Robotic Resection of Presacral Tumors

Davide Ferrari
Mayo Clinic
Tommaso Violante
Mayo Clinic
Poppy Addison
Mayo Clinic
William R.G. Perry
Mayo Clinic
Amit Merchea
Mayo Clinic
Scott R. Kelley
Mayo Clinic
Kellie L. Mathis
Mayo Clinic
Eric J. Dozois
Mayo Clinic
David W. Larson
Larson.David2@mayo.edu
Mayo Clinic

Research Article

Keywords: Minimally invasive surgery, Robotic surgery, Presacral tumors, Tailgut cysts

Posted Date: January 9th, 2024

DOI: https://doi.org/10.21203/rs.3.rs-3837760/v1

Additional Declarations: No competing interests reported.

Version of Record: A version of this preprint was published at Techniques in Coloproctology on April 23rd, 2024. See the published version at https://doi.org/10.1007/s10151-024-02922-6.

Abstract

Background: Presacral tumors are a rare entity typically treated with an open surgical approach. A limited number of minimally invasive resections have been described. Aim of the study was to evaluate the safety and efficacy of robotic-resection of presacral tumors.

Methods: This was a retrospective single system analysis, conducted at a quaternary referral academic healthcare system, and included all patients who underwent a robotic excision of a presacral tumor between 2015 and 2023. Outcomes of interest were operative time, estimated blood loss, complications, length of stay, margin status, and recurrence rates.

Results: Sixteen patients (11 females, 5 males) were included. Median age of the cohort was 51 years (range 25-69). Median operative time was 197 minutes (range 98-802). Median estimated blood loss was 40 ml, ranging from 0 to 1800 ml, with one patient experiencing conversion to open surgery after uncontrolled hemorrhage. Urinary retention was the only post-operative complication that occurred in 3 patients (19%) and was solved within 30 days in all cases. Median length of stay was one day (range 1-6). Median follow-up was 6.7 months (range 1-110). All tumors were excised with appropriate margins, but one benign and one malignant tumor recurred (12.5%). Ten tumors were classified as congenital (one was malignant), two were mesenchymal (both malignant), and five were miscellaneous (one malignant).

Conclusions: Robotic resection of select presacral pathology is feasible and safe. Further studies must be conducted to determine complication rates, outcomes, and long-term safety profiles.

INTRODUCTION

Presacral tumors are a heterogeneous group of rare masses located in the presacral space, which is bound by the mesorectum anteriorly, the sacrum posteriorly, the levator muscles inferiorly, and the lumbosacral plexus, ureters, and iliac vessels laterally. [1,2] Within this anatomically complex space, totipotential cells differentiate into endoderm, ectoderm, and mesoderm lineages. Tumors can be classified as congenital, neurogenic, osseous, or miscellaneous and defined as benign or malignant.[3,4]

Management can include observation or surgical resection with or without various neoadjuvant therapies. Transabdominal, transperineal, and para-sacral approaches have been described and primarily determined by the tumor's location in relation to the third sacral body (S3)[3,5–7]. While typically treated in an open fashion, minimally invasive approaches have been described as safe and feasible.[7,8] Few reports in the literature describe robotic resection.[7,9–12].

This paper presents a quaternary care institution's experience with robotic excision of presacral pathology.

METHODS

This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guidelines for reporting observational studies and the methodological quality and synthesis of case series guide[13,14].

After Institutional Review Board approval (ID 23-003829), data on all patients older than 18 years who underwent robotic excision of a presacral tumor at Mayo Clinic, Rochester, MN, and Mayo Clinic, Jacksonville, FL were retrospectively retrieved using a prospectively maintained database. Patients were excluded if they denied Research Authorization.

Tumors were classified according to the anatomical relationships of their upper margin with S3, a historic landmark in deciding on a minimally invasive transabdominal approach (Fig. 1). The robotic Da Vinci® Xi Surgical System (Intuitive Surgical, Sunnyvale, California, USA) was used for all procedures.

Variables collected included patient characteristics [age at surgery, sex, body mass index (BMI), American Society of Anesthesiology (ASA) score], preoperative evaluation [patient-reported symptoms, imaging characteristics, preoperative pathology], intraoperative characteristics [operative time, need for levator muscle incision, estimated blood loss, conversion rate, use of surgical drain, air leak test, intact excision], pathological data [tumor size, specimen area, margin status, final histology], postoperative data [complications, length of stay (LOS), 30-day morbidity, 30-day readmission, 30-day reoperation, functional outcomes, local and/or systemic recurrence]. The extent of follow-up was defined as their last documented interaction.

Reported complications included surgical (bleeding with an intra- or post-operative need for transfusion, ileus, postoperative small bowel obstruction, deep and superficial surgical site infection, anastomotic leak) and nonsurgical (atrial fibrillation, congestive heart failure, myocardial infarction, deep venous thrombosis, pulmonary embolism, sepsis, pneumonia, respiratory failure, urinary tract infection, acute kidney injury as defined by the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines[15], urinary retention leading to discharge with either an indwelling urinary catheter or continuation of intermittent catheterizations).

Operative technique

Under general endotracheal anesthesia with complete paralysis, the patient is placed in a lithotomy position with Yellofin® stirrups (Hill-Rom, Allen Medical, Acton, MA, USA), and arms are padded and tucked. The use of ureteral stents or ureteral injection of indocyanine green for ureteral identification is based on surgeon preference. The abdomen is insufflated using an AirSeal™ (ConMed, Utica, USA) device with an 8-mm tracer, and four robotic 8-mm trocars are placed under direct visualization, commonly aligned on the supraumbilical line (Fig. 2). An additional one or two assist trocars are placed in the right abdomen. The 30° robotic camera is placed in arm three, and the pelvis is targeted. The presacral space is entered, exposing the sacral promontory. The superior hypogastric nerves are identified and protected. It is often necessary to mobilize the rectum to the level of the pelvic floor to appropriately visualize the

entirety of the mass. At this point, the strategy of excision must be individualized based on the tumor's anatomical relationships with the levator muscles, the coccyx, the mesorectum, and the rectum itself. Effort to excise the tumor en bloc is paramount. Once the tumor has been isolated from the surrounding structures, it can be removed through a Pfannenstiel incision or by enlarging one of the trocar incisions. An air leak test can be performed in cases where there may be concern for rectal injury.

Follow-up

There is limited data on which to base any firm recommendations regarding follow-up. In our practice, we typically recommend an annual visit with a digital rectal examination to assess for recurrence in patients who have benign lesions resected. Pelvic magnetic resonance imaging (MRI) is obtained 1-year post-resection and then again at five years. In the interim, pelvic imaging is performed if a mass is palpated. Secondary to high rates of recurrence following R0 resection, our current surveillance protocol following aggressive angiomyxoma excision is pelvic MRI every three months for two years, and if there is no recurrence during that timeframe, every six months for three more years. For malignant tumors, patients typically undergo an annual physical examination, pelvic MRI, and computed tomography (CT) of the chest and abdomen for 5 years.

Statistical analysis

Continuous variables were summarized with median and range. Categorical variables were reported using numbers and percentages. Statistical analyses were performed using IBM SPSS Statistics 27 (IBM, Armonk, NY, USA).

RESULTS

Sixteen patients underwent robotic excision of presacral tumors between January 2015 and August 2023, 11 women (69%) and 5 men. Median age was 51 years (range, 25-69), median BMI was 27.5 kg/m^2 (range, 18.7-46.6), and median ASA score was 2 (range, 1-3). Five patients (31%) were asymptomatic with presacral pathology incidentally found on imaging for other reasons. Symptomatic patients complained of abdominal discomfort (n=6, 38%), sensation of buttock fullness (n=5, 31%), obstructive symptoms (n=5, 31%), and low back pain (n=1, 6%). Thirteen were operated for primary disease (81%), while three had operations for recurrent disease (19%) (**Table 1**).

Table 1. Patient demographics and clinical characteristics. Continuous variables are expressed in median (range), and categorical variables are expressed in number (percentage).

	Patients (n=16)
Age	51 (25-69)
Female	11 (69%)
BMI	27.5 (18.7-46.6)
ASA score	2 (1-3)
Symptoms	
Abdominal discomfort	6 (38%)
Buttock fullness	5 (31%)
Obstructive	5 (31%)
Low back pain	1 (6%)
No symptoms	5 (31%)

Preoperative assessment

All tumors were staged with cross-sectional imaging: a preoperative pelvic MRI was performed on 15 patients, while one underwent CT imaging. The diagnostic accuracy of imaging alone was 93.7%, with all image diagnoses of malignant pathology confirmed by preoperative biopsy. One cystic tumor (epidermoid cyst) with no imaging concern for malignancy was found to harbor malignancy post-excision. Of the sixteen tumors, four were malignant. The median tumor size on imaging was 5.2 cm. (range, 1.6-20). Tumors were classified according to their anatomical relationships with the sacral levels: eight were at the level of S3 (50%), four were at the level of S2 (25%), one (6%) at S1, one (6%) at S4, one (6%) at S5, and one (6%) at the tip of the coccyx. Ten masses were classified as cystic, with three being multiloculated cysts. A radiologically guided preoperative biopsy with solid components was performed in five cases. Three were diagnostic, with two malignancies (spindle cell tumor and solitary fibrous tumor), a benign aggressive angiomyxoma, and two cases (40%) were inconclusive. No patients received preoperative oncologic therapy.

Intraoperative outcomes

The median operative time was 197 minutes (range, 98-802), and the median estimated blood loss was 40 mL (range, 0-1800). There was only one case of conversion to open surgery after uncontrolled hemorrhage from the middle sacral vessels, requiring intraoperative transfusion. Levator muscle was included in the resection in seven patients due to tumor involvement within the pelvic floor. Fifteen tumors were excised intact, while in one case, a millimetric capsule rupture was reported. No patient had concomitant resection of pelvic organs, and none of the operations required resection of the coccyx. No biopsy tract was excised. Per the surgeon's discretion, a drain was placed in five cases, all removed before discharge.

Postoperative outcomes, pathological findings, and follow-up

Median length of stay was one day (range, 1-6). The only post-operative complication was urinary retention in three (19%) patients. One was discharged with a urinary catheter in place, and the other two continued with intermittent catheterizations. Within thirty days after surgery, all patients could spontaneously void without issue.

Pathological findings are reported in **Table 2**: nine patients were affected by congenital lesions, five by miscellaneous tumors, and two by mesenchymal tumors. Four patients were affected by malignant diseases. In all cases of malignant tumors, except for a case of a malignant epidermoid cyst, the tumor was known to be malignant before the operation and was excised intact. An R0 resection rate was reported for all malignant tumors, and all final pathologies reported appropriate margins.

Table 2. Histopathological characteristics and recurrence.

Classification		Histopathology	Tumor size (cm)	Recurrence	F-U (months)	F-U after recurrence (months)
Congenital	Benign	Tailgut Cyst	5.4 x 2.3 x 1.2	0	3	
		Cystic hamartoma	7.5 x 17.5 x 6	0	35	
		Tailgut Cyst	2.4 x 2.0 x 1.0	0	27	
		Duplication Cyst	3 x 2.5 x 1.5	0	8	
		Tailgut Cyst	5.5 x 3.5 x 0.5	0	12	
		Tailgut Cyst	5.7 x 4.8 x 3.3	0	1	
		Epidermoid cyst	6.5 x 4.3 x 3.1	0	6	
		Cystadenoma	7.9 x 5.9 x 4.1	0	3	
	Malignant	Epidermoid Cyst	7.6 x 4.6 x 3.5	0	1	
Mesenchymal	Malignant	Solitary fibrous tumor	6.5 x 5.2 x 4.1	0	6	
		Follicular dendritic cell sarcoma	5.4 x 2.8 x 2.1	0	4	
Miscellaneous	Benign	Myelolipoma	4.2 x 3.2 x 2.1	0	2	
		Benign peritoneal mesothelioma	15 x 4 x 0.3	0	68	
		Angiomyxoma	17.7 x 9.7 x 5.8	0	9	

		Angiomyxoma	20 x 8 x 3.3	1	3	44
	Malignant	Leiomyosarcoma	1.9 x 1.8 x 1.7	1	54	56

cm: centimeters, F-U: follow up.

Median follow-up was 6.7 months (range, 1- 110), with six patients having a follow-up longer than one year, with two cases of recurrence, both in the miscellaneous malignant tumor group. One patient with recurrent leiomyosarcoma underwent radiotherapy after multidisciplinary evaluation, administering 5000 cGy in 25 fractions and a complete clinical response, which has been maintained to date after 56 months. The second patient experienced a recurrence of an aggressive angiomyxoma after three months despite negative margins reported in the pathology report of the primary intervention. Analysis of the specimen revealed ER and PR positivity with appropriate margins. The recurrence was treated with leuprolide and subsequently re-resection through an open approach, which required extended local excision, partial vaginectomy, and salpingo-oophorectomy. The patient recovered well and has been disease-free for 44 months. No recurrence was noted along unexcised biopsy tracts.

Patients were assessed for functional outcomes at postoperative visits (one month, six months, and then annually): one patient reported urinary and sexual dysfunction, with a diminished terminal stream and retrograde ejaculation after six months from intervention, and one patient reported pelvic pain exacerbated by sexual intercourse, with a late onset 24 months after intervention. This patient underwent a pelvic MRI, which was unremarkable. Among the 11 initially symptomatic patients, all described the resolution of the symptoms after surgery.

DISCUSSION

Robotic excision of presacral tumors is capable of safely and effectively removing a diverse array of tumors from multiple locations, along with achieving a low rate of intraoperative and postoperative complications with accompanying short lengths of stay.

Despite previously published treatment algorithms based on tumor location (Fig. 1),[3,16–18] technology and surgical experience with the robotic platform offer new opportunities to address tumors in all areas of the pelvis with low risk and excellent results, allowing the resection of tumors below S3 that extend through the levator complex into the ischioanal space, as was done for three cases in the present series. The goals of the surgery continue to conform to principles of surgical approach of complete tumor resection, intact excision, and avoidance of injury to surrounding structures[7]. Varied pathology, location, including benign or malignant etiology appear to be addressed with reasonable operative results.

In the present study, we reported a 93.7% diagnostic accuracy of imaging techniques. This is consistent with previous reports[6,19]. Among the five patients with suspected malignancy, a preoperative biopsy was

performed. In three patients, preoperative histological analysis provided a definitive diagnosis (60%), which was a malignant tumor in two cases and a benign aggressive angiomyxoma in another case. A singular case of malignant epidermoid cyst was not suspected by the preoperative radiologic imaging and was discovered only on final pathology.

The robotic-assisted approach provided short postoperative stays, with median discharge on postoperative day 1. This was made possible by a low rate of postoperative complications. Moreover, the complications that did occur were minor, and all resolved within 30 days. Only one case of conversion to open surgery was reported, caused by bleeding from the middle sacral vessels in a case of a malignant solitary fibrous tumor. During the same case, as the mass was being detached from the anterior surface of the sacrum, injury was made into the prostatic urethra. This patient experienced UR and urinary and sexual dysfunction for 6 months. These specific complications are not unusual, given the proximity of this tumor to neurovascular structures.

While a previous small series describe minimally invasive approaches, identifying the difference between laparoscopic and robotic approaches is challenging.[7] Compared to a recent systematic review of the MIS approach that included 69 patients who underwent laparoscopic resection, our cohort reported longer operative times (197 mins compared to the laparoscopic 135 mins). However, our patients tended to be discharged sooner (median one day vs laparoscopic median 4 days). Regarding oncologic safety, the laparoscopic approach has more data and longer follow-up, with only one report of an R1 margin in a patient with colloid sarcoma and no recurrences reported in 57 patients with a mean follow-up of 28 months (range 5–71 months). Future series will need to provide additional follow-up and volume in malignant disease.

In comparison to the open approach, there is a large systematic review of over 1,000 patients published within the last decade.[20] As described here, the robotic approach has a similar operative time (197 mins compared to the open 175 mins). Whereas our patients were discharged with a median length of stay of 1 day, patients undergoing open surgery tended to stay much longer, on average discharging on postoperative day 9 +/- 7. However, this undoubtedly reflects the increased complexity of tumors that are removed in an open fashion compared to the selected patients from our series who underwent robotic resection. Moreover, this series presented an overall recurrence rate of 21.6%. This recurrence rate for miscellaneous tumors has been previously reported as high as 53.4%[20].

This study has several important limitations, most notably selection bias. While the robotic platform appears safe, these patients were carefully selected and appropriate for a minimally invasive approach. A contraindication for this technique would be a patient with a very large tumor requiring a large extraction site or malignant tumors invasive to the pelvic side wall, sacrum, or other surrounding bony structures. The tumor should be able to be removed en bloc without disruption, requiring a highly skilled robotic surgeon to prevent complications. The description of this technique and outcomes does not suggest that any approach is superior to another. Moreover, the nonrandomized retrospective nature of

the study, single-healthcare system experience, and small patient sample size represent further limitations of this series.

CONCLUSION

Robotics facilitated a diverse resection capability for presacral tumors. Overall, this approach appears safe and effective while representing an alternative to open surgery for eligible patients.

Declarations

Funding information: This research did not receive external funding.

Potential conflicts of interest: The authors declare no conflict of interest.

Informed consent: All patients signe a Research Authorization.

Data availability statement: To facilitate transparency and research, the corresponding author will share anonymized data upon reasonable request, ensuring participant privacy.

Research involving human participants and/or animals: This retrospective study involving human participants has been granted Institutional Review Board approval (ID 23-003829) prior to commencing.

References

1. Hobson KG, Ghaemmaghami V, Roe JP, Goodnight JE, Khatri VP. Tumors of the retrorectal space. Dis Colon Rectum. 2005;48(10):1964–1974.
2. Neale JA. Retrorectal tumors. Clin Colon Rectal Surg. 2011;24(3):149–160.
3. Kelley SR, Dozois EJ. Presacral Tumors. In: *The ASCRS Textbook of Colon and Rectal Surgery.*2022:375–396.
4. Uhlig BE, Johnson RL. Presacral tumors and cysts in adults. Dis Colon Rectum. 1975;18(7):581–589.
5. Woodfield JC, Chalmers AG, Phillips N, Sagar PM. Algorithms for the surgical management of retrorectal tumours. Br J Surg. 2008;95(2):214–221.
6. Chéreau N, Lefevre JH, Meurette G, et al. Surgical resection of retrorectal tumours in adults: long-term results in 47 patients. Colorectal Dis. 2013;15(8):e476-482.
7. Mullaney TG, Lightner AL, Johnston M, Kelley SR, Larson DW, Dozois EJ. A systematic review of minimally invasive surgery for retrorectal tumors. Tech Coloproctol. 2018;22(4):255–263.
8. Kim CW, Lee S-H. Laparoscopic Resection of Presacral Tumor: A New Approach in the Era of the Minimally Invasive Surgery. J Minim Invasive Surg. 2019;22(3):131–133.
9. Roy SP, Khalessi A, Phan-Thien KC. Robotic resection of a multicystic tailgut cyst. BMJ Case Rep. 2019;12(9).

10. Solís-Peña A, Ngu LWS, Kraft Carré M, et al. Robotic abdominal resection of tailgut cysts - A technical note with step-by-step description. Colorectal Dis. 2022;24(6):793–796.
11. Marano A, Giuffrida MC, Peluso C, Testa V, Bosio P, Borghi F. Robotic approach to large tailgut cyst with malignant transformation: A case report. Int J Surg Case Rep. 2020;77s(Suppl):S57-s60.
12. Rompen IF, Scheiwiller A, Winiger A, Metzger J, Gass JM. Robotic-Assisted Laparoscopic Resection of Tailgut Cysts. Jsls. 2021;25(3).
13. Murad MH, Sultan S, Haffar S, Bazerbachi F. Methodological quality and synthesis of case series and case reports. BMJ Evid Based Med. 2018;23(2):60–63.
14. Elm Ev, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007;335(7624):806–808.
15. KDIGO Clinical Practice Guideline for Acute Kidney Injury. Kidney Int Suppl. 2012;2(Suppl 1):8.
16. Macafee DA, Sagar PM, El-Khoury T, Hyland R. Retrorectal tumours: optimization of surgical approach and outcome. Colorectal Dis. 2012;14(11):1411–1417.
17. Sagar AJ, Tan WS, Codd R, Fong SS, Sagar PM. Surgical strategies in the management of recurrent retrorectal tumours. Tech Coloproctol. 2014;18(11):1023–1027.
18. Dozois EJ, Jacofsky DJ, Billings BJ, et al. Surgical approach and oncologic outcomes following multidisciplinary management of retrorectal sarcomas. Ann Surg Oncol. 2011;18(4):983–988.
19. Sagar AJ, Koshy A, Hyland R, Rotimi O, Sagar PM. Preoperative assessment of retrorectal tumours. Br J Surg. 2014;101(5):573–577.
20. Baek SK, Hwang GS, Vinci A, et al. Retrorectal Tumors: A Comprehensive Literature Review. World J Surg. 2016;40(8):2001–2015.

Figures

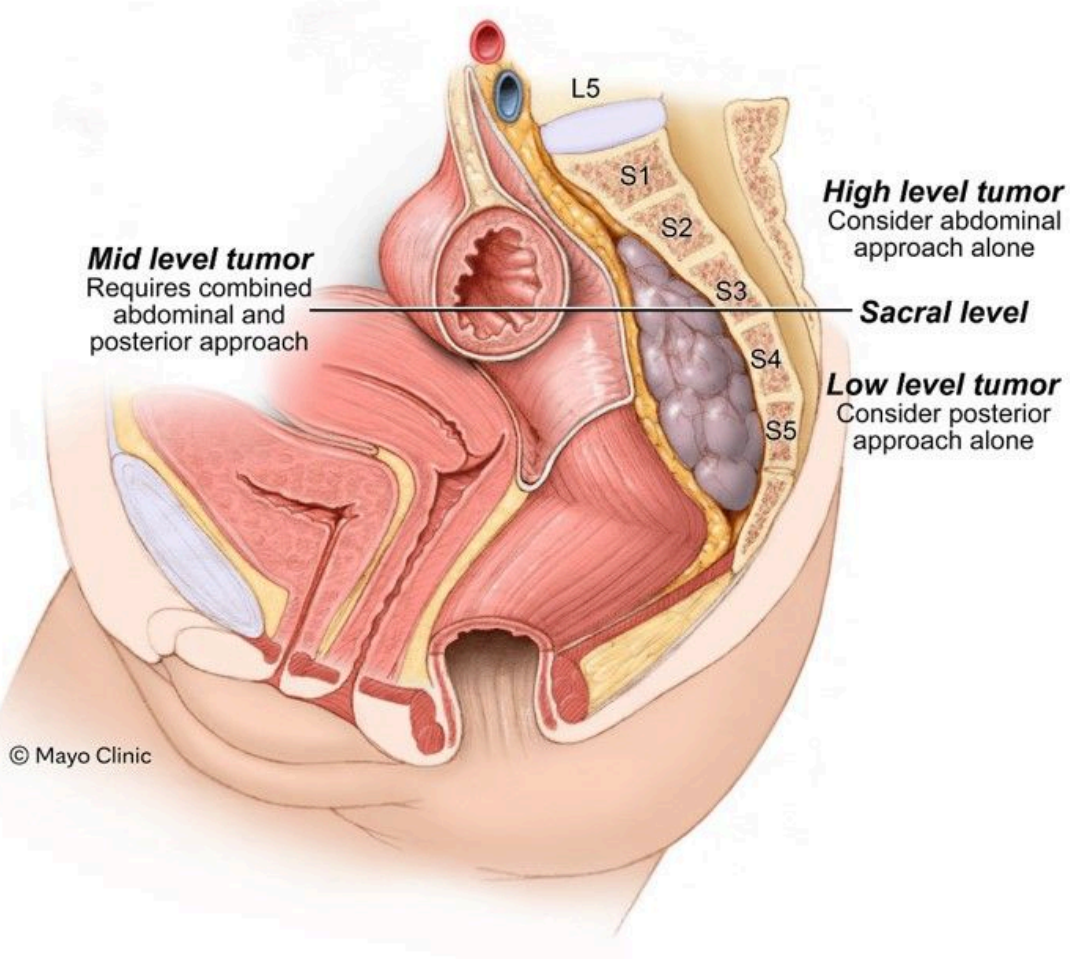

Figure 1

Anatomical relationship of the tumor to 3rd sacral body and typically proposed surgical approaches. (Reused with the permission of Mayo Foundation for Medical Education and Research, all rights reserved)

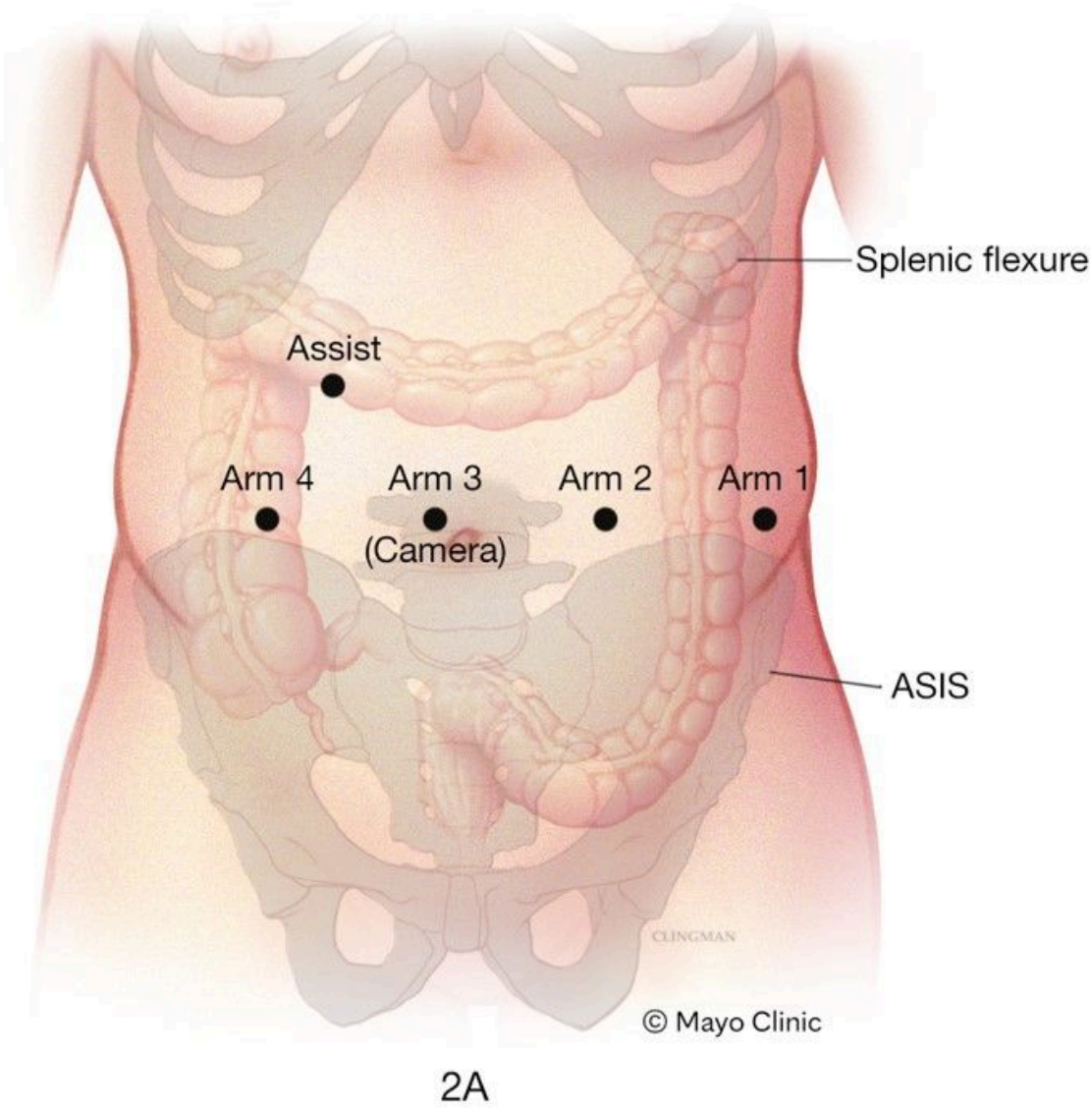

Figure 2

Robotic and assistant trocar placement. (Reused with the permission of Mayo Foundation for Medical Education and Research, all rights reserved)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- completedSTROBEcohortchecklist.docx