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First Report of Total Laparoscopic Splenic Aneurysm Resection and Splenic Artery Reconstruction

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Abstract

The incidence of splenic aneurysms ranks third among visceral aneurysms. Once diagnosed, the splenic aneurysms should be treated properly. The majority of patients receive interventional therapy, which is difficult to preserve the spleen. We presented a case of splenic aneurysm resection and splenic artery anastomosis performed completely by laparoscopic surgery. The operation went smoothly with the spleen successfully preserved. The patient reported no discomfort or complications after the surgery. A review of intensive CT at 3 months post-operation revealed a normal spleen size and shape as well as patent blood flow at the anastomosis. Laparoscopic surgery have the advantage of exploring the entire abdominal cavity, clearly observing the situation around the aneurysm, and peeling the tumour from the splenic artery for ligation without damaging the spleen; however, laparoscopic surgery requires a skilful laparoscopic technique.

Keywords: Splenic aneurysm; Laparoscopy; Splenic aneurysm resection; Splenic artery reconstruction

Introduction

The patient, a 37-year-old man, was admitted to the hospital with a left adrenal adenoma discovered by a health examination 6 weeks prior and a splenic aneurysm demonstrated by a Computed Tomography (CT) scan at the same time. He had a history of hypertension for 18 years, with the highest blood pressure reaching 180/120 mmHg (1 mmHg = 0.133 kPa). After administration of controlled-release nifedipine tablets, the blood pressure was stabilized at 140/90 mmHg. He was diagnosed with diabetes for 3 years without systematic treatment, and the blood glucose level varied in the range of 8 mmol/L to 10 mmol/L. Physical examination: General condition with no obvious abnormalities of the heart, lungs or abdomen; bilateral kidneys were not palpated; and no sacral pain in the kidney areas, no bulges in the suprapubic bladder area, and no abnormalities in the external genitalia. Preoperative contrast-enhanced urinary MRI (Figure 1): There was a left adrenal nodule with a size of 2.3 cm × 1.9 cm, T1WI low signal intensity, in-phase/anti-phase decreased signal intensity, T2WI slightly high signal intensity, and DWI high signal intensity. The post-contrast arterial phase image showed significant enhancement, and the delay phase showed circular enhancement, considered as sebaceous adenoma; local nodular enlargement of the splenic artery near the inside of the spleen was identified, approximately 1.9 cm × 1.4 cm in size. The plain scan indicated a flow-shadow signal, and the post-contrast image showed a prominent highlight signal, similar to the splenic artery signal, considered a splenic aneurysm. Preoperative blood tests, blood biochemical tests, and cardiopulmonary function examinations were performed routinely. No obvious abnormalities were reported with a normal level of adrenalin. After the patient was admitted to the hospital, a Multidisciplinary Team (MDT) discussion was organized by the urinary department, interventional department, vascular surgery department, imaging department, and anesthesia department after patient admission. Based on the patient's medical history and auxiliary examination results, the diagnosis of left adrenal adenoma and splenic aneurysm was confirmed, with indications for surgery. Given that the splenic aneurysm was a benign lesion and was on the same side as the left adrenal tumor, a decision was made to perform a surgical operation at the same time, and a spleen-preserving surgical scheme was adopted.

Materials and Methods

A 3D laparoscopic resection of the left adrenal tumour and splenic aneurysm + splenic artery anastomosis was performed under general anesthesia. The patient took a right 70° inclined supine

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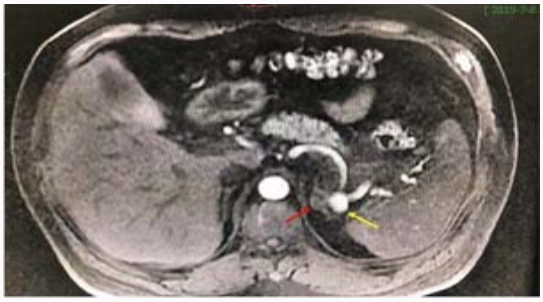

Figure 1: Preoperative post-contrast MR indicated that the left adrenal adenoma was adjacent to the splenic aneurysm (red arrow: Adrenal adenoma; yellow arrow: Splenic aneurysm).

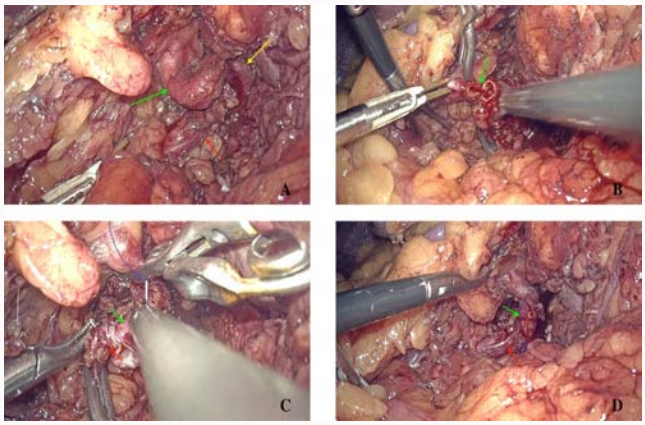

Figure 2: Resection and anastomosis reconstruction of the splenic artery during surgery. (A) Dissociation of the splenic aneurysm. (B) Resection of the distal part of the aneurysm. (C) Suturing of the splenic artery. (D) Completion of the anastomosis (red arrow: proximal part of the splenic aneurysm; green arrow: distal part of the splenic aneurysm; yellow arrow: body of the splenic aneurysm).

position. Laparoscopic trocar position: 2 cm above the umbilicus for the 12 mm trocar, which was the lens hole; 5 mm and 12 mm trocars were placed as the main knife operation holes below the inferior costal margin of the midline of the left clavicle and at the midpoint of the umbilical and anterior superior iliac spine lines; and a 10 mm trocar was placed on the plane of the axillary midline as an auxiliary hole for the assistant, and the position was diamond-shaped with the other three holes. During the operation, the left adrenal tumor was observed in the lateral branch, was approximately 2.5 cm in size, and was slightly adhered to the surrounding tissue. During progressive adenoma resection, no significant fluctuation in blood pressure was observed. Subsequently, the splenic artery was discovered near the renal hilum on the inside of the spleen, combined with preoperative CT positioning. The assistant provoked the spleen through the auxiliary hole. The splenic aneurysm was located 4 cm near the spleen, and the tumour was approximately 2.0 cm in size with obvious vascular fluctuations. The splenic aneurysm and its distal and proximal 2 cm normal splenic arteries were completely separated, and the proximal and distal ends of the splenic artery were blocked with vascular blocking clips. The aneurysm sacs became soft. Incise the tumour wall, the normal splenic artery boundaries were identified under direct vision, and the aneurysm was completely removed with scissors. The normal splenic artery wall was anatomized with 5-0 vessel lines, and the vessel cavity was flushed with heparin saline to prevent thrombosis. After the anastomosis, the vascular blocking clip was released, and the splenic artery was filled well without bleeding (Figure 2). The operation time was 2 h and 10 min, the arterial occlusion time was 25 min, and the intraoperative blood loss was 50 ml.

Results

Postoperative pathological examination showed [1] macroscopic observation (Figure 3): Adrenal glands and surrounding fat, nodular masses within the adrenal gland, approximately 2.3 cm × 2.0 cm × 1.5 cm in size; a section of blood vessel, 2.0 cm in length and 0.5 cm in diameter, with a tumour-like bulge on the vessel wall, approximately 1.7 cm × 0.5 cm × 0.5 cm in size [2]. The tumor cell cytoplasm was mostly transparent with no mitotic images or local protrusion of the capsule observed. There was no necrosis or vascular invasion, which was consistent with the adrenal adenoma; the local blood vessel wall budged locally, considering the gross morphology, which was consistent with the aneurysm. The patient reported no discomfort, no complications, and a normal body temperature. He resumed walking and eating on the first postoperative day and was discharged on the fourth postoperative day. The treatment cost was no more than 30,000 Yuan. A review of intensive CT at 3 months post-operation revealed patent blood flow at the anastomosis and a normal spleen size and shape (Figure 4).

Discussion

In August 2019, a case of splenic aneurysm resection with splenic artery anastomosis and reconstruction was completed under laparoscopy in the urology department of our hospital. The spleen was preserved, and the operation was a success. After a literature

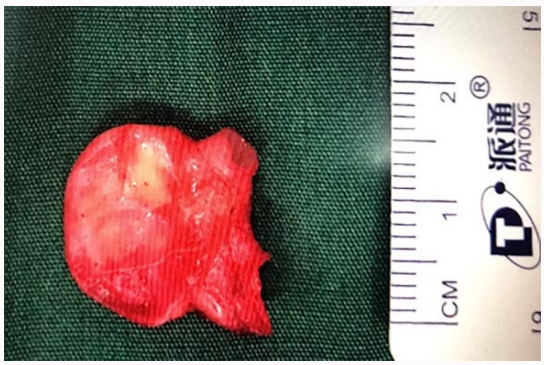

Figure 3: Resected splenic aneurysm.

Figures 4: Postoperative contrast-enhanced CT at 3 months post-operation indicating successful reconstruction of the splenic artery, with good filling and normal flow.

search, we confirmed it as the first case worldwide. We report the case as above.

Splenic artery aneurysms are the third most prevalent type of visceral aneurysms, only after abdominal aortic aneurysms and iliac aneurysms. The female: male incidence of splenic artery aneurysms is approximately 4:11. In recent years, the incidence of splenic aneurysms has increased substantially, with asymptomatic splenic aneurysms mostly discovered on health examination. However, symptomatic aneurysms are more life-threatening, among which hemorrhagic shock caused by the sudden rupture of the splenic artery is most common and most severe, especially for pregnant patients, with a mortality rate reaching as high as 70% [2]. Once a splenic aneurysm is diagnosed, it should be treated promptly. Indications for the surgical treatment of splenic aneurysms include (1) acute rupture or threaten of rupture; (2) a tumor larger than 2 cm in diameter or a progressive increase in tumor volume (reviewed every 2 months); (3) intentioned pregnancy or has been pregnant; (4) the diameter is less than 2 cm with a good general condition, while the patient requires treatment; (5) the tumor compresses adjacent anatomical structures, causing pathophysiological changes and resulting in symptoms; and (6) portal hypertension and regional portal hypertension [3].

It was the France surgeon Beaussier who first reported splenic aneurysms in 1770 and performed the first open splenic aneurysm resection worldwide [4]. Originally, splenic aneurysms were mostly treated by surgery. Because surgery corrects the hemodynamic abnormality caused by splenic aneurysms and avoids further tortuous and enlarged consequences, it has a relatively good long-term effect. Although traditional surgery can completely remove the lesion and achieve anastomosis under direct vision, reducing the risk of splenectomy due to the secluded position of the spleen artery and the complex surroundings such as the pancreas, stomach, colon, and adrenal glands, the incision has to be large enough for better exposure, which often leads to problems such as large trauma, a high incidence of complications, and slow recovery after surgery.

With the advancement of science and technology, most splenic aneurysms can currently be treated effectively with interventional embolism. Although interventional surgery is less invasive and the patient recovers quickly, this technique also has certain defects. (1) Patients undergoing embolization will suffer from different degrees of embolism syndrome, such as low fever, abdominal pain, lower back pain, and gastrointestinal symptoms. (2) Whether simple tumor lumen coil embolization or stent covering is performed, there is a possibility of insufficient blood supply to the spleen. In severe cases, this technique may even cause a large-scale acute spleen infarction, spleen abscess and major bleeding. (3) Potential aneurysm neck expansion and postoperative endoleak can lead to stent displacement, followed by failure of vascular lumen isolation and continuous pressure on the tumor wall to increase the risk of rupture. (4) If the spring coil fails to fulfill the tumor cavity during the operation, blood will enter the tumor cavity constantly, and the effect of complete isolation can hardly be achieved. (5) For patients with stent implantation, the risk of stent displacement and stent stenosis cannot be ignored, so the long-term application of aspirin and clopidogrel for antiplatelet therapy is essential, which results in higher costs, increased risk of bleeding and reduced quality of life [5].

During the last two decades, laparoscopic surgery has gradually become a mature minimally invasive surgical approach, demonstrating advantages such as limited trauma, reduced pain, fast postoperative recovery, few complications, and short hospitalization. Compared with traditional open surgery, it can more clearly and intuitively display the tissue relationship around the aneurysm, with a higher degree of refinement. However, there are few reports on the laparoscopic treatment of splenic aneurysms, which is mainly due to the higher requirements of the laparoscopic technique and experience of the surgeon. In 1997, Kawasaik et al. [6] reported the first case of successful laparoscopic aneurysm repair [6]. Under laparoscopy, a flake intestinal clamp was placed on the base of the splenic aneurysm, and an endovascular stapler was used for repair. The nails were arranged parallel to the longitudinal axis of the splenic artery without tumor incision, as a result of which the cystic cavity was completely separated from the splenic artery. This case was the first domestic and foreign 3D laparoscopic splenic aneurysm resection and splenic artery reconstruction reported. The treatment was precisely the same as that of open surgery, which removed the lesion integrally under the premise of blocking the normal distal splenic artery and then anatomized and reconstructed the splenic arteries under laparoscopy to restore the integrity of the vascular cavity. Finally, the vascular blocking clip was released, and the patency of anastomotic blood flow was assessed directly. Compared with the method reported by Kawasaik, the treatment in this case had more accurate anastomosis of blood vessels under direct vision while avoiding the retention of metal foreign bodies and reducing the cost of surgery. This surgical method is safe and reliable, with the advantages of limited trauma and rapid postoperative recovery, but it has certain challenges. The requirements for the laparoscopic vascular anastomosis technique and the surgical experience of the operator are relatively high, so it should be carried out prudently.

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Professor Nianzeng Xing contributed to the conception and design of the study, as well as final approval of the version to be submitted. Dr. Yajian Li and Feiya Yang play vital roles in the management of the patient. Dr. Yajian Li has also done literature research. Dr. Jianhua Du was in charge of literature research, drafting the article and revising it critically for important intellectual content.

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