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Case report

Robot-assisted ventral sacral Tarlov cystectomy; A case report

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ABSTRACT

Introduction and importance: Although asymptomatic Tarlov cysts (TCs) are reported in up to 13% of the population, symptomatic TCs are rare (less than 1%), making the management of the symptomatic cysts controversial. The most common location of symptomatic TCs is sacral nerve roots where they can cause pelvic, perineal chronic discomfort and pain, and lower extremity sensory and motor changes. Ventral (intrapelvic retroperitoneal) sacral TCs are extremely rare with no management recommendations. Available surgical options include cyst resection, and inlet-obliteration, however, these methods are often considered invasive and not definitive.
Case presentation: A 39-year-old woman presented with debilitating low back pain (LBP) radiating to her pelvis and the right lower extremity for 4 years. Magnetic Resonance Imaging (MRI) showed multiple sacral nerve root TCs including a large retroperitoneal right S3 TC. Surgical resection of the right S3 cyst was achieved utilizing a robot-assisted anterior approach which provided excellent visualization and maneuverability in the targeted retroperitoneal space. Postoperatively, the patient experienced significant pain relief, and she was able to perform activities of daily life and return to work.
Clinical discussion: Robotic-assisted pelvic surgery has gained widespread popularity in the last two decades due to its many potential benefits. Utilizing robotic systems in sacral nerve sheath lesions shows a promise to deliver effective minimally invasive surgical management without sacrificing good visualization or instrument maneuverability.
Conclusion: Robot-assisted resection of sacral nerve roots TCs represents a minimally invasive and safe surgical option to manage cysts located anterior to the sacrum in the pelvic retroperitoneal space.

1. Introduction

1.1. History and present knowledge

Perineural (Tarlov) cysts (TCs) were first described in the 1930s as lesions most commonly affecting the sacral spinal nerve roots [1]. Later with the technical imaging revolution, they were reported in up to 13% of the population, with the vast majority remaining asymptomatic and with a static course [2]. Tarlov cysts become symptomatic in 1% of patients [3]. The symptoms include low back pain (LBP), radicular pain, motor, or sensory changes, pelvic/perineal sensory changes, bowel/bladder/sexual dysfunction, and cerebrospinal fluid (CSF) leak-related symptoms [4]. The etiology of TCs remains elusive with theories of an inflammatory process that results in sealing off a portion of the perineural space, local hemorrhage resulting from previous trauma or surgery, or an arachnoid proliferation that results in the sequestration of a perineural cyst as a result of inflammation of degenerative changes [1,5,6]. These theories may explain the growth of TCs by the pulsatile pressure of the CSF along with a ball-valve phenomenon.

Due to the rare incidence of symptomatic TCs, the management protocols are often controversial [2]. The non-surgical interventions include non-steroidal anti-inflammatory drugs (NSAIDs), and physical therapy, while interventional treatments include percutaneous aspiration, fibrin glue injections, and others. Surgical options may require lumbar-peritoneal shunts (LPS), open microsurgical resection, and reduction [7].

1.2. The utility of robot-assisted surgery

Robot-assisted spine surgery has been proposed to enable spine

Abbreviations: TC, Tarlov Cyst; LBP, Low Back Pain; CSF, Cerebrospinal Fluid; NSAIDs, Non-Steroidal Anti-Inflammatory Drugs; LPS, Lumboperitoneal Shunt; ALIF, Anterior Lumbar Interbody Fusion; ADL, Activities of Daily Life; MRI, Magnetic Resonance Imaging.

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surgeons to perform less invasive, and more precise spine procedures with less radiation exposure. Since the early 2000s, multiple robotic systems have been introduced to achieve this goal [8]. While this advanced technology showed some promise, it faced several roadblocks in the implementation phase which restricted its application to be limited to spinal instrumentation and fusion [8,9]. The Da Vinci Surgical System® (Intuitive Surgical, Mountain View, CA, USA) is one of the systems that have been utilized to assist in several spinal procedures such as anterior lumbar interbody fusion (ALIFs), spinal neurofibroma resection, and paraspinal schwannoma resection [2,10,11]. Early reports of robot-assisted spinal surgery showed no additional benefit of its utility to traditional techniques, but with updated iterations and technological advances, robotic systems have demonstrated improved efficiency [12].

This report, in line with the SCARE 2020 criteria [13], describes a case of a large symptomatic sacral TC managed surgically using Da Vinci robot-assisted anterior pelvic approach. To the authors' knowledge, this is the first report of a robotic-assisted application to treat symptomatic perineural cysts or TCs with a complete recovery upon short-term follow-up.

2. Presentation of case

A 39-year-old Caucasian female patient presented with a 4-year history of LBP precipitated by a car accident and radiating to the perineum, and the right lower extremity and associated with dyspareunia. The pain was dull aching varying in severity and aggravated by sitting, standing, lifting moderately heavy objects, leaning forward, and squatting, limiting her activities of daily living (ADLs). Her family history is not contributory, and she does not have drug use history. Magnetic Resonance Imaging (MRI) of the lumbosacral spine revealed multiple bilateral large TCs with a large right S3 nerve root fluid-filled intrapelvic cyst measuring 2.3 cm × 3.3 cm. Fig. 1A She had undergone nonsurgical management, including NSAIDs, physical therapy, and local nerve block without pain relief. On physical examination, the patient showed decreased pinprick sensation on the left buttocks, antalgic gait, and a positive right Lasegue test.

2.1. Operation

The surgery was performed under general anesthesia in a supine position by a general surgeon and a neurosurgeon. Bilateral ureteral stenting was done for identification and protection of the ureters. After sterile prepping, the initial incision was made in the left upper quadrant and a Veress needle was inserted with insufflation to 15 mmHg of pneumoperitoneum. Then, a 5 mm 30-degree camera was placed within an optical trocar to obtain direct view access to the abdominal cavity. Under direct visualization, three additional trocars for robotic instruments were placed transversely across the abdomen. The Da Vinci robot was docked beside the patient. Fig. 2 The uterus was retracted towards anterior abdominal wall using A 3-0 silk Keith needle. Atraumatic robotic graspers were then used to reflect the rectum. The right posterior peritoneal reflection was excised to expose the sacral promontory using a combination of blunt dissection and electrocautery. This plane was explored laterally and inferiorly exposing the sacral roots. The S3 nerve root was confirmed using a nerve monitoring probe through a 5 mm trocar to confirm the nerve roots. Fig. 3 A large clear fluid-filled cyst adjacent to the S3 nerve root was identified. After it was mobilized from its surrounding structures, two separate 2-0 silk sutures were used to suture-ligate the dilated nerve root superiorly and inferiorly before transection. A 5 mm clip was placed on the ligated end of the

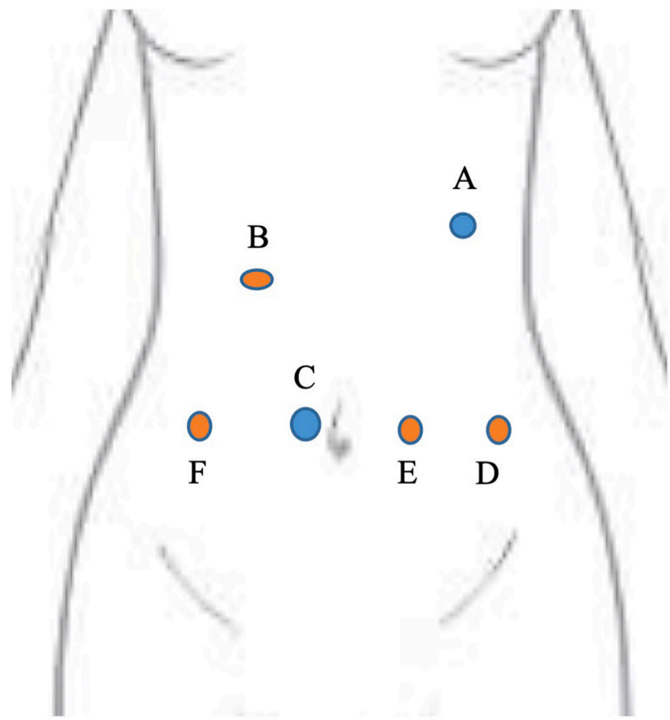

Fig. 2. Illustration showing the initial incision and the tractor entry points. A) Veress Needle entry point; B) Assistant entry point; C) Camera entry point; D, E, and F) Torcars 1, 2, and 3 entry points respectively.

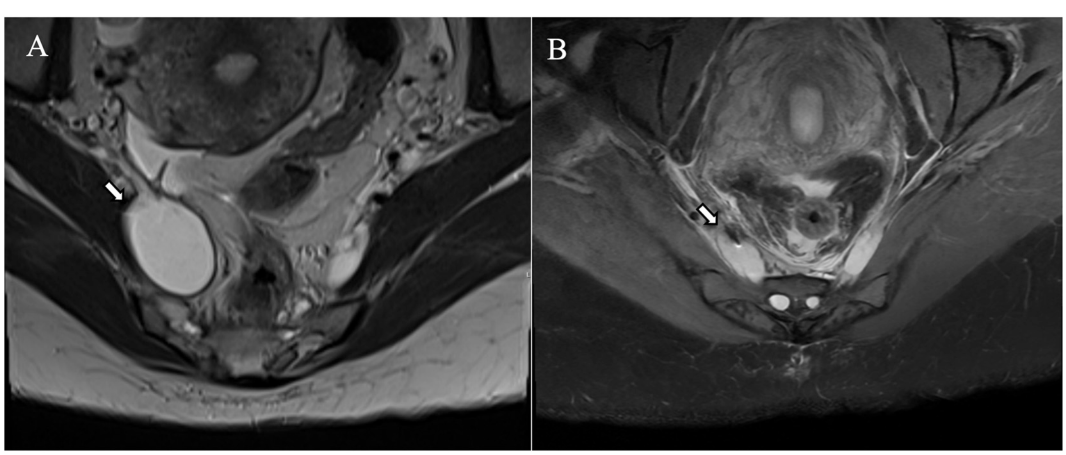

Fig. 1. Axial T2 MRI (A) Preoperative, and (B) Postoperative; illustrating the resection of right S3 nerve root Tarlov Cyst. White arrows indicate the location of the targeted cysts.

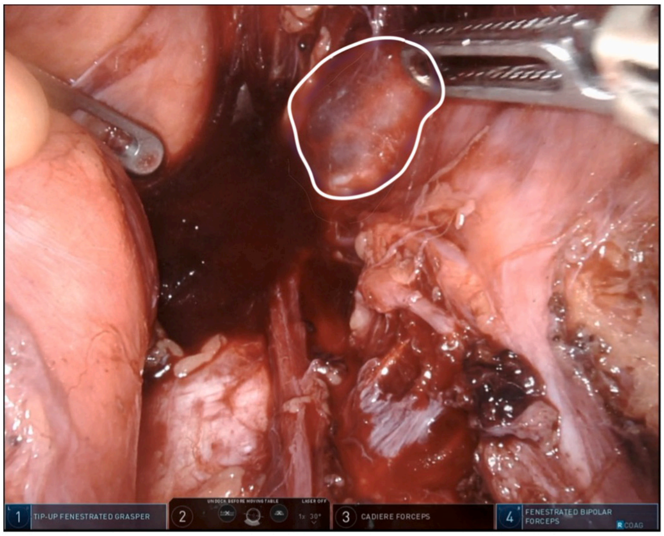

Fig. 3. Intraoperative view showing a large right S3 Tarlov cyst (outlined with white line).

nerve root to facilitate radiographic identification postoperatively. Fibrin glue was used at the site of the suture-ligation and the posterior dissection plane to prevent the development of CSF leakage. The estimated blood loss of the procedure was 50 mL.

2.2. Follow-up

The patient tolerated the procedure well with no complications. She was discharged home on postoperative day 2 with satisfactory pain control and ambulation without difficulty. Postoperative MRI showed resection of the right S3 ventral cyst. Fig. 1B At 6-weeks follow-up, the patient reported significant improvement in her pain and return to perform ADLs. Lasegue test was negative bilaterally with intact sensation in the perineum and both lower extremities.

3. Discussion

Intra-pelvic TCs are extremely rare with only a few cases reported in literature. This location resulted in unique features related to the sacral nerve roots involved and the mass effect of the TCs [14]. In addition to the common symptoms, the ventral extension of TCs into the pelvic cavity caused perineal discomfort, pain, and dyspareunia [15]. Due to this special nature, the diagnosis of intra-pelvic TCs can be challenging in some cases and easily misdiagnosed as hydrosalpinx, or ovarian cysts [16]. Therefore, imaging of intra-pelvic TCs is critical to determine the most appropriate approach for cyst treatment [14].

The management options for TCs remain controversial due to the lack of high-quality evidence [4,17]. In this case, the complete resection of a large right S3 nerve root intra-pelvic retroperitoneal TC was successfully achieved using an anterior robot-assisted approach. Alternative approaches include laminectomy and fistula inlet obliteration using fibrin glue, and muscle flaps [15,18]. However, due to the unique location of these cysts, it was decided to pursue an anterior approach. Additionally, the open surgical approaches to pre-sacral pathologies are invasive and technically challenging. Therefore, a robot-assisted approach was utilized to allow for a less invasive surgical option, short recovery time, improved pain control, and early mobilization. Zhu et al. reported 3 cases of large TCs with pelvic extension. In their management, they opted to posteriorly expose the vertebral plate of L5 and the sacral nerve root canal. Then, through a lateral sacral window, they assessed the posterior components of the cysts and evacuated the CSF. Later, they filled the cysts with pedicle muscle flaps reinforced with fibrin glue to block the fistulae between the cysts and the thecal sac [18]. In another case report, Wang et al. described a large TC at the right S2 nerve root sleeve with an intra-pelvic extension in a 67-year-old female patient with Marfan syndrome. Their surgical approach included right S1, 2, and 3 laminectomies and obliteration of the cyst using an aneurysm clip [15]. In both reports, the posterior approach was used to obliterate the inlet of the fistula connected to the pre-sacral cysts due to the presence of both anterior and posterior components to the cysts. However, it was decided to avoid a posterior approach as MRI showed the entirety of TCs present in the pelvic cavity without posterior extension of the cysts and to minimize surgical invasiveness and post-operative pain resulting from the posterior approach [14,15].

Furthermore, the utilization of robotic systems in spine surgery is growing in popularity as it offers an alternative precise and minimally-invasive method compared to traditional techniques [19]. Pre-sacral nerve sheath tumor surgery is among the approaches benefitting from robotic systems. Pu et al. reported a series of 12 cases with pre-sacral nerve root tumors treated using a Da Vinci-assisted anterior approach. All patients achieved full recovery with no perioperative complications [20]. Additionally, Jun et al. reported a case where a robot-assisted method was employed to resect a pre-sacral right S2 nerve root schwannoma [21]. In both reports, robotic-assisted treatments showed high levels of safety, minimal blood loss, rapid recovery, and decreased length of stay [20,21]. In this case, utilizing Da Vinci Surgical System enabled the surgeon to perform a minimally invasive exposure of the ventral sacral roots in a small window with improved visualization, maneuverability, and suturing capability.

4. Conclusion

Symptomatic TCs with intra-pelvic components are extremely rare findings. While no consensus treatment currently exists for the management of TCs, a robot-assisted resection of the intra-pelvic TCs may be considered as a minimally invasive, safe, and effective option to achieve resection and resolution of symptoms on short-term follow-up.

Ethical approval

This deidentified case report is exempted by the institutional review board of the University of Pennsylvania, Perelman School of Medicine.

Consent

Written, and signed informed consent was obtained from the patient. We confirm that a statement of obtaining a written and signed consent was included in the manuscript. No identifying characteristics were included in the manuscript that can lead to identifying the identity of the patient.

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Research registration

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AA: Literature review, manuscript writing; JMS & ISS: Manuscript Revision; WCW: Data collection, Supervision, Revision.

Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijscr.2021.106732.

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