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34 ABSTRACT

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36 Introduction

Inguinal hernia repair is among the most common procedures in general surgery. Contents within the hernia sac are variable and in rare cases, the hernia sac contains the vermiform appendix termed Amyand's Hernia. While laparoscopic technique is the most accepted approach, few prospective studies have been completed comparing laparoscopic versus robotic techniques for hernia repair and none in the setting of an Amyand's hernia. We describe the first documented robotic approach to repair of Amyand's hernia.

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45 Case Report

We present a 40 year old male that presented to outpatient surgery clinic with complaint of right scrotal mass. He was diagnosed with right inguinal hernia and was electively scheduled for robotic repair with mesh. Intra-operatively, type 1 Amyand's hernia (Table 1) was discovered. Using robotic technique the hernia was reduced and successfully repaired with mesh. Patient post-operative course was unremarkable.

52

53 Conclusion

Amyand's hernia is a rare subtype of inguinal hernia containing vermiform appendix within the hernia sac. Management of Amyand's hernia is surgery and extent of intervention is dictated by pathology of the vermiform appendix. While open and laparoscopic techniques have been well documented, robotic approach is safe, effective and provides a surgeon with a unique advantage in repair of Amyand's hernia.

Classification model (Table 1). The robotic platform Da Vinci Surgical System's 3D
high definition imaging coupled with advanced degree of dissection control provides
a surgeon with a unique advantage over open and laparoscopic techniques. Robotic
approach to repair of Amyand's hernia is safe and effective.

Early View Article Manuscript Accepted Keywords: Amyand's Hernia, Incarcerated Amyand's Hernia, Robotic Herniorrhaphy, Appendectomy, Robotic Inguinal Hernia

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97 INTRODUCTION

⁹⁸ Inguinal hernia repair is among the most common procedures in general surgery.

However, the contents within the hernia sac are variable. In rare cases, the hernia
sac contains the vermiform appendix. This is termed "Amyand's Hernia" after
Claudius Amyand, an English surgeon who performed the first appendectomy on an
eleven-year-old boy with a perforated appendix inside an inguinal hernia sac in 1735
[1, 2].

Usually, these are discovered as an incidental finding intra-operatively. The
incidence of a normal appendix within the inguinal hernia sac is estimated to be 1%
and that of an inflamed appendix to be 0.1% [2].

Treatment includes herniorrhaphy with or without appendectomy and/or mesh repair 107 108 depending on the vermiform appendix's inflammation status, the patient's general 109 condition, and other factors [3]. There are current classifications to help guide 110 physicians proposed by Losanoff and Basson in 2007 [4, 5] (Table 1). There are 111 however few guidelines on the approach to these situations with laparoscopic or 112 robotic methods. In a case series done by Sahu et al. three patients with Amyand's 113 hernia underwent laparoscopic transabdominal preperitoneal hernioplasty without 114 appendectomy. Investigators found that laparoscopic repair, in the setting of 115 Amyand's hernia, has a number of advantages including better visualization of the 116 sac and the ability to inspect and repair a left sided inguinal hernia if present [6].

In 2000, robotic surgery platform da Vinci was the first robotic surgery platform
approved by Food and Drug Administration (FDA) for general laparoscopic surgery.
In the years to follow, this novel technology quickly penetrated all aspects of surgical
fields including general surgery. The robotic platform Da Vinci Surgical System's 3D

high definition imaging coupled with advanced degree of dissection control provides
a surgeon with a unique advantage over open and laparoscopic techniques.

This technology although not specific to the setting of hernias, has already proven to improve precision and dexterity, allowing surgeons to perform various operations that were traditionally not amenable to minimal access techniques [7]. RoFew prospective studies have been completed comparing laparoscopic versus robotic

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techniques for hernia repair and none in the setting of an Amyand's hernia. Thus as
a start, this case report will document the first known documented robotic approach
to repair a type 1 Amyand's hernia.

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131 CASE REPORT

A 40-year-old male presented to the outpatient surgery clinic with a right sided scrotal mass that had been present since he was a child. Patient admitted that it has progressively become enlarged but has never become firm, irreducible, erythematous, or exquisitely painful. He denied changes in bowel habits, nausea, vomiting, fever, or chills. He did however complain that he could feel his bladder "slip into the swelling" on occasion which caused him difficulty in urination. This was not associated with any dysuria, pyuria, or hematuria.

Patient has a past medical history significant for obstructive sleep apnea on a CPAP machine at home, obesity, and borderline hypertension. His only surgical history was a childhood tonsillectomy. He was not on any medications and has allergies to penicillin. He denied smoking or drinking but admitted to occasional marijuana use approximately once every two weeks.

On physical exam, he presented with a reducible right inguinal hernia extending into his scrotum. There was no erythema or tenderness. The testicles were present in the scrotal sacs bilaterally. The patient was scheduled for an elective robotic assisted laparoscopic right inguinal hernia repair with mesh, possible bilaterally, in the ambulatory setting. Preoperative labs were within normal limits.

149 Standard antiseptic technique was used to prep the patient and a total of three port 150 site incisions were made for the Da Vinci robot arms to dock and enter. The patient 151 was placed in Trendelenburg position and robotic 8-mm trocars were placed in each 152 anterior axillary line and a 30-degree camera was placed in the up position in the 153 umbilical port. The robot was docked in the standard fashion. The right inguinal 154 region was visualized and incarcerated inguinal hernia was noted. Once hernia 155 contents reduced, a non-inflamed appendix and portion of the cecum was seen in 156 the hernia sac. Type 1 Losanoff and Basson classification Amyand hernia was noted 157 (Figure 1-2).

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158 The appendix, cecum, and pericolonic fat were reduced into the abdomen and the 159 peritoneum was scored from the medial umbilical fold laterally to the anterior 160 superior iliac spine. A preperitoneal flap was created by dissecting the peritoneum 161 away from the spermatic cord vas deferens anteriorly with the hook electrocautery. 162 A 3D max mesh and a 6-inch V-Loc suture were introduced intraperitoneally under 163 direct visualization. The mesh was used to cover the preperitoneal space overlying 164 the direct and indirect inguinal spaces. No direct hernia was observed. The indirect 165 space and rest of the potential hernia sites were covered with mesh with adequate 166 coverage. The mesh was tucked into the small peritoneal pocket and appeared 167 secure without evidence of migration. The peritoneal flap was closed with a running 168 6-inch V-Loc suture. Patient was extubated in the OR and discharged home the 169 same day after a non-complicated postoperative course.

170

171 **DISCUSSION**

Robotic surgery has progressed within the past 30 years from the Puma 560 used in 173 1985 by Kwoh et al to perform neurosurgical biopsies to the NASA influenced Da 174 Vinci Surgical system used today [8,9]. This system is a complex of 4 arms 175 controlled by a remote console usually in the same room as the patient. Through 176 small incisions, the Da Vinci robot features a magnified 3D high-definition 177 visualization of the operative field and allows precise wristed movements with tiny 178 instruments that can bend and rotate far better than the human hand.

179 From their inception, surgical robots have extended the capabilities of human 180 surgeons beyond the limitations of laparoscopic surgery. Currently there are only 181 few small scale studies comparing the two techniques, such as that done at Baptist 182 Health South Florida by Dominguez et al. This single institution study was a 183 retrospective chart review of A total of 123 robotically repaired hernias, 45 of which 184 were bilateral hernias. Researchers concluded that robotic transabdominal 185 preperitoneal (TAPP) inguinal hernia repair is evidenced to be a safe and adaptable 186 approach that allows surgeons to perform this procedure in more complex cases 187 such as those involving incarcerated and/or recurrent hernias [10]. Furthermore, 188 early studies have shown that Da Vinci ventral hernia surgery has a lower rate of

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recurrent hernia as well as a lower rate of pain, and lower rate of switching to open [11, 12, 13].

191 In our case of Amyand hernia, the precision and enhanced visualization provided by the Da Vinci system allowed easy manipulation of the vermiform appendix and 192 193 placement of mesh without trauma to the appendix. This is especially important 194 considering the fact that any trauma endured by the appendix while it is being 195 reduced can increase the risk of appendicitis developing postoperatively [14]. Local 196 trauma while handling the appendix could potential transform classification of Amyand's hernia from Type 1 to Type 4, thus complicating treatment and 197 198 intervention.

199

200 CONCLUSION

Amyand's hernia, the presence of the appendix within the hernia sac, is a rare 201 202 subtype of inguinal hernia and typically is an incidental finding. While there is no 203 consensus on the ideal method for repair, Losanoff and Basson classification 204 provides guidance on management. Robotic surgery is a relatively new field of the 205 minimally invasive surgery spectrum. The superior anatomical imaging of the 3D 206 high definition robotic endoscope coupled with the advanced dexterity, surgical 207 control and degree of motion affords the surgeon a unique advantage over open and 208 laparoscopic surgery. Our experience is the first documented case of robotic repair 209 of Amyand's hernia and demonstrates that this is a safe and viable approach.

210

211 CONFLICT OF INTEREST

Authors do not have any conflict of interests to disclose pertaining to this case report

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214 AUTHOR'S CONTRIBUTIONS

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- Group1 Conception and design, Acquisition of data, Analysis and interpretation ofdata
- 218 Group 2 Drafting the article, Critical revision of the article
- 219 Group 3 Final approval of the version to be published
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- 230 ACKNOWLEDGEMENTS
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275

276 SUGGESTED READING

- 277
- 278 Video
- 279 Robotic Repair of Right Inguinal/Scrotal Hernia:
- 280 https://www.youtube.com/watch?v=uD5dRr48Bzo
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285 TABLES

- Table 1: Losanoff and Basson classification of Amyand Hernia

Classification	Description	Management
Type 1	Normal appendix in an inguinal	Hernia reduction, mesh
	hernia	placement
Type 2	Acute appendicitis in an inguinal	Appendectomy, primary no
	hernia with no abdominal sepsis	prosthetics hernia repair
Туре З	Acute appendicitis in an inguinal	Laparotomy, appendectomy, and
	hernia with abdominal and	primary no prosthetic hernia
	abdominal wall sepsis	repair
Туре 4	Acute appendicitis in an inguinal	Same as type 3 plus
	hernia with abdominal	management of concomitant
	concomitant pathology	disease

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FIGURE LEGENDS

- Figure 1: Robotic endoscope 3D high definition image of right incarcerated inguinal
- 305 hernia. (A)- Incarcerated inguinal hernia, (B)- Medial umbilical fold

Figure 2: Robotic endoscope 3D high definition image of partially reduced Amyand's
hernia.

- **FIGURES**



314 Figure 1: Robotic endoscope 3D high definition image of right incarcerated inguinal

- 315 hernia. (A)- Incarcerated inguinal hernia, (B)- Medial umbilical fold

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327 Figure 2: Robotic endoscope 3D high definition image of partially reduced Amyand's

328 hernia. (A)- Appendix, (B) - Medial umbilical fold