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New Technologies in Endourology

Single Port Access Adrenalectomy

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Abstract

Objective: To report the first single port access (SPA) adrenalectomy to minimize patient discomfort through a less invasive procedure.
Methods/Results: We performed the first SPA in a 63-year-old, otherwise healthy Caucasian female who had a 4.5-cm left adrenal mass that was incidentally discovered on computed tomography scan of the abdomen and pelvis. Through a 2-cm single longitudinal supraumbilical incision extended down to the abdominal fascia, three 5-mm ports were placed through separate facial entry points, to make a triangular port arrangement. The adrenal vein was identified and ligated using hemoclips. The remainder of the dissection was done using hemocoagulation. The adrenal gland was extracted via an EndoCatch bag device by removing one 5-mm port and upsizing to a 12-mm port.
Conclusion: We report on the first SPA adrenalectomy. Although this technology is still in its infancy, the use of a single port for surgery provides a means to provide a potentially better patient outcome with a less invasive procedure.

Introduction

Laparoscopic adrenalectomy was first described in 1992 when Gagner and colleagues reported their technique1 in a patient with Cushing's syndrome due to an adrenocortical adenoma. Since that time, minimally invasive adrenalectomy through either the transperitoneal or retroperitoneal approach has become the standard approach for almost all adrenal tumors.[2] The transperitoneal approach has the benefit of wide working space for instrumentation and earlier ligation of the adrenal vein, and the retroperitoneal approach allows for a more direct access and decreased risk of damage to the intraperitoneal organs. Either approach has been shown to be safe with similar blood loss and no difference in blood pressure and heart rate increments when compared with open adrenalectomy.[3] These patients, when compared to the open approach, also experience a faster resolution of ileus, with decreased analgesic requirements, and have a shorter length of hospital stay and a shorter convalescence with a quicker return to normal activity.[4,5]

As we progress to more minimally invasive surgery, we attempt to continue to minimize patient discomfort, reduce hospital stays, and decrease time to convalescence in a manner that is safe and beneficial to patients. Recently, in 2006 the American Society for Gastrointestinal Endoscopy/Society of Gastrointestinal and Endoscopic Surgeons working group on natural orifice transluminal endoscopic surgery (NOTES) launched the Natural Orifice Surgery Consortium for Assessment and Research, introducing intraperitoneal surgery without an incision.[6] The first NOTES nephrectomy, accomplished in a porcine model, was performed by Gettman and colleagues in 2002 via a transvaginal approach.[8] Although promising, at the present time NOTES surgical procedures need further research, looking at the physiologic consequences and infectious complications. Furthermore, at this stage it requires a team to have the expertise of both an advanced therapeutic endoscopic as well as laparoscopic surgeon.[6]

The potential benefit of decreasing the number of ports utilized in laparoscopic surgery, providing better patient comfort, improved cosmesis, improved pain control, and quicker convalescence, has now been documented within the literature through the use of single port access (SPA) surgery in humans,[7] through the use of high-dexterity instruments (Real Hand™ by Novare Surgical Systems, Cupertino, CA). We now report on the first SPA adrenalectomy, using the Starion TLS (Starion Instruments, Sunnyvale, CA) and the Olympus Endoeye camera (Olympus America, Center Valley, PA) in a patient with pheochromocytoma.

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Methods/Results

The patient was a 63-year-old otherwise healthy Caucasian female who had a 4.5-cm left adrenal mass that was incidentally discovered on computed tomography scan of the abdomen and pelvis. The patient did not have a family history of pheochromocytoma or other history suggestive of familial syndromes such as von Hippel-Lindau or multiple endocrine neoplasia syndromes. Twenty-four-hour urine catecholamines, metanephrines, and vanillylmandelic acid levels were normal and nonindicative of a pheochromocytoma. Laparoscopic removal of the mass was recommended given no prior abdominal surgery and low suspicion for malignancy.

Discussion of procedure

The trunk was stabilized in a moldable bean bag mattress and the body secured to the operating table with a safety strap. A roll was applied under the chest wall to protect the axilla, with the arm suspended across the body. The operating table was flexed to open up the subcostal and flank regions. The patient was tilted to the left to bring her umbilicus anteriorly. A 2-cm single longitudinal supraumbilical incision was made and extended down to the level of the abdominal fascia. The first transparent 5-mm port was placed into the peritoneum and insufflation commenced. A 5-mm 0-degree scope was inserted, and initial exploration revealed no unsuspected findings. The scope was removed and the abdomen desufflated. Bilateral subcutaneous flaps were then raised, extending no more than 1 cm laterally on each side of the central trocar. A 30-degree 5-mm scope was inserted through the transparent 5-mm trocar, allowing visualization of the lateral ports on entry into the abdomen. Next, two additional 5-mm ports were placed through separate facial entry points, to make a triangular port arrangement (Fig. 1). As previously mentioned, the instruments included a Real Hand™ articulating grasper and Maryland dissector engineered by Novare Surgical Systems, which afforded greater mobility over standard laparoscopic equipment (Fig. 2).

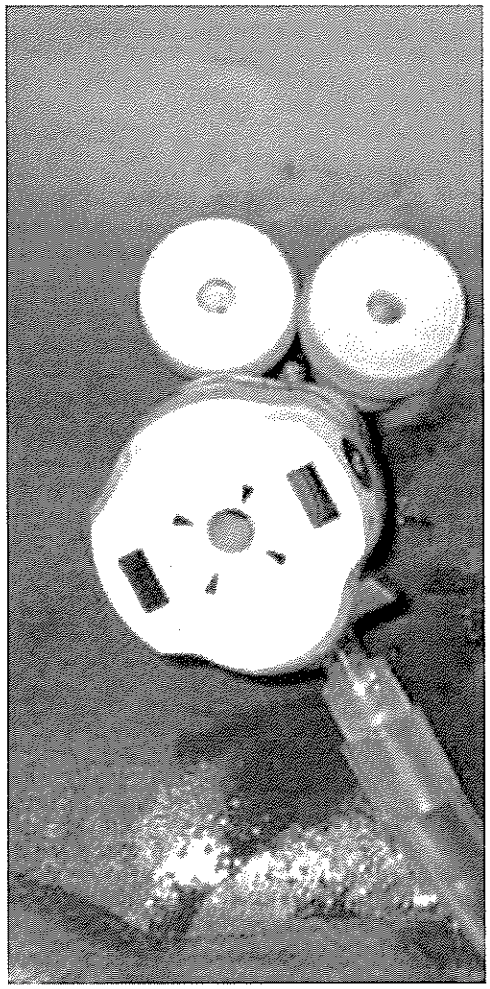

FIG. 1. Trocar positioning.

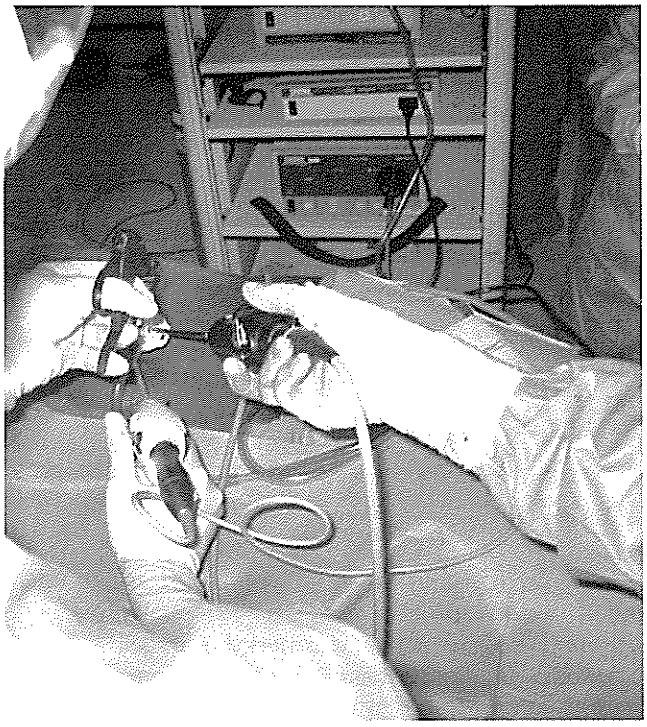

FIG. 2. Surgeon hand positioning and instrument positioning during single port access surgery.

First, the white line of Toldt was incised using the Thermal Lighting Shears (Starion, Sunnyvale, CA) with the aid of the Real Hand™ Maryland grasper. Once the junction of the colonic mesentery and Gerota's fascia was identified, the plane was dissected until the left kidney vasculature was identified. The adrenal vein was identified medial to the gland and was doubly clipped and ligated. Suction was accomplished using the Davol Hydro-Surg Plus laparoscopic irrigator (Davol, Cranston, RI) with Nezhat-Dorsey SmokeEvac Trumpet Valve (Davol), 33-cm tip and conjoined suction and irrigation tubing. The bariatric tip can be used to further the hands from conflicting positions. Alternating use of the Maryland grasper and the Nezhat aspirator by the surgeon's left hand was performed for exposure, although the Starion was predominantly used by the surgeon's right hand for coagulation and dissection. Hemoclips (5 mm) were used when necessary.

Retrieval of the gland was accomplished by exchanging the central 5-mm trocar for a 12-mm trocar and inserting a retrieval bag. The fascial incisions were connected in order

to retrieve the gland through the single skin incision. Closure was completed with several 0-vicryl sutures in interrupted figure-of-eights. The umbilical skin was approximated using a 4-0 monocryl running suture.

The estimated blood loss was approximately 125 mL, and total operative time of 120 min. The patient was not placed on a patient-controlled analgesia but did receive morphine for a total of 6 mg equivalents in the 23-hour admission time and requested only Tylenol for pain at discharge. The patient was discharged on the first postoperative day with no complications to date at 8 months of follow-up.

Discussion

When evaluating a patient for pheochromocytoma, it is important to determine if the tumor is sporadic or hereditary and whether it is unilateral or bilateral. In patients who develop pheochromocytoma, 90% are unilateral. When comparing the operative parameters of the open approach to the laparoscopic approach, there has been no difference observed in heart rate, blood pressure, or blood loss.[3] This along with the documented advantages of minimally invasive surgery including decreased hospital stay and postoperative analgesic requirement and quicker convalescence have provided patients with proven benefits.[4,5] Therefore, with the further decrease in the number of ports, the patients stand to benefit even further through SPA and NOTES surgery.

Hirano and colleagues published the first series of SPA endoscopy in 2005.[9] In their study, they evaluated 53 patients who underwent retroperitoneoscopic adrenalectomy for adrenal tumors via a single large port. This port was created by a 4.5-cm incision, and a 4-cm diameter rectoscope tube was used for direct visualization. There was no insufflation, and the procedure was otherwise performed using standard laparoscopic equipment. Even though this procedure was not truly laparoscopic, it provided a platform for the evolution of SPA surgery.

Through our experience we have identified three main limitations of SPA surgery: (1) limited maneuverability and tearing of the port site fascia, (2) difficult visualization, and (3) potential difficulty with vascular control. First, when evaluating maneuverability, traditional laparoscopic instruments have two flaws when being used for SPA surgery. First, the hand pieces of the instruments are traditionally bulky, limiting the full mobility of the instruments, and with the increase in torque needed to perform a task, fascial tears could result, which would result in loss of pneumoperitoneum and failure to progress. In an effort to overcome this need, the Real Hand™ instruments including the articulating grasper and Maryland dissector were used. This provided a greater range of motion, making the surgery more efficient and safer for the patient.

Second, any laparoscopic or endoscopic surgeon realizes that without proper visualization, the procedure will not only fail to progress but will pose a risk to the patient. For this reason, we used the Olympus Endoeye, which is a 5-mm endoscopic camera. These benefits of using the Endoeye include articulation in four directions, allowing for direct visualization of normally difficult-to-see sites within the abdominal cavity. Additionally, another advantage is the "chip on the tip" eye inside technology, allowing for a wider field of view with fewer lenses and better distribution of light and reducing the need to focusing.

The third difficulty is obtaining vascular control. During traditional laparoscopic procedures at our institution, we use the Harmonic Scalpel (Ethicon, Summerville, CA). However, we found that during the SPA procedure, the harmonic scalpel has a very bulky handle and does not allow easy mobility when in close proximity to the camera and second instrument. In addition, it has larger instrument tips, making delicate dissection difficult. Therefore, for this procedure the Starion TLS (5-mm laparoscopic Thermal Ligating Shears) was used to control all vasculature except for the initial control of the adrenal vein. The Starion uses thermal energy and pressure to simultaneously coagulate and then divide blood vessels as well as other soft tissues. This technology has been shown to have less collateral damage when ligating vessels 1 mm in diameter in pig mesenteric samples evaluated microscopically in comparison to the coagulation of the same type of vessels using the ultrasonic coagulator.[5] The allowance of better precision, decreased collateral damage, and good vascular control through the use of the Thermal Ligating Shears demonstrates that this instrument may show a benefit particularly in cases where greater precision is necessary.

Future considerations to further improve SPA surgery would be using an occlusive device (similar to GelPort™ technology [Applied Medical, Rancho Santa Margarita, CA]) to reduce the shearing of fascia and therefore maintain the pneumoperitoneum. This may also allow for multiquadrant surgery to be performed more easily. In addition, articulating coagulation devices would provide better mobility and vascular control in a very limited working space. Last, in order to demonstrate the beneficial outcomes from SPA surgery, a comparative prospective trial would be needed to look at results of procedural outcomes and postoperative outcomes including pain control, hospitalization time, and time to convalescence.

Conclusion

We report on the first SPA adrenalectomy completed using the Starion TLS and Olympus Endoeye 5-mm endoscope. Although this technology is still in its infancy, the use of a single port for surgery provides a means to provide a potentially better patient outcome with a less invasive procedure.

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Abbreviations Used

NOTES = natural orifice translumenal endoscopic surgery
SPA = single port access