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Endoscopic endocrine surgery in the neck

An initial report of endoscopic subtotal parathyroidectomy

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Abstract
Background: The fervor surrounding minimally invasive surgery, which began with laparoscopic cholecystectomy in the late 1980s, has spread to nearly all surgical specialties.
Methods: After experimental success in an animal model, we recently performed our first case of endoscopic subtotal parathyroidectomy in a 37-year-old man. The patient, who had a history of severe pancreatitis and pancreatic calculi, was diagnosed as having hyperparathyroidism. The option of endoscopic parathyroidectomy was proposed and accepted. After placing the first trocar directly under the platysma, a space was created by bluntly dissecting with the tip of a 5-mm endoscopic camera. Four parathyroid glands were identified, and after a frozen-section diagnosis of parathyroid hyperplasia, three-and-one-half of the glands were resected.
Results: The patient developed slight hypercarbia and subcutaneous emphysema during the procedure, but no other problems were noted. His postoperative course was otherwise unremarkable.
Conclusions: This is the first case reported of an endoscopic parathyroidectomy. This experience makes us optimistic about the future of endoscopic neck surgery.

Key words: Endoscopic surgery — Thyroidectomy — Parathyroidectomy — Surgical technique — Hyperparathyroidism

Surgical procedures for the endocrine organs of the neck are very common, well established, and, for the most part, well tolerated. These operations, mostly for thyroid masses and hyperparathyroidism, began about 100 years ago [8] and have changed very little over the last several decades.

Since the late 1980s, minimally invasive surgical techniques have gained interest among all surgical specialties. Practical experience in endoscopic surgery, however, has, until recently, been limited to procedures performed in the abdomen or thorax. This is due to these areas having a preexisting cavity or space in which to work. With the advent of preperitoneal and retroperitoneal laparoscopy via balloon or blunt dissection, the knowledge about creating and then working in a potential space has grown quickly. We have used these methods in the laboratory to develop techniques for retroperitoneal adrenalectomy, mediastinal surgery, and, more recently, endoscopic surgery in the neck. Over the last 18 months, we have attempted to define the role of minimally invasive techniques in a variety of neck operations. A successful trial of thyroid and parathyroid surgery in the laboratory made these procedures appear feasible and safe, and after gaining institutional approval, these techniques were taken to the operating room.

A young man suffering from hyperparathyroidism and associated chronic, severe pancreatitis underwent a successful endoscopic subtotal parathyroidectomy. We present this case as an initial report of the endoscopic neck surgery and discuss the general issues and a future possibilities of this procedure.

Clinical experience

Patient's history

The patient was a 37-year-old male with a history of chronic, severe pancreatitis, pancreatic calculi and a dilated pancreatic duct. During his evaluation for pancreatitis, he was found to have hypercalcemia and an elevated serum parathyroid hormone level. An ultrasound of the neck did not reveal an adenoma, but a ^{99m}Tc-SESTAMIBI scintigram showed four areas of abnormal uptake in the neck, which was consistent with primary hyperparathyroidism. He underwent a successful laparoscopic longitudinal pancreaticojejunostomy with cholecystectomy 2 weeks prior to the endoscopic parathyroidectomy.

Surgical technique and postoperative course

The patient was placed in a supine position with his neck in extension. Under general anesthesia, the neck area was prepared and draped in the fashion typical for conventional surgery. A 5-mm skin incision was made

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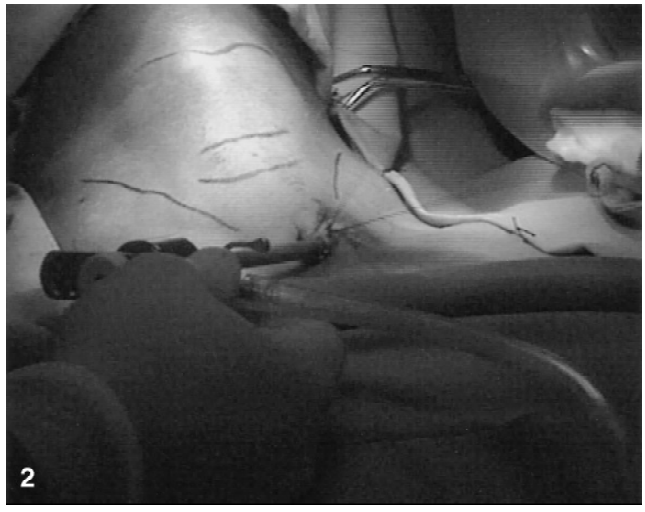
just above the sternal notch in the lower midline of the neck (Fig. 1). After sharply dissecting below the platysma, a 5-mm trocar was inserted. A purse-string suture was placed around the trocar to prevent both gas leakage and the trocar from slipping out of the wound (Fig. 2). Carbon dioxide was then insufflated to 15 mmHg. A 5-mm, 30° telescope was inserted through the trocar, and the subplatysmal tissue was very gently bluntly dissected with the tip of the telescope. Once enough space was created, another 5-mm trocar was inserted in the right neck about one finger breadth anterior to right sternocleidomastoid muscle. An endoscopic scissors was used for additional blunt and sharp dissection to enlarge the subplatysmal space (Fig. 3). A working area of approximately 5 × 7 cm was formed. Two more 5-mm ports were placed in the left and right neck. Using an endoscopic hook and an electrocautery, the strap muscles were divided vertically in the midline and retracted laterally. The isthmus of the thyroid gland was identified and then both lobes were dissected from the investing fascia (Fig. 4). The lower pole of the left lobe was explored first by gently mobilizing the lateral margin of a thyroid gland medially. A curved dissecting clamp, passing through one of the right-sided ports, was used to roll or pull the gland toward the midline. The 30° endoscope and a dissecting clamp, scissor, or hook were often placed on the side being dissected. The left inferior parathyroid was the first to be identified and a biopsy was performed. A frozen-section examination determined it to be a normal parathyroid. The left superior parathyroid was found after dissecting the upper portion of the thyroid and the medial edge of the carotid sheath. It was also reported to be a normal parathyroid per biopsy. The recurrent laryngeal nerve on this side was observed but not extensively mobilized. The right inferior and superior parathyroid glands were next identified after near identical dissection along the right lateral side of the thyroid. Biopsies of these two parathyroid glands demonstrated hyperplasia. Once the four parathyroid glands were identified, three-and-one-half glands were removed; one-half of the right lower parathyroid was preserved. Feeding vessels were clipped with a 5-mm clip applier (Fig. 5). Before completing the operation, a 3-mm closed suction drain was placed under the platysma through the site of the most inferior trocar on the right. The platysma and skin were closed with 4-0 sutures.

The procedure took nearly 5 h to perform during which the patient developed mild hypercarbia ($PaCO_2$ between 41 and 45 mmHg) which was controlled by a slight increase in minute ventilation. The insufflation required to maintain this space also generated subcutaneous emphysema which extended from the patient's face to the lower abdomen; this resolved within 2 days postoperatively (Fig. 6). There was no pain nor other complications related to the diffuse carbon dioxide. He had no evidence of recurrent laryngeal nerve injury, and the cosmetic result was excellent. He was discharged on 4th postoperative day without other complications.



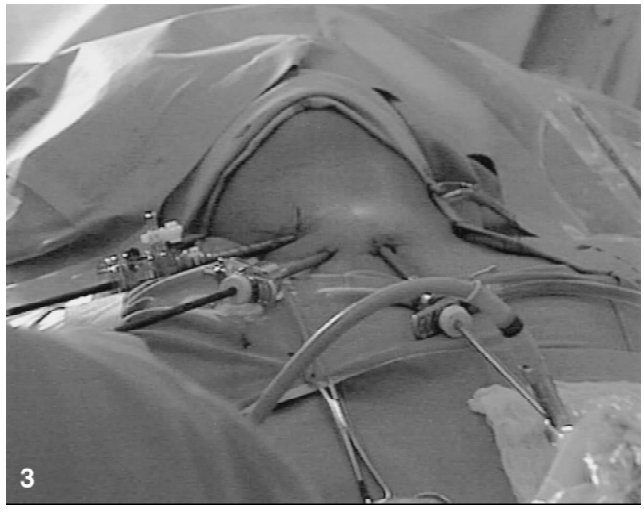


Fig. 1. A small skin incision was created in the lower midline.

Fig. 2. A 5-mm trocar was inserted through the wound into subplatysmal space and secure with a purse-string suture.

Fig. 3. Outside view during the procedure. Once we create the space, we inserted other trocars, which allowed utilization of the endoscopic instruments.

Discussion

In 1891, Von Recklinghausen described the characteristic fibrocystic disease of bone that was later recognized to be produced by hyperparathyroidism. Askanazy, in 1903, was the first to propose the association between parathyroid enlargement and bone disease. Schlagenhaufer, who also believed that parathyroid tumors may be the cause of bone disease, suggested in 1915 that excision of the gland might be a possible treatment. This hypothesis was confirmed when Mandl performed the first parathyroidectomy a decade later in 1925 in Vienna. The first successful surgical excision of a parathyroid neoplasm in the United States was performed in 1929. Also, in the early 19th century, Parry, Graves, and von Basedow gave descriptions of hyperthyroidism or exophthalmic goiter. The surgical treatments for this disease were first started by Billroth in the 1860s. After that, Theodor Kocher performed more than 2,000 cases in the late 19th century [2, 8].

Surgical procedures involving the thyroid, parathyroids, and other structures in the neck are well tolerated and safe. However, generally, surgical procedures for endocrine organs can lead a hormonal imbalance due to the partial or

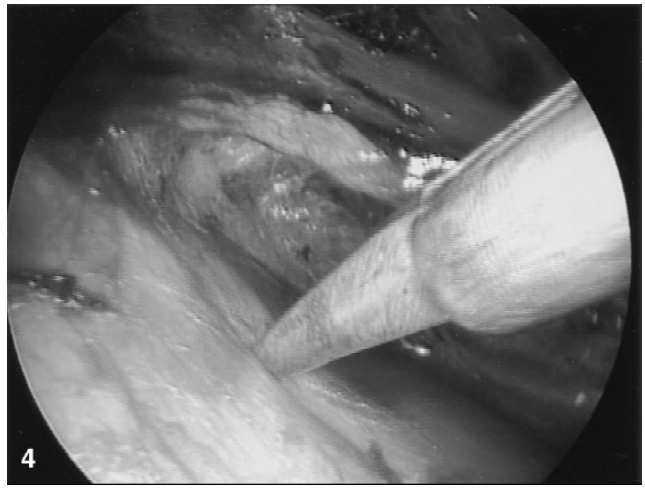
complete resection of the organ. Whenever performing endocrine surgeries, surgeons should be aware of the possibility of hormonal disorder after surgery. It is widely recognized that postoperative hypothyroidism or hypoparathyroidism is one of the most common complications after these procedures. As many articles show, the incidence of postoperative hypothyroidism or hypoparathyroidism is 10–50% [1, 9–11] and 2–5% [3, 7, 12], respectively. On the other hand, an insufficient resection can be a cause of a persistent hyper function of these organs. The operative scar and its complications are also an important issue. These procedures require wide transverse skin incisions, approximately 7–10 cm, along the neck. The prevalence of the hyperthyroidism and hyperparathyroidism is much higher in women. The male-to-female ratios are 1:6 and 1:4, respectively [8]. Considering these factors and the large scar in the neck, reducing the size of skin incision is a big benefit for patients who are suffering from these diseases.

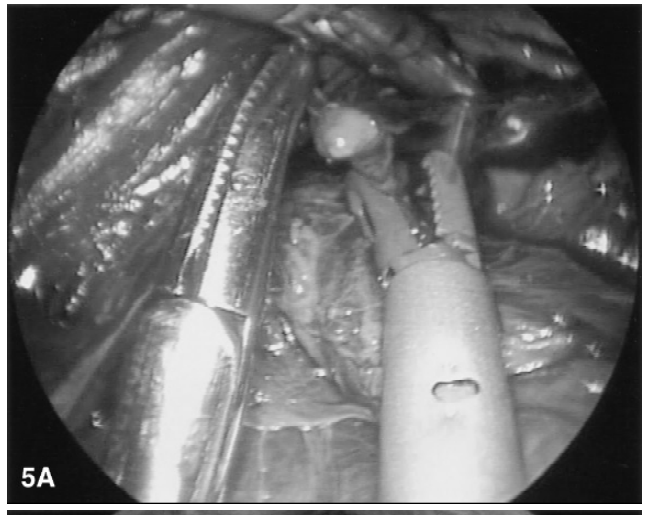
The advent of laparoscopic cholecystectomy has ushered in a new era of minimally invasive surgery which has grown to include nearly all intraabdominal and retroperitoneal surgery and a number of thoracic, vascular, and spinal procedures. Our and other research groups have successfully developed these methods in the laboratory and applied them in the operating room. Of late, we have worked in an animal model to define the role of endoscopic surgery in a variety of procedures performed in the neck. Upon completion of a successful trial of thyroid and parathyroid surgery in the laboratory, and after gaining institutional approval, these methods were taken to the operating room. A subtotal parathyroidectomy via four 5-mm trocars was performed with minimal morbidity and an excellent cosmetic result.

There are several theoretical advantages of endoscopic surgery of the neck. Perhaps the most important, which was recognized both in the laboratory and in the operating room, is the precise anatomic detail seen through the greatly magnified view (10–20×) one receives using an endoscopic camera. Small nerves and blood vessels are easily identified, which might possibly contribute to the reduction of the 1–3% incidence of recurrent laryngeal nerve injury [4–6]. This technique also allows easy reach into hidden areas, such as behind the sternum, without extending the wound onto and through the chest. As for the other minimally invasive techniques, decreased pain and better cosmetic results may be the greatest expectations from this procedure due to the decreased size of skin incision. This may also result in a lower incidence of postoperative wound complications. Transection of the neck musculature and the subsequent functional loss that result could also be decreased.

In contrast, there are also some disadvantages to this procedure. One is the lack of direct palpation and manipulation. The inability to use tactile sensation may make locating a tumor or node more difficult; with endoscopy in its present state, it must be seen to be appreciated. Creating enough space to work can also be difficult. A narrow working area results in an inability to see and perform fine surgery. In laparoscopic or thoracoscopic surgery, the space needed to operate already exists. In the neck, however, a working area needs to be created by bluntly dissecting the subplatysmal tissue.

Another space-related problem is gas insufflation. To maintain the working area, carbon dioxide gas was insufflated into the subplatysmal space, which resulted in significant subcutaneous emphysema and a slight respiratory acidosis. Both problems quickly resolved, but each represents operative morbidity. The final and perhaps the most





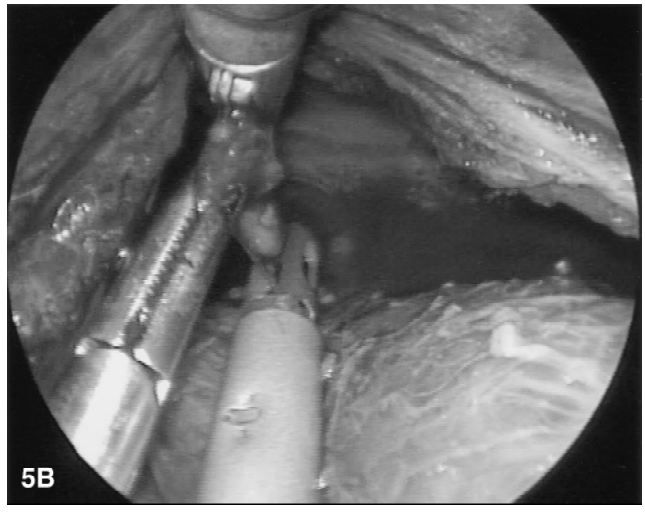


Fig. 4. After dividing the strap muscle, the isthmus of the thyroid gland was identified and then both lobes were dissected from the investing fascia.

Fig. 5. Once the four parathyroid glands were identified, three-and-one-half glands were removed. Feeding vessels were clipped with a 5-mm clip applier. **A** The left lower; **B** the left upper parathyroid gland.

Fig. 6. Neck area, 3 days after surgery. Subcutaneous emphysema was absorbed in 2 days.

limiting problem with implementing this procedure is that it requires a surgeon with advanced endoscopic skills. Experience working in a two-dimensional field, performing fine dissection endoscopically, and using an angulated scope is a must in highly advanced minimally invasive surgery. Practice in animal models can help overcome the handicaps associated with endoscopic surgery in general and neck surgery in particular.

During the operation and in retrospect, we appreciated several technical changes that either were or could have been implemented. One was simply positioning of the patient. Initially his neck was extended the same as in conventional surgery. The extra tension on the skin and subcutaneous tissues, however, prohibited us from creating an adequate subplatysmal space. Moving the neck into a more neutral posture improved the exposure tremendously and expedited the operation. This problem may actually be best managed by placing the patient in a slightly flexed neck position. The use of helium in the place of carbon dioxide for insufflation of the subplatysmal space is an addition modification that we have adopted and will apply to future cases. This should decrease the incidence of respiratory acidosis and subsequent need for hyperventilation, but it probably would not eliminate the subcutaneous emphysema. A mechanical elevation, as used in laparoscopy, may provide a viable alternative and aid in solving these problems.

Expansion of minimally invasive surgery into the cervical area will be enhanced by the future development of instruments for this particular area. Based on our experience, trocars need to be shortened to about 5 cm and need to have a small balloon tip or some other mechanism which prevents slipping. Instruments should also be shorter; 15–18 cm would be an adequate length to reach across the neck in any patient. Miniaturization of instruments for this area should also include decreasing the diameter of the tools. The recent introduction of 2-mm instruments and scopes to abdominal surgery has given us hope for their application in the neck. In this scenario, the ''needlescopic'' instruments would be used for optics, dissection, and retraction and a single 5-mm port would be used for the clip-applier, specimen extraction, and the 5-mm scope as needed. Our preliminary investigation has demonstrated that they are a workable alternative in the neck.

This report has demonstrated the feasibility of the endoscopic parathyroidectomy and dissection of the thyroid. At this point, only cosmetic advantage has been found and more cases will need to be done to confirm this statement and hopefully decrease operating time and hospital stay.

The treatment of concurrent thyroid disease is an unresolved problem and it may be necessary to convert to an open approach to treat both. We believe endoscopic surgery may find a role in endocrine surgery in the neck, upper esophageal myotomy, excision of a Zenker's diverticulum, and otolaryngologic procedures. We have continued our experimental endeavors in the laboratory to better define these and other cervical operations in an effort to incorporate them as part of minimally invasive surgery in the future.

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