IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 5 Ver. 2 (May. 2018), PP 03-08
www.iosrjournals.org

Contemporary techniques for Embolization of splenic artery aneurysm maintaining parent artery

Bilal Ahmad Hijazi, Hai-Bin Shi*, Sheng Liu.
**Department of Interventional Radiology, Jiangsu province Hospital*
The First affiliated Hospital Nanjing Medical University
**Corresponding Author: Hai-Bin Shi*
Email:shihb@vip.sina.com

Abstract: *Splenic artery aneurysm (SAA) is an uncommon and difficult diagnosis. SAA is more common in females. Only 20% of SAA is symptomatic and may present as a rupture. A ruptured SAA is rare and is associated with a 25% mortality rate if untreated. Thus, Surgeons must be prepared to perform open procedures to reduce mortality rates. Endovascular management is currently considered the optimal treatment of SAAs with its contemporary techniques. However, careful monitoring and follow-up is needed after embolization as rapid recanalization of the SAA may possibly occur, Various endovascular approaches for the treatment of splenic artery aneurysms while maintaining the flow of the parent artery has become a reliable procedure with high success rate up to 98% preventing of spleen infarction and low peri-procedural morbidity.*

Keywords: *Aneurysm, Splenic artery, Embolization, Endovascular.*

Date of Submission: 17-04-2018 Date of acceptance: 05-05-2018

I. Introduction:

The Splenic artery is the third most common site of intra-abdominal aneurysms after aneurysms of the abdominal aorta and iliac arteries [(1)]. True prevalence is unknown, with estimates varying wide from 0.2% to as high as 10.4% [(2,3)].

Although, they were once thought to be rare, with wider use of cross-sectional imaging, Splenic artery aneurysms (SAA) are being diagnosed with increasing frequency as incidental findings [(4)].

The significance of splenic artery aneurysm lies within the potential risk for rupture and life threatening hemorrhage that happens in 10% of cases with a mortality rate of 10–25% in non-pregnant patients and up to 70% during pregnancy. [(5)]

A true aneurysm is completely different from pseudoaneurysm. In a true aneurysm, all the layers of the vessel are intact with a thinned and expanded wall [Fig.1] while, pseudoaneurysm or false aneurysm result from a tear within the vessel wall, i.e. , muscularis propria and the adventitia with subsequent formation of a peri-arterial hematoma and is typically secondary to a local inflammatory process like in pancreatitis.[(6)]Till date, the literature pointed the presence of some risk factors correlating to the development of SAA such as fibro-muscular dysplasia, collagen vascular diseases, female gender, history of multiple pregnancies and portal hypertension.[(7)]

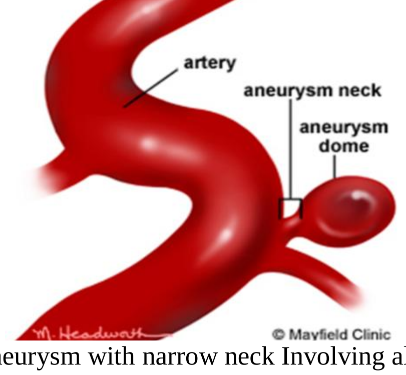

Fig.1. Saccular true aneurysm with narrow neck Involving all layers of the vessel.

II. Incidence:

Beaussier[8]reported the primary case of SAA in 1770 in an autopsy. These comparatively uncommon lesions are being incidentally detected with larger frequency as a result of the widespread use of high-resolution imaging techniques. True prevalence data are wide varying from 0.098% in a massive autopsy series to 0.78% in a study of 3,600 arteriogram to 10.4% in an autopsy series on patients aged 60 years or older with special attention given to the splenic artery [9,10,11]. SAA is four times more common in women. however, it is three times more likely to rupture in men [12].

III. Pathophysiology:

Although the precise etiology of SAA remains unknown, it's been related to Systemic hypertension, portal hypertension, liver cirrhosis, liver transplantation, and multiple pregnancies [13,14]. Less remarkable associated conditions embrace arterial fibro dysplasia, arteritis, arteriosclerosis, α1-antitrypsin deficiency, and chronic inflammatory processes [13]. In contrast to aneurysms of larger vessels like the aorta, atherosclerosis isn't thought to be the underlying cause. Histopathologically, 80–99% of SAA reveal atherosclerosis; but, this is most likely a secondary method occurring from primary degeneration of the media [15, 16, 17].

True aneurysms of the splenic artery are usually smaller than 3 cm, starting from 2 to9 cm in one series of nine cases [17]. They could be multiple and are most typically set within the distal portion of the artery, though they will arise from different segments of the splenic artery. Peripheral calcification is common; Dave et al, [17] reported that 80% show atherosclerotic changes along with calcification, and mural clot could also be present.

IV. Clinical Presentation:

Most SAAs are found incidentally at the time of initial presentation throughout abdominal imaging examination for unrelated disorders. Clinically, most SAAs are asymptomatic. A large series from the Mayo clinic showed that 97.5% of patients with non-ruptured SAAs were asymptomatic [13]. Early reports of SAA proposed that chances of rupture are 10% [18]. However, recent information recommends rupture rates are nearer to 2–3% [19,20]. The frequency of rupture is higher with liver transplantation, portal hypertension, and pregnancy [21]. Typical clinical manifestation of ruptured SAA associated with abdominal pain, hemodynamic instability, and gastrointestinal hemorrhage. Sudden sever pain of the left hypochondrium sometimes indicates rupture has occurred [21]. There may be spontaneous stabilization but consequent circulatory collapse. This is often termed as “double rupture” phenomenon, whereby initial bleeding into the lesser sac, but followed by flooding into the peritoneal cavity [22].

V. Diagnosis:

Direct catheter angiography has been assumed to be the golden standard for diagnosis of SAA and pseudoaneurysm. The high spatial resolution of digital subtraction angiography (DSA) permits clear imaging of small vessels, and treatment is performed accordingly. However, this procedure needs arterial puncture, keeping in view its associated complication. The use of gray-scale and Doppler ultrasonography for the diagnosis of SAAs has been reported [23]. This technique is operator-dependent and will be restricted due to obesity, shadowing from bowel gas, and arteriosclerosis[24]. Additionally, small lesions are lost on ultrasonography owing to restricted spatial resolution[25]. MRI and MRA techniques have additionally been represented,with enhancements in spatial resolution compared to ultrasonography [25]. Limitations of MRI enclosed its contraindication in patients with pacemakers or other aneurysm clips, those littered with claustrophobia, and those unable to carry their breath[25]. With current MDCT technology, patients are imaged quickly throughout the arterial phase, which is important for detecting these lesions [Fig.2]. Some contraindications to CT angiography include renal failure, poor IV access, and allergic reaction to contrast medium.

Current generation MDCT scanners are capable of high spatial resolution and short breath-hold times. The high temporal resolution facilitates the acquisition of data throughout a strictly arterial phase and results in decreased motion artifact.

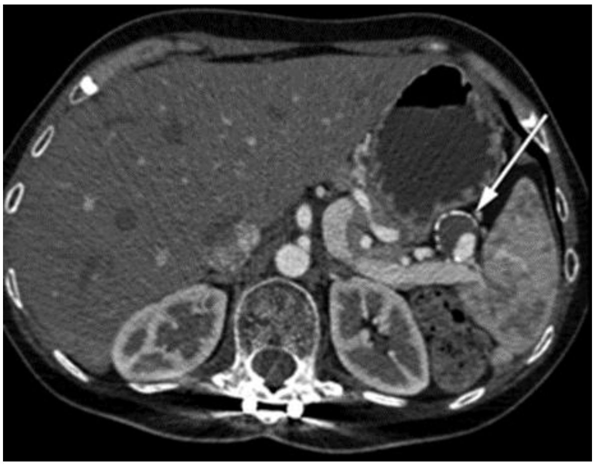

Fig. 2. 52-year-old female with history of Gaucher's disease, incidentally discovered splenic artery aneurysm on CT. Axial arterial phase contrast-enhanced CT scan shows 2.2-cm, partially thrombosed, peripherally calcified aneurysm (arrow) arising from distal splenic artery.

VI. Treatment and Management:

Ruptured, symptomatic SAAs and those in pregnant women need urgent treatment. Enlarging or those bigger than 2 cm in diameter SAAs have significant indication for intervention, though these criteria aren't absolute. Patients with portal hypertension or waiting for liver transplantation to be treated additionally[26]. Patient`s medical condition and age factor may play a significant role in the treatment option. Most vascular surgeons would think about appropriate elective intervention for asymptomatic patients with aneurysms having diameter more than 2 cm while the surgical risk is assumed to be low. If one estimates the incidence of rupture to be 2% with a death rate approximately of 25% rupture has occurred, operative mortality rates must be lower than 0.5% to justify elective surgical procedure [26].

Laparoscopic repair of SAAs by clipping or exclusion has been reported; intra-operative ultrasound is believed to be a very important adjunct to this procedure [27]. Laparoscopic occlusion combined with coil embolization has been projected as a treatment for aberrant SAAs located within the retro-pancreatic position, that traditional procedure would be exceptionally difficult [28,29].

Endovascular Therapy:

The endovascular occlusion of SAAs has been used recently with remarkable success. Treatment choices include stent-grafting, particularly for saccular lesions of the middle splenic artery. Coil embolization of the splenic artery each proximal and distal to the aneurysm itself, thereby effectively trapping the lesion. Alternative choices include embolization of the aneurysm sac with coils or n-butyl cyanoacrylate glue or each modality at the same time or occlusion of the lesion with percutaneous or open thrombin injection. [28,30]. There has been some concern relating to splenic infarction and pancreatitis once embolization of very distal splenic artery lesions has been performed. [28, 31, 32]

Interventional therapy, including stent implantation for embolization, is now days thought to be the treatment of choice for SAAs. Stent implantation thus straddling of the aneurysm, preserving the splenic artery blood flow[33]. numerous embolization techniques exist, i.e. isolation technique consists of embolizing each the inflow and the outflow arteries of the aneurysm. To avoid total splenic infarction, this strategy could also be used solely in presence of collateral arteries, that ensure the splenic flow and can't be applied to aneurysms placed at the origin of the splenic artery. As an alternative, in the packing technique, a framework with interlocking detachable coils is established, and the fibered coils or microcoils are packed within the aneurysm itself until there's no blood flow. A balloon catheter is employed to manage splenic arterial blood flow throughout the procedure. Finally, a mixture of the isolation and packing techniques is employed if there are intra-splenic branches that originate from the aneurysm, so as to prevent recanalization due to retrograde back flowing from the vessels of the splenic side. The primary technical success rate of transcatheter embolization is 88%, reaching 100% on a second treatment [33]. the foremost frequent complication is the post embolization syndrome, like transient fever and pain, resolvable in little time with symptomatic treatment in most cases[33,34]. Less frequent possible complications include transient elevation of pancreatic enzymes, splenic infarction, infection, abscess, and rarely, the rupture of a pseudoaneurysm [34,35]. Nevertheless, the majority of the data in the literature concerns the treatment of SAAs of a diameter of lower than 40 mm, whereas the optimum treatment of giant SAAs isn't well established. giant SAAs area rare entity, and only some cases treated with transcatheter embolization are reported in the literature, all with the positive result [36,37].

Bare stents, coils, and combined occlusive agents: Before the development of coated stents, one way to preserve the parent artery was to coil the aneurysm itself. Implantation of a bare stent may be performed before or once the coiling procedure is completed to shield the parent vessel and facilitate to maintain its patency. Tulsyan et al, used similar techniques to treat visceral aneurysms in which a mix of n-BCA and coils were used before stent placement[38]. The development of newer stents with high metallic coverage is additionally being considered for the exclusion of aneurysmal sacs.

A self-expanding bare stent , Cardiatis multilayer stent [Cardiatis, Isnes, Belgium] has been approved in Europe in recent years for the treatment of aneurysms within the central nervous system and peripheral vessels. It's manufactured from phynox, and its style consists of a three-dimensional braided tube manufactured from two interconnected layers. The multilayer configuration in conjunction with the three-dimensional geometry confers a decrease in velocity within the aneurysmal sac whereas maintaining laminar flow within the main artery and surrounding branches. Recently, Balderi et al, reported a case of hepatic artery aneurysm treatment using this stent. Therefore, surmise that visceral aneurysms, as well as SAAs, will be treated with such a tool because a wide range of diameters is available from 5 to 20 millimeters and from 30 to 120 millimeters in length [39].

Covered stents: SAA exclusion with preservation of the parent artery is possible using coated stents. The first limiting issue of this approach is that the tortuosity of the SA, which might prevent the progression of the guiding catheter or the guiding sheath to an appropriate level of deployment. However, recent developments in coronary artery stent grafts with low profiles provide new possibilities if the diameter of the SA is adequate. additionally, to the preservation of parent vessel patency, exclusion of the SAA with a stent graft has the benefit of decreasing computed tomographic artifacts, that are additional prominent with platinum coils or n-BCA with radio-opaque agents.

Percutaneous approach: In cases of difficult vascular access to the splenic artery, whether it's concerning its size, location or vascular anatomy preventing an endovascular approach, one will consider accessing the aneurysmal sac directly through a percutaneous approach. This may be performed either under computed tomographic or ultrasonographic guidance. The aneurysm will then be occluded with coils, thrombin, n-BCA, or Onyx. Complications similar to parent vessel thrombosis and distal embolization alongside recanalization of the lesion has also been reported [40].

Ultrasound-guided percutaneous thrombin injection seems to be a viable technique for treating failed endovascular interventions or maybe an alternative to initial endovascular treatment [41]. Actually, this method is similar to thrombin injections for femoral artery pseudoaneurysms, were ultrasound or CT guidance or both are used to facilitate delivering thrombin to the nidus of an aneurysm, therefore facilitating thrombosis. This is often particularly applicable to saccular aneurysms with a narrow neck arising from the parent vessel. It is true for saccular aneurysms treated by coil or thrombin embolization Reported of reperfusion and even rupture once successful embolization been achieved, this support that a thrombosed aneurysm might not represent the definitive treatment in all cases [41,42].

Aneurysm coiling. Classic transcatheter coil embolization with dense packing of the aneurysmal sac is another choice used to maintain native circulation [Fig.3]. The utilization of detachable coils permits a lot of precise deployment. Ikeda et al, used this approach to treat 22 visceral aneurysms, and a high success rate was achieved in SAAs [43]. However, they also represented the risk of coil migration or dislocation once using a similar technique for the treatment of renal artery aneurysms. To prevent the migration of the coil, detachable 3D coil which is spherical in shape and so called "framing coils" just like used in intracranial aneurysm is packed to create a frame to achieve higher packing density during further filling of the aneurysm with 2D coils which form coin shape roll, this method will reduce aneurysmal perfusion and prevent migration of the coil [44]. This approach is appropriate for patients with saccular aneurysms Also, using liquid occlusive agents like n-BCA or onyx is another fashion to treat the lesion. Ethyl vinyl alcohol copolymer (Onyx) has currently become popular for off-label use in peripheral interventions. This is due to its capability to supply better management of the embolization session, permitting longer injection rates due to its non-adhesive properties.

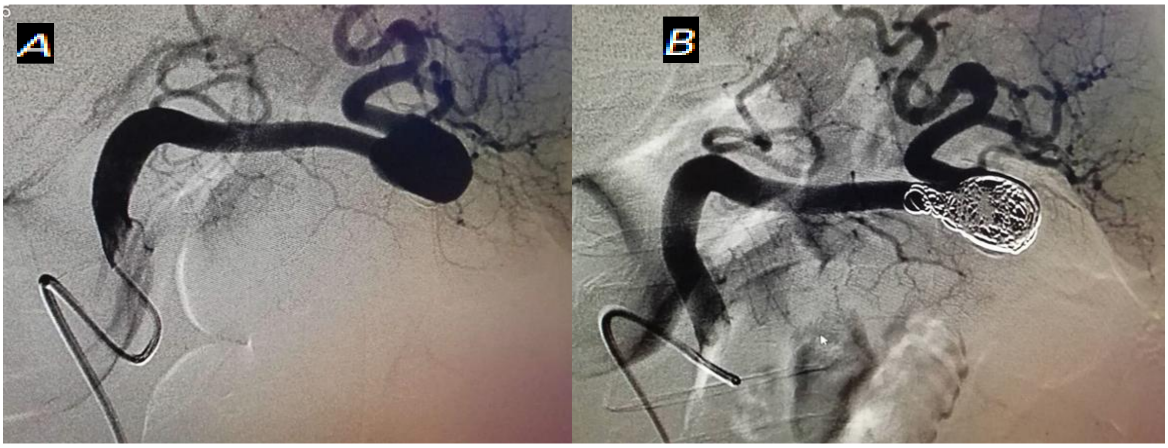

Fig.3.(A) Digital Subtraction Angiography (DSA) of the splenic artery of 57-year-old male shows 24mm x 18mm saccular aneurysm lying distally near to the spleen ,**(B)** DSA post Embolization of the aneurysmal sac packed with coils.

Results of different treatment options for splenic artery aneurysms:

The results of open operative therapy are dependent on whether the procedure is an elective or emergency one, depending on the anatomical complexity of the lesion and the nature of the specified repair keeping in view the associated complications. Elective procedures have considerably lower peri-operative morbidity and mortality compared to the emergency techniques for ruptured aneurysms that carries death rate higher than 50% in several reported series[45].

Various endovascular embolization approach such as stent graft, glue, coil and percutaneous ultrasound guided thrombin injection of SAAs are suitable and have shown high success rate ranges from 81% to 98%, which results in keeping parent artery flow intact. Although some studies showed that the presence of hemodynamic instability shouldn't preclude endovascular management [46,47].

End-organ ischemia is a particular concern with regard to endovascular repair. Direct complications may result from this selection of treatment such as arterial dissection, acute thrombosis, or embolization to non-target tissues, or inadequate collateral circulation after deliberate vessel occlusion. Though initial technical success rates with an endovascular procedure for treating SAAs approach 100%, the long-term success is still under further consideration [48].

VII. Conclusion:

There are multiple modalities for the treatment of the SAAs. Various endovascular approaches for the treatment of splenic artery aneurysms while maintaining the flow of the parent artery has become a reliable procedure with high technical success and low peri-procedural morbidity. Treatment choices are dictated by the anatomic location, the age of the patient, and also the physiologic and clinical conditions.

References:

[1]. Trastek VF, Pairolero PC, Joyce JW, Hollier LH, Bernatz PE. Splenic artery aneurysms. Surgery 1982; 91:694–699.
[2]. Stanley JC, Thomas NW, Fry WJ. Splanchnic artery aneurysms. Arch Surg 1970; 101:689–697.
[3]. Bedford PD, Lodge B. Aneurysm of the splenic artery. Gut 1960; 1:312–320.
[4]. Rokke O, Sondenaa K, Amundsen S, Bjerke-Larssen T, Jensen D. The diagnosis and management of splanchnic artery aneurysms. ScandJ Gastroenterol 1996; 31:737–743.
[5]. Manian U, Badri H, Coyne P, Nice C, Ashour H, Bhattacharya V. Endovascular treatment of a ruptured splenic artery aneurysm using amplatzer ((R)) vascular plug. Int J Biomed Sci: IJBS 2009;5(1):81–4.
[6]. Cordova AC, Sumpio BE. Visceral artery aneurysms and pseudoaneurysms should they all be managed by endovascular techniques? Ann Vasc Dis 2013;6(4):687–93.
[7]. Mees B, Robinson D, Verhagen H, Chuen J. Non-aortic aneurysms – natural history and recommendations for referral and treatment. Austr Fam Physician 2013;42(6):370–4.
[8]. Beaussier M. Sur un aneurisme de l'artèrespléniquedont les parois se sont ossifies. J Med Clin Pharm 32:157 ;1770 .
[9]. Stanley JC, Thomas NW, Fry WJ. Splanchnic artery aneurysms. Arch Surg 1970; 101:689–697.
[10]. Bedford PD, Lodge B. Aneurysm of the splenic artery Gut 1960; 1:312–320.
[11]. Moore SW, Guida PM, Schumacher HW. Splenic artery aneurysm. Bull SocIntChir 1970; 29:210–218.
[12]. Abbas MA, Stone WM, Fowl RJ, et al. Splenic artery aneurysms: two decades experience at Mayo clinic. Ann VascSurg 2002; 16:442–449.
[13]. Abbas MA, Stone WM, Fowl RJ, et al. Splenic artery aneurysms: two decades experience at Mayo clinic. Ann VascSurg 2002; 16:442–449.
[14]. Selo-Ojeme DO, Welch CC. Review: spontaneous rupture of splenic artery aneurysm in pregnancy. Eur J ObstetGynecolReprodBiol 2003; 109:124–127.

[15]. Trastek VF, Pairolero PC, Joyce JW, Hollier LH, Bernatz PE. Splenic artery aneurysms. Surgery 1982; 91:694–699.
[16]. Rokke O, Sondenaa K, Amundsen S, Bjerke-Larssen T, Jensen D. The diagnosis and management of splanchnic artery aneurysms. Scand J Gastroenterol 1996; 31:737–743.
[17]. Dave SP, Reis ED, Hossain A, Taub PJ, Kerstein MD, Hollier LH. Splenic artery aneurysm in the 1990s. Ann VascSurg 2000; 14:223–229.
[18]. Busuttil RW, Brin BJ. The diagnosis and management of visceral artery aneurysms. Surgery 1980; 88:619–624 .
[19]. Stanley JC, Wakefield TW, Graham LM, Whitehouse WM Jr, Zelenock GB, Lindenauer SM. Clinical importance and management of splanchnic artery aneurysms. J VascSurg 1986; 3:836–840.
[20]. Trastek VF, Pairolero PC, Bernatz PE. Splenic artery aneurysms. World J Surg. 1985; 9:378–383
[21]. Mattar SG, Lumsden AB. The management of splenic artery aneurysms: experience with 23 cases. Am J Surg 1995; 169:580–584 .
[22]. Remy D, Linder JL. Splenic aneurysm rupture: case report and review of the literature. Acta ChirBelg 1993; 93:54–57.
[23]. Derchi LE, Biggi E, Cicio GR, Bertoglio C, Neumaier CE. Aneurysms of the splenic artery: noninvasive diagnosis by pulsed Doppler sonography. J Ultrasound Med 1984; 3:41–44.
[24]. Lin CT, Chiang CW, Hsieh HC. Extrasplenic pseudoaneurysm.: the role of color flow Doppler ultrasound in diagnosis. Jpn Heart J 1999; 40:365–368.
[25]. Pilleul F, Beuf O. Diagnosis of splanchnic artery aneurysms and pseudoaneurysms, with special reference to contrast-enhanced 3D magnetic resonance angiography: a review. Acta Radiol 2004; 45:702–708.
[26]. Nosher JL, Chung J, Brevetti LS, et al: Visceral and renal artery aneurysms: a pictorial essay on endovascular therapy. Radiographics 2006; 26:1687-1704.
[27]. Arca MJ, Gagner M, Heniford BT, et al: Splenic artery aneurysms: methods of laparoscopic repair. J VascSurg 1999; 30:184-188.
[28]. Alsheikhly A.S.: Ruptured True Aneurysm of the Splenic Artery: A Rare Cause of Haemoperitoneum: The Middle East Journal of Trauma and Emergency medicine 2008;8:197-199.
[29]. Mastracci TM, Cadeddu M, Colopinto RF, Cina C: A minimally invasive approach to the treatment of aberrant splenic artery aneurysms: a report of two cases. J VascSurg 2005; 41:1053-1057.
[30]. Huang IH, Zuckerman DA, Matthews JB: Occlusion of a giant splenic artery pseudoaneurysm with percutaneous thrombin-collagen injection. J VascSurg 2004; 40:574-577.
[31]. Saltzberg SS, Maldonado TS, Lamparello PJ, et al: Is endovascular therapy the preferred treatment for all visceral artery aneurysms?. Ann VascSurg 2005; 19:507-515.
[32]. Carroccio A, Jacobs TS, Faries P, et al: Endovascular treatment of visceral artery aneurysms. VascEndovascSurg 2007; 41:373-382.
[33]. S. Yamamoto, S. Hirota, H. Maeda et al., "Transcatheter coil embolization of splenic artery aneurysm," CardioVascular and Interventional Radiology, vol. 31, no. 3, pp. 527–534, 2008.
[34]. E. N. Brountzos, K. Vagenas, S. C. Apostolopoulou, I. Panagiotou, D. Lymberopoulou, and D. A. Kelekis, "Pancreatitis-associated splenic artery pseudoaneurysm: endovascular treatment with self-expandable stent-grafts," CardioVascular and Interventional Radiology, vol. 26, no. 1, pp. 88–91, 2003.
[35]. D. C. Madoff, A. Denys, M. J. Wallace et al., "Splenic arterial interventions: anatomy, indications, technical considerations, and potential complications," Radiographics, vol. 25, pp. S191–S211, 2005.
[36]. R. K. Hung, C. Loh, and L. Goldstein, "Selective use of electrolytic detachable and fibered coils to embolize a wide-neck giant splenic artery pseudoaneurysm," Journal of Vascular Surgery, vol. 41, no. 5, pp. 889–892, 2005.
[37]. R. Pappy, C. Sech, and T. A. Hennebry, "Giant splenic artery aneurysm: managed in the cardiovascular catheterization laboratory using the modified neck remodeling technique," Catheterization and Cardiovascular Interventions, vol. 76, no. 4, pp. 590–594, 2010.
[38]. Tulsyan N, Kashyap VS, Greenberg KR, et al. The endovascular management of visceral artery aneurysms and pseudoaneurysms. J Vasc Surg. 2007;45:276-283.
[39]. Balderi A, Antonietti A, Pedrazzini, F, et al. Treatment of hepatic artery aneurysm by endovascular exclusion using the multilayer cardiatis stent. Cardiovasc InterventRadiol. 2010;33:1282-1286.
[40]. Pezzullo JA, Dupuy DE, Cronan JJ. Percutaneous injection of thrombin for the treatment of pseudoaneurysms after catheterization: an alternative to sonographically guided compression. AJR Am J Roentgenol. 2000;175:1035- 1040.
[41]. Szopinski P, Ciostek P, Pleban E, et al: Percutaneous thrombin injection to complete SMA pseudoaneurysm exclusion after failing of endograft placement. Cardiovasc InterventRadiol 2005; 28:509-514.
[42]. Carr SC, Pearce WH, Vogelzang RL, et al: Current management of visceral artery aneurysms. Surgery 1996; 120:627-633.
[43]. Ikeda O, Tamura Y, Nakasone Y, et al. Nonoperative management of unruptured visceral artery aneurysms: treatment by transcatheter coil embolization. J Vasc Surg. 2008;47:1212-1219.
[44]. Guglielmi G, Viñuela F, Briganti F, Duckwiler G. Carotid-cavernous fistula caused by a ruptured intracavernous aneurysm: endovascular treatment by electro thrombosis with detachable coils. J Neurosurg. 1992;31:591–6.
[45]. Pulli R, Dorigo W, Troisi N, et al: Surgical treatment of visceral artery aneurysms: a 25year experience. J VascSurg 2008; 48:334-342.
[46]. Gabelmann A, Gorich J, Merkle EM: Endovascular treatment of visceral artery aneurysms. J EndovascTher 2002; 9:38-47.
[47]. Salam TA, Lumsden AB, Martin LG, Smith 3rd RB: Nonoperative management of visceral aneurysms and pseudoaneurysms. Am J Surg 1992; 164:215-219.
[48]. Sachdev U, Baril DT, Ellozy SH, et al: Management of aneurysms involving branches of the celiac and superior mesenteric arteries: a comparison of surgical and endovascular therapy. J VascSurg 2006; 44:718-724.

Bilal Ahmad Hijazi et al, "Contemporary techniques for Embolization of splenic artery aneurysm maintaining parent artery."IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 5, 2018, pp 03-08,Corresponding Author: Hai-Bin Shi
Email: shihb@vip.sina.com