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Robot-assisted splenectomy in a teenager with chronic autoimmune thrombocytopenia

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ABSTRACT

The use of the Da Vinci Xi system is gaining popularity among all surgical disciplines. A splenectomy is a treatment option for patients with hematological disorders and splenic lesions. The laparoscopic approach is nowadays the standard of care. Despite the initial controversy, recently it has been demonstrated the superiority of robotic splenectomy performed in "difficult" cases. We report, to our knowledge, the first case of robot-assisted splenectomy following embolization of the splenic artery in a 15-year-old patient with chronic immune thrombocytopenia, worsened by a severe cerebral sinus thrombosis, while being treated with eltrombopag and mycophenolate. Due to the need for a rapid rise in platelet counts and failure of several medical treatments, splenectomy was advocated. To raise the platelet count pre-operatively and minimize intraoperative bleeding, the embolization of the spleen artery was performed before the planned splenectomy. The intervention was carried on without any complication and at 1 year follow up the patient is in good clinical condition and has improved his neurological condition. We propose a robotic splenectomy following embolization of the splenic artery as a feasible and safe procedure. The advantages of the Da Vinci Xi system are highlighted especially in complex cases, requiring maximum precision.

1. Introduction

The use of the Da Vinci Xi system is gaining popularity among all surgical disciplines in different fields, since its FDA approval in July 2000 [1]. Its employment has been met with enthusiasm and new surgical indications have been developed. At the current estate of art, only a few surgical indications, have been proved to be effectively superior performed by robotic-assisted technology compared to other mini-invasive approaches. Of course, the main debate is about the elevated costs and prolonged operating times compared to the advantages brought by the DaVinci System. It's intuitive that, considering the pediatric population, which vary considerably in terms of size and corporal district, these numbers are impossible to obtain due to the intrinsic epidemiology of pediatric pathologies [2].

A splenectomy is a treatment option for patients with hematological disorders, lymphoproliferative disorders, splenic traumas, cystic or solid splenic lesions, sarcoidosis [3–6]. Since 1991, when the first laparoscopic splenectomy was reported by Delaitre and Maignien [7], this mini-invasive approach has been progressively successful, becoming nowadays the standard of care [6]. Relative contraindications to laparoscopic approach to splenectomy were individuated in coagulopathy, post-traumatic rupture, and severe portal hypertension, due to a minor control of possible bleeding compared to open surgery, and massive splenomegaly because of the steric occupation of the operating field [5]. The most common complications are postoperative hemorrhage, lung atelectasis and pancreatitis [6].

Both the contraindications to laparoscopic splenectomy and the evaluation of common complications made reasonable the possible superiority of robotic technology. Despite the initial controversy, re-

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cently it has been demonstrated the superiority of robotic splenectomy performed in "difficult" cases, determined by the Minimally Invasive Splenectomy Score (MISS score). The robotic approach shortened total operative time, reduced blood loss and number of conversions to open and obtained therapeutic success in all treated patients [8]. Giulianotti et al. reported the robotic total and partial splenectomy as a valid alternative to laparoscopic splenectomy, in particular in difficult and demanding cases [9].

In consideration of the lack of literature regarding robotic splenectomy in the pediatric population, we report, to our knowledge, the first case of robot-assisted splenectomy following embolization of the splenic artery in a 15-year-old patient with chronic immune thrombocytopenia, worsened by concomitant multiple comorbidities.

2. Case presentation

A 15-year-old boy with chronic immune thrombocytopenia developed a severe cerebral sinus thrombosis (CST) with secondary hemorrhagic infarcts while being treated with eltrombopag and mycophenolate. The thrombosis involved the right superior sagittal and transverse sinus, and the corresponding cortical veins and resulted in severe headache and left hemiplegia. Despite anticoagulation with heparin and conservative measures, the CST progressed into refractory cerebral hypertension, requiring endovascular thrombolysis and decompressive hemicraniectomy.

At admission his platelet count was normal and eltrombopag was discontinued because it has been associated with an increased thrombotic risk. Over the following weeks, despite several medical treatments were offered the platelet count decreased reaching values less than 10 x 10^9. The patient received high doses of intravenous immunoglobulins, dexamethasone, and cyclophosphamide without response. Due to the need for a rapid rise in platelet counts, splenectomy was preferred to other immunosuppressive treatment.

To raise the platelet count pre-operatively and minimize intraoperative bleeding, the embolization of the spleen artery was performed 5 days before the planned splenectomy. As first approach the inferior branch of the splenic artery was embolized using contour embolization particles 355–500, with the result of a partial devascularization of the inferior third of the spleen. The day after the main branch of the splenic artery was embolized with contour embolization particles 355–500, obtaining a complete devascularization of the spleen. This intervention was associated with no adverse events but only a modest and transient increase in platelet count (up to 19 x10^9/L).

Perioperatively, on general physical examination, the patient presented in stable clinical condition, alert and oriented. Bodyweight was 73kg. Considering his chronic hematologic condition in poor control at the moment of surgery, the patient was classified as IV grade according to the American Society of Anesthesiologists Classification. Six units of blood and two units of platelet were requested and at disposal in the operating room, due to the high risk of intraoperative bleeding. From the surgical point of view, the patient was daily evaluated and three days before the intervention he underwent abdomen computed tomography because of pain in the left hypochondrial region. At the CT no active bleeding was recognized, but only minimal perisplenic and peripancreatic fluid, as an inflammatory reaction to the embolization. The spleen had a bipolar diameter of 127mm and presented a small vascularized area in his medial perihilar part.

At surgery, the patient was positioned supine on the operating table with the left side up. One 8mm camera port was placed in the umbilical region, using a Hasson open technique. Two other 8mm reusable robotic working ports were placed under direct vision on a perpendicular line compared to the line between the camera and the operative target, one on the median line and the other on the anterior axillary line. A 12mm trocar was placed in the inferior left hypogastric region and used for the robotic air-seal. An accessory laparoscopic 5mm trocar was placed in the right flank for retraction and suction, as necessary (Fig. 1). The first and second assistant stood on the right side of the patient and the scrub nurse at the feet of the patient.

Once the camera was introduced, the peritoneal cavity was inspected. The spleen appeared almost ischemic and no accessory spleens were encountered. The surrounding tissues, comprehensive of the omentum and the peripancreatic and perisplenic tissue, were massively inflamed, edematous and fragile as a reaction to the preoperative embolization (Fig. 2). The spleen was adherent to the abdominal wall and at the superior and inferior pole were present blood clots similar to previous extracapsular bleeding. The isolation was conducted without any bleeding using the curved bipolar dissector and

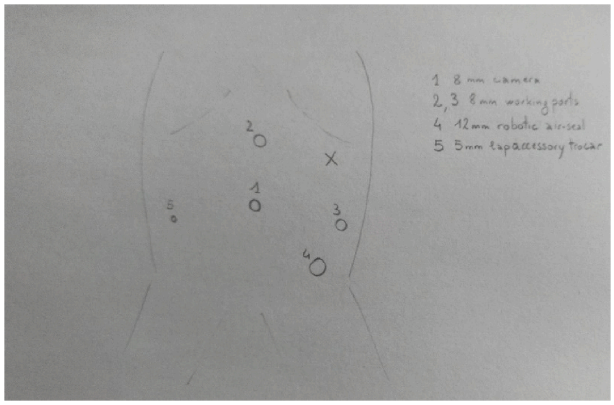

Fig. 1. Trocar position.

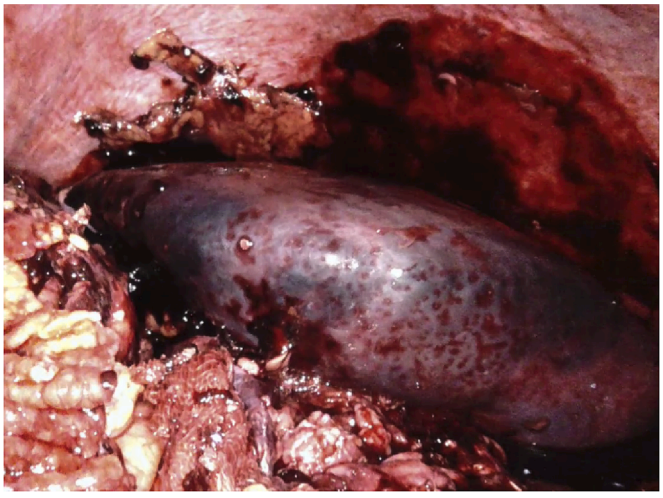

Fig. 2. Spleen and inflamed tissue.

the hilar vessels were ligated with the use of Da Vinci vessel sealer. The dissection of the short gastric vessels required some efforts because of the tenacious adhesions. The abdominal cavity was accurately irrigated and the splenic bed carefully examined for hemostasis; although no active bleeding was present, the Floseal hemostatic matrix was apposed in the splenic cavity, where a tubular drainage was positioned. The spleen was inserted in an Endo Catch and extracted, after morcellation, through an ampliation of the umbilical port and the positioning of an Alexis Retractor, without assisting at any spillage. At the end of the procedure, all the trocar port sites were closed in layers using resorbable sutures.

The total operative time was measured in minutes from the incision of the skin for the first trocar placement to the closure of all port sites and counted 280 minutes. The robot docking time influenced the total operative time for approximately 15 minutes and was measured once all the ports were inserted to the time when all the robotic arms were connected and the camera was in place and ready to be used.

The intervention was conducted under general anesthesia with endotracheal intubation and muscle relaxation. Before surgery, with the support of ultrasound, a central vein catheter and multiple peripheric lines were placed and an arterial line was positioned for blood pressure monitoring and blood gas control, mandatory during this kind of surgery. Propofol, remifentanil, and cisatracurium were used in a continuous infusion to maintain general anesthesia and boles of fentanyl were administered as needed. The depth of anesthesia was guaranteed by the Bis Spectral Index. Before the start of surgery, a Foley catheter was positioned to monitor the diuresis and anti-thrombus stockings were placed at his lower extremities. During surgery, the patient didn't have any anesthesiological problems and maintained vital parameters stable. The patient received one unit of platelets and two units of blood to support his general circulation and not because of any massive intraoperative bleeding. At the end of the surgery, the patient was awakened in the operating room and appeared to have good pain control with paracetamol at times and morphine in a continuous infusion. He was then accompanied to the intensive care unit where the first postoperative monitoring was conducted.

On postoperative day 3, the abdominal drainage was removed and the patient was transferred from the intensive care unit to the onco-hematology unit, where he began the rehabilitation and continued medical treatment. Despite the good surgical result, splenectomy results in a transient and poor response in platelet count, with persistent severe thrombocytopenia in the following months, requiring further pharmacological treatment.

At 1 year follow up the patient is in good clinical condition and has improved his neurological condition.

3. Conclusion

Total splenectomy is one of the first procedures performed by surgeons with the new robotic technique. Although strong evidence supports the laparoscopic approach for this intervention [6], the use of the DaVinci system isn't yet fully approved. In the pediatric population, few cases are reported among other general robotic procedures and none are described in such complex patients, only one adult with a score of IV according to ASA classification underwent robotic splenectomy in a case series [3].

To the best of our knowledge, we report the first case of robot-assisted splenectomy following embolization of the splenic artery in an adolescent. The advantages of the robotic approach are reported in difficult splenectomies and our patient, with a platelet count of 19 x 10^9/l, joins this category [8]. A value of 50 x 10^9/l platelets is usually required for major surgery and, in patients with immune thrombocytopenia, it is usually obtained with medical treatment before surgery. Our patient did not respond to medical treatment and this threshold could not be reached. Thus, splenic embolization was attempted as a bridge treatment to reduce intraoperative bleeding. Despite the lack of response in terms of platelet count, we could operate a devascularized spleen under major safety. Besides, this new technique was at disposal and the precise dissection, provided by the wrist movements and the robotic vessel seal, and the magnified 3D vision permitted to guarantee the safety of the procedure.

However, we were ready in the operating room with every device for the conversion to open, also on the base of the known conversion rate from the laparoscopic approach to open up to 12% [5].

The intervention was carried on without any complication and, regarding the operative time, we can assert that it was similar to reported times of first robotic splenectomy in the literature [4]. The postoperative course was uneventful despite low platelet counts also post-operatively.

We propose a robotic splenectomy following embolization of the splenic artery as a feasible and safe procedure. The advantages of the Da Vinci Xi system are highlighted especially in complex cases, requiring maximum precision. The multidisciplinary approach to this patient, comprehensive of haemato-oncologist, neurosurgeon, anesthetist, intensivist, pediatric surgeon, interventional radiologist, permitted the optimal therapeutic choice with everyone providing his professional competence of field. Further studies are requested to collect enough evidence to support this approach to total splenectomy. The pediatric population varies in indication and size, therefore single centers can't reach numbers sufficient to produce strong evidence. We advocate the creation of a common register among hospitals that use the Da Vinci Xi System.

Patient consent

Consent to publish the case report was not obtained. This report does not contain any personal information that could lead to the identification of the patient.

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Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

Declaration of competing interest

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