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CLINICAL TECHNIQUES AND TECHNOLOGY

Da Vinci robot–assisted endocrine surgery: Novel applications in otolaryngology

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Endoscopic procedures and minimally invasive surgeries have been touted for their improved postoperative outcomes while preserving comparable efficacy to open procedures. These results provided impetus for the creation of the da Vinci Surgical System (Intuitive Surgical, Inc, Sunnyvale, CA). This revolutionary robotic technology consists of a master console linked to a video cart mounted with robotic arms. The surgeon sits at the computer console, in front of a three-dimensional (3D) display gathered by a binocular endoscope (Fig 1). Three-dimensional movements of the surgeon's hands in the console are translated to the robotic instruments to perform identical 3D movements. While transferring these intended operations, the computer filters out regular oscillations, such as resting tremors. The robotic tower supports the use of three to four robotic arms, which are attached to the video telescope and surgical instruments.[1] These features separate the da Vinci system from other endoscopic instrumentation.

While the emergence of robotic technology has been embraced avidly by several specialties including cardiothoracic and urological surgeries, otolaryngology has not widely implemented its use in the surgical management of head and neck diseases. In the porcine model, the da Vinci Surgical System has demonstrated to be effective in four different types of neck surgery, including a neck dissection and thymectomy.[2] Surgical robotic use in human patients by otolaryngologists in the United States is limited to excision of a vallecular cyst.[3] This report reviews our experience with two cases of robot-assisted endocrine surgery and, to our knowledge, represents its first reported application in otolaryngology literature.

PATIENTS AND RESULTS

Case 1

A 62-year-old male was referred for evaluation of primary hyperparathyroidism. Palpation of the neck failed to reveal any masses. Delayed images of a Sestamibi nuclear medicine scan with Tc-99m revealed focal retention of radiotracer in the midline of the superior mediastinum.

After induction of general endotracheal anesthesia, the patient was prepped on the operating table in semi-supine position, resting on his left side. The robotic cart of the da Vinci system was wheeled into the right side of the operating table (Fig 1). The computer console was placed remotely away from the robotic cart. Three 2-cm incisions were made in the right hemi-thorax for use as ports for the video telescope and surgical instruments. Thoracic surgery assisted during the case by providing exposure to the inferior neck and anterior mediastinum. The otolaryngology service continued dissection with the da Vinci system in the right anterior mediastinum. The thymus was carefully dissected away and excised. After sectioning, an adenoma-appearing mass was identified in the left inferior thymus. Intraoperative histopathological analysis confirmed tissue of parathyroid origin. Intraoperative monitoring of parathyroid hormone levels supported this finding.

The entire procedure was performed with the da Vinci system. It was executed with moderate ease and the patient tolerated it without complication. His postoperative course was uneventful. The patient was discharged on postoperative day five.

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The research presented here is in accordance with and approval of the policies of the Office of Health Research & Institutional Review Board of The George Washington University, Washington, DC.

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Figure 1 The surgeon controls the da Vinci robot from a computer console positioned remotely away from the patient. The robotic tower, wheeled into the side of the operating table, supports robotic arms. The central arm serves to maintain the video telescope (12 mm diameter), which contains two separate 4-mm scopes that provide the surgeon a three-dimensional view. The remaining arms hold surgical instruments (8 mm diameter). © *2006 Intuitive Surgical, Inc.*

Case 2

A 69-year-old female presented for evaluation of a long-standing history of enlarging goiter and hyperthyroidism. Computed tomography demonstrated a 7- to 8-cm goiter with mediastinal extension to the level of the aorta. Similar to the case above, thoracic surgery used the surgical robot to provide intrathoracic exposure to the superior mediastinum.

With the da Vinci Surgical System, the otolaryngology service dissected the thyroid mass away from the mediastinal structures including the aorta, superior vena cava, trachea, esophagus, and subclavian artery. Care was taken to preserve the vagus and phrenic nerves. Following the robotic release of the mediastinal attachments of the thyroid, an open-neck approach was used to dissect and remove the thyroid from the neck. Specimen analysis confirmed a benign multinodular goiter. The case was completed without difficulty and the patient tolerated the procedure without complication. The patient was discharged on postoperative day five.

DISCUSSION

Several surgical specialties have embraced the da Vinci robot, since the FDA approved its use in July 2000.[1] Otolaryngologists have been slow to implement its use in their clinical practice. This is mostly in part due to the limited areas of application in the head and neck. However, we have presented an area of use that may benefit the patient, allowing for less morbidity, faster postoperative recovery, and better cosmesis.

The obvious advantage of the da Vinci system is that it is a stride in the direction of minimally invasive surgery. This has been associated with improved postoperative outcomes while preserving equal efficacy to open procedures. However, there are several other advantages to the application of this system, including increased surgical precision. Unlike other endoscopic techniques, the da Vinci system enables three-dimensional viewing of the surgical field and filters out irregular oscillations, such as hand tremors. Additionally, it allows for surgeons to utilize open surgical movements through keyhole-sized surgical fields.

Our experience with the da Vinci operating system makes us optimistic about its utility in other otolaryngology applications, including laryngotracheal and sinonasal surgery. In vitro use of the da Vinci robot has confirmed some of these envisioned possibilities. In both porcine and human cadaveric models, otolaryngic procedures have been successfully executed.[2,4] Robotic surgery provided assistance in operating within the narrow larynx,[4] as it provided the surgeon a three-dimensional view and allowed for wide surgical movements. Reported problems with the operation were secondary to the widely spaced ports of the da Vinci system, as its instrument arms were originally designed to be utilized in the thorax or abdomen. With continued research and development, we are confident that surgical robots will be engineered to tailor the size and versatility of smaller operative fields within the head and neck. Ultimately, this will allow for further trials of application in the sinonasal and endolaryngeal regions. Other reported disadvantages of employing the da Vinci robot include an exhaustive preoperative

system setup, exorbitant equipment costs, and a formidable learning curve.[5]

It is highly recommended that centers initiating protocols for using robotics gain sufficient experience with the technology and the particular visibility windows. At our center, other surgical specialties have performed robotic-assisted surgeries for treatment of coronary artery disease, esophageal lesions, prostate disease, and lung masses. Similar experience by these specialists at other institutions can allow interested otolaryngologists an opportunity to learn telerobotic surgery. In our reported cases, if conventional approaches were utilized, both thoracic surgery and a partial or complete sternotomy would have been required. With the use of the da Vinci robot, only the latter is eliminated. This trend has not only minimized patient morbidity, but allowed thoracic surgeons to introduce the use of the da Vinci robot to our department.

Within many surgical specialties, robotics technology has demonstrated itself as an effective means of minimally invasive surgery. As surgical robotics is engineered to operate within the confines of the head and neck, otolaryngologists may find themselves welcoming this innovative application into their practices. Future studies and investigations will most likely confirm their safety and surgical efficiency.

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