the literature review is not specified.

b Right hepatic artery.

c Left hepatic artery.

d Abberant right heptic artery.

Acute upper endoscopy was conducted, revealing an arterial bleeding in the second part of the duodenum. Endoscopic intervention failed to induce bleeding cessation, and subsequent angiography did not reveal a bleeding source (Fig. 1).

Despite subsequent embolization of the gastro-duodenal artery, the patient had another circulatory collapse, prompting acute laparotomy. During surgery, an aneurysm of the common hepatic artery with a fistula to the duodenal lumen was discovered. The aneurysm was resected, and a vascular prosthesis from the celiac trunk to the common hepatic artery was attached (Figs. 2–3). The treatment resulted in complete haemostasis. The post-operative
course was complicated by colon pseudo-obstruction, for which surgical resection of the right colon was performed.

The patient was discharged five weeks after admission. He died from a cerebral infarction five years later.

3. Discussion

3.1. Diagnostics

Reported symptoms associated with HAAs are: upper or lower GI bleeding, abdominal pain, jaundice, anaemia or haemobilia [3].

These symptoms mimic those from other and more common GI diseases, providing little information as to the underlying pathology. The mortality rates are 50–100% in the case of rupture, making early diagnostics paramount [24].

Pseudo-HAAs causing gastrointestinal haemorrhage are reported multiple times, with different pathogenesis: abdominal trauma [36–38], surgery (liver transplantation, cholecystectomy etc.) [39,40], cholecystitis [41,42], cholecystolithiasis [43], or infectious liver disease [44]. However, in the case of HAAs, the underlying pathology is not so obvious. Like other aneurysms, the only predisposing factors are: atherosclerosis, connective tissue disorders (e.g. fibromuscular dysplasia, Marfan syndrome etc.), and vasculitis (e.g. polyarthritis nodosa) [45]. In HAAs presenting with GI haemorrhage, the blood loss can range from chronic haemorrhage to massive haemorrhage with the risk of circulatory collapse [3]. Patients are often asymptomatic in intervals, due to mural thrombus formation providing intermittent bleeding cessation [19]. Endoscopy may reveal a non-pulsatile mass compressing the duodenal bulb, but it is usually not sufficient to ensure the diagnosis [46].

In our case, the final diagnosis was delayed, as a preoperative CT-scan did not reveal the aneurysm. However, the device used was a 64-slice CT scanner. The implementation of the 128-slice CT modality in our department has increased the accuracy for haemorrhage detection (0.3–0.5 mL/min) [47], and it is possible that this could have ensured the diagnosis. Furthermore, the aneurysm could not be visualised with celiac trunk angiography (Fig. 1), which prompted prophylactic endovascular embolization of the gastroduodenal artery [48]. Consequently, even though imaging does not reveal an HAA, the possibility should still be considered, especially in treatment refractory cases.

3.2. Treatment

Treatment methods used in the case of true-HAA’s range from reconstructive surgery with resection or ligation [24,25], to endovascular treatment strategies, using embolisation or stent placement [32,33].
Embolisation is an effective treatment modality in the case of saccular aneurysms, or fusiform aneurysms with good collateral blood supply. In case of insufficient collateral flow or concomitant liver disease, surgical procedures not impairing antegrade flow may be considered [49].

Covered metal stents have been considered contraindicated in the case of enteric fistula, due to the risk of contamination. However, the successful use of metal stents in the treatment of HAA has been described twice [32,33]. No infection occurred in any of the cases. Endovascular stent placement could therefore be a safe treatment of GI haemorrhage arising from an HAA.

Treatment using endovascular techniques requires, that the diagnosis can be made during angiography. In our case, the only possibility was surgical resection and grafting, as the aneurysm was not discovered, before open surgery was performed.

4. Conclusions

In this report, we present a rare case of an HAA presenting with GI haemorrhage. This is an uncommon cause of GI haemorrhage, which can be difficult to diagnose. The complete arterial supply from the celiac trunk should be visualised during angiography, as massive haemorrhage from a fistula to the GI tract could arise from other sites than the gastroduodenal artery. However, even though complete angiography is performed, the diagnosis may still be missed. As the survival of patients with HAA relies on early and efficient treatment, this cause should be kept in mind in the case of refractory GI haemorrhage.

Competing Interests

The authors have none to declare.

Funding

The Department of Gastrointestinal Surgery, Aalborg University Hospital, funded the study. There were no other sources of funding.

Ethical approval

The Regional Ethics Committee where not prompted for approval under Danish Law.

Consent

“Written informed consent was not obtained from the patient for publication of this case report and any accompanying images. The next of kin could not be localized, and therefore a written consent is not available for review by the Editor of this journal. The use of this patient case was approved by the Chief of Surgery at Aalborg University Hospital. The study was registered at Research Registry on 6 June 2017 (UIN = researchregistry2621).

Author contributions

SP was the surgeon who performed the operation, made the clinical case description and drafted the manuscript.

SLR compiled the literature search and aided in drafting the manuscript.

Guarantor

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Acknowledgements

The authors wish to thank, Professor Ole Thorlacius-Ussing for his supervision, and review of the article. The study was funded by The Department of Gastrointestinal Surgery, Aalborg University Hospital.

References

[1] M.A. Arneson, R.S. Smith, Ruptured hepatic artery aneurysm: case report and review of literature, Ann. Vasc. Surg. (July) (2005) 540–545.
[2] M.A. Abbas, R.J. Fowl, W.M. Stone, J.M. Panneton, W.A. Oldenburg, T.C. Bower, et al., Hepatic artery aneurysm: factors that predict complications, J. Vasc. Surg. (July) (2003) 41–45.
[3] C.J. Shanley, N.L. Shah, L.M. Messina, Common splanchnic artery aneurysms: splenic, hepatic, and celiac, Ann. Vasc. Surg. (May) (1996) 315–322.
[4] E. Werner, B. Bonnevie, Gastrointestinal bleeding from a fistula between an aneurysm of the hepatic artery and the pancreatic duct, Eur. J. Vasc. Surg. (January) (1993) 95–97.
[5] W.P. Graham, B. Eiseman, R. Pryor, Hepatic artery aneurysm with portal vein fistula in a patient with familial hereditary telangiectasia, Ann. Surg. (March) (1964) 362–367.
[6] T.F. Mortimer, G.A. Gresham, Aneurysm of the hepatic artery, Br. Med. J. 19 (December) (1964) 1592–1593.
[7] J.A. Macdonald, C.B. Baker, W.K. Welsh, Hepatic artery aneurysm: report of a case, Ann. Surg. (January) (1965) 94–96.
[8] J.D. Gyboski, A. Clemett, Congenital hepatic artery aneurysm with superior mesenteric artery insufficiency: a steal syndrome, Pediatrics (March) (1967) 344–347.
[9] P. Sandblom, Gastrointestinal hemorrhage through the pancreatic duct, Ann. Surg. (January) (1970) 61–66.
[10] S. Gupta, V. Cope, Hepatic artery aneurysm as a cause of gastrointestinal blood loss, Br. J. Radiol. (October) (1972) 726–728.
[11] E.A. Santiago-Delpin, E. Marquez, O.L. Rodriguez, F.E. Oliveras, C. Baldizon, R. Martinez-Cabrera, Perforated hepatic artery aneurysm and multiple aneurysms in incomplete Marfan syndrome, Ann. Surg. (December) (1972) 772–776.
[12] R.D. Croom, P.T. Frantz, C.G. Thomas, A.L. Hoithem, Aneurysms of the hepatic artery, South. Med. J. (August) (1976) 1013–1016.
[13] E.J. Baltazar, Hemobilia Calcified hepatic artery aneurysm presenting with massive gastrointestinal bleeding, Gastrointest. Radiol. 18 (December) (1977) 71–74.
[14] N.N. Harlafitis, J.T. Akin, Hemobilia from ruptured hepatic artery aneurysm. Report of a case and review of the literature, Am. J. Surg. (February) (1977) 229–232.
[15] B. Cranston, R.B. Smith, Hepatic artery aneurysm. An unusual case of upper gastrointestinal bleeding, Br. J. Clin. Pract. (May) (1984) 193–194.
[16] H.E. Hügel, W. Oser, E. Bodner, Aneurysm of the proper hepatic artery as a rare source of upper gastrointestinal bleeding, Gastrointest. Radiol. (January) (1986) 158–160.
[17] P. Sieriri, D. Graf, B. Stamm, Recurrent bleeding from a hepatic artery aneurysm feeding a large cavernous hemangioma of the liver, VASA (January) (1991) 164–168.
[18] D. Paathakis, G. Müller, M. Noa, J. Diebold, H.P. Bruch, Present management of hepatic artery aneurysms. Symptomatic left hepatic artery aneurysm; right hepatic artery aneurysm with erosion into the gallbladder and simultaneous colocolicystic fistula—a review of two unusual cases and the current state of etio, VASA (January) (1992) 210–215.
[19] I. Hulbloue, B. Keymeulen, G. Delvaux, G. Somers, Hepatic artery aneurysm. Case reports with review of the literature, Acta Clin. Belg. (January) (1993) 246–252.
[20] C. Sarkar, D.K. Mazumdar, T.J. Sarkar, T.N. Mazumder, A rare case of haemobilia, J. Indian Med. Assoc. (January) (1998) 186–187.
[21] D. O’Driscoll, S.P. O’liff, J.F. O’liff, Hepatic artery aneurysm, Br. J. Radiol. (October) (1999) 1018–1025.
[22] M. Pross, K. Ridwelski, F. Reiber, H. Lippert, Hepatic artery aneurysm associated with upper gastrointestinal bleeding after intrahepatic artery chemotherapy, Hepatogastroenterology (January) (1999) 2285–2288.
[23] Y.P. Cho, H.J. Jang, S.Y. Kim, D.H. Lee, S.G. Lee, Extended surgery for the hepatic artery aneurysm involving duodenum and pancreas—a case report, Hepatogastroenterology (January) (2003) 684–686.
[24] G. Maralcan, I. Baskin, C. Sanal, Hemobilia in a patient with multiple intrahepatic, hepatic artery aneurysms, Acta Chir. Belg. (February) (2003) 113–115.
[25] T.A. Shuster, J. Almeida, R. Coats, A. Kalra, D. Silver, Gastrointestinal bleeding as the initial manifestation of a polycystic nodosa-associated hepatic artery aneurysm-duodenal fistula—a case report, Vasc. Endovasc. Surg. (January) (2004) 563–568.
[26] H.S. Narula, A. Kotru, A. Nejim, Hepatic artery aneurysm: an unusual cause for gastrointestinal haemorrhage. Emerg. Med. J. 1 (April) (2005) 302.

[27] G. Traversa, M. Zipp, A. Bruni, M. Mancuso, P. Di Stefano, G. Occhigrossi, A rare case of hemobilia associated with aneurysms of the celiac trunk, the hepatic artery, and the splenic artery, Endoscopy (January) (2006) E5–E6.

[28] T. Morisawa, H. Marusawa, S. Ono, Spontaneous rupture of intrahepatic aneurysm, Clin. Gastroenterol. Hepatol. A30 (April) (2007).

[29] M.-S. Soon, H.-H. Yen, Y.-Y. Chen, H.-K. Wu, Electronic clinical challenges and images in GI: image 1. Hepatic artery aneurysm, Gastroenterology (October) (2008) e1–e3.

[30] S. Papafagkou, L. Haimovic, E. Gonzalez, L. Barrett, E. Cirincione, Hepatic artery aneurysm erosion into the stomach: an unusual cause of gastrointestinal bleeding, J. Emerg. Med. (July) (2010) 32–34.

[31] C.-H. Wu, L.-J. Wang, Y.-C. Wong, S.-C. Hung, Y.-C. Liu, Y.-P. Hsu, Hepatobiliary and Pancreatic Hemobilia caused by bleeding from hepatic artery aneurysms, J. Gastroenterol. Hepatol. (March) (2010) 648.

[32] M. Huisman, M.A.A.J. van den Bosch, E. Moonweer, I.Q. Molenar, J.A. van Herwaarden, Endovascular treatment of a patient with aneurysm of the proper hepatic artery and a duodenal fistula, J. Vasc. Surg. (March) (2011) 814–817.

[33] Y. Kobayashi, M. Iwasa, R. Sugimoto, R. Mifujii-Moroka, N. Fujita, Y. Takei, Hepatobiliary and Pancreatic Duodenal bleeding from a hepatic artery aneurysm, J. Gastroenterol. Hepatol. (August) (2013) 1256.

[34] S. Komatsu, T. Iwasaki, N. Nishio, A. Toyokawa, K. Teramura, Hemobilia associated with a giant thrombosed aneurysm of the hepatic artery requiring hepatectomy, Ann. Vasc. Surg. 1934 (November) (2014) e13–1934 (e17).

[35] R.A. Agha, A.J. Fowler, A. Saeta, I. Barai, S. Rajmohan, D.P. Orgill, et al., The SCARE statement: consensus-based surgical case report guidelines, Int. J. Surg. (October) (2016) 180–186.

[36] O. Ozbek, Y. Solak, A. Batur, A. Gaipov, Hepatic pseudoaneurism secondary to blunt trauma successfully treated with percutaneous transhepatic intervention, BMJ Case Rep. (January) (2012).

[37] X. Luo, S. Tan, J. Wang, C. Qian, Upper gastrointestinal hemorrhage from hepatic artery pseudoaneurism secondary to trauma: a case report, Med. Princ. Pract. (January) (2010) 493–495.

[38] A.P. Schouten van der Velden, W.M.J. de Ruijter, C.M.M. Jansen, L.J. Schulzke Kool, E.C.T.H. Tan, Hemobilia as a late complication after blunt abdominal trauma: a case report and review of the literature, J. Emerg. Med. (November) (2010) 592–595.

[39] C. Adam, F. Güney, C. Cinar, H. Bozkaya, S. Baş, E. Akbal, et al., An unusual case of severe upper gastrointestinal bleeding treated using an endovascular technique, Ann. Surg. (December) (2014) E367–E369.

[40] D. Sommacale, Preservation of the arterial vascularisation after hepatic artery pseudoaneurysm following orthotopic liver transplantation: long-term results, Ann. Transplant. (January) (2014) 346–352.

[41] R.T. Poon, H. Tuen, C. Yeung, GI hemorrhage from fistula between right hepatic artery pseudoaneurysm and the duodenum secondary to acute cholecystitis, Gastrointest. Endosc. (April) (2000) 491–493.

[42] S.S. Saluja, S. Ray, M.S. Gulati, S. Pal, P. Sahni, T.K. Chattopadhyay, Acute cholecystitis with massive upper gastrointestinal bleed: a case report and review of the literature, BMC Gastroenterol. 12 (January) (2012).

[43] B. Xie, H. Liu, W. Wu, Recurrent lower gastrointestinal bleeding: diagnosis and therapy, Gastroenterology (January) (2011) e9–10.

[44] A. Gopanpalikar, P. Rathi, P. Sawant, R. Gupta, S. Dhadphale, H.L. Deshmukh, Hepatic artery pseudoaneurysm associated with amebic liver abscess: presenting as upper GI hemorrhage, Ann. J. Gastroenterol. (August) (1997) 1391–1393.

[45] R. Tétéreau, H. Beji, L. Henry, P.-J. Valette, F. Pilleul, Arterial splanchic aneurysms: presentation, treatment and outcome in 112 patients, Diagn. Interv. Imaging 17 (January) (2016) 81–90.

[46] K.S. Baker, J. Tinsado, S.R. Cho, M.C. Beachley, Splanchnic artery aneurysms and pseudoaneurysms: transcatheter embolization, Radiology (April) (1987) 135–139.

[47] J.M. Artigas, M. Martí, J.A. Soto, H. Esteban, I. Pinilla, E. Guillén, Multidetector CT angiography for acute gastrointestinal bleeding: technique and findings, Radiographics (September) (2013) 1453–1470.

[48] M. Mille, J. Huber, R. Wlasak, T. Engelhardt, Y. Hillner, H. Kriechling, et al., Prophylactic transcatheter arterial embolization after successful endoscopic hemostasis in the management of bleeding duodenal ulcer, J. Clin. Gastroenterol. (October) (2015) 738–745.

[49] J.O. Balzer, A. Thalhammer, T.J. Vogl, C. Schick, R.G. Ritter, Hepatic artery aneurysm: treatment options, Eur. Radiol. 1 (January) (2004) 157–159.

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