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Short Commentary

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Operating Room Assessment in Endoscopic Skull Base Surgery

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Introduction

Since the introduction of endoscopic endonasal surgery for skull base pathologies in the 1990s [1], increasing experience with this technique has led to many progressive changes in patient positioning, technique, and assessment in the operating room. In addition, new surgical instruments have been developed for endoscopic endonasal skull base surgery. We present our experience and assessment of the operating room.

Materials and methods

We report our experience in assessing the operating room and surgical instruments in the last 218 endoscopic endonasal skull base procedures.

Results

Operating room assessment: For the first procedures, preparation of the operating room was time-consuming. Over time, we standardised the position of all devices (Table 1). After intubating the patient, we positioned the magnetic flat-panel emitter under the patient's head and performed magnetic neuronavigation. We never used a Mayfield head holder so that we could move the patient's head if necessary.

Position of the patient: The patient is positioned supine, in neutral head position for pituitary surgery, in extended head position for anterior fossa surgery, and in hyperflexive head position for clivus and craniovertebral junction surgery. We drape the entire body except the nose and right paraombelical abdomen if we need autologous fat.

Endoscope holder: Prior to surgery, an 800-bar pneumatic high-power holder arm (Mitaka) is placed on the left side of the patient and attached to the operating table with a light adapter, then it is covered with a punctum holder drape. We alternate between the freehand and endoscope holder techniques as needed, but for deeper procedures, such as sellar, suprasellar, and parasellar, we prefer the endoscope holder to have a fixed endoscope and operate safely with both hands. Especially in long procedures, the pneumatic endoscope holder helps and improves ergonomics in neurosurgical endoscopic procedures. In our experience, the endoscope holder has also proven to be very helpful during 3D procedures.

Endoscopic equipment: The endoscopic column is positioned in front of the surgeons, with two screens for the surgeons and for the nursing staff and anesthesiologist. 0, 30, 45 and 70 degree, 4 mm diameter and 18 cm length rigid Storz endoscopes have been used. In the last 8 procedures, we have had our experience with 3D endoscopes. A foot pedal irrigation system is always used to clean the surgical field during the procedure. Instruments were always inserted along the endoscope for the two-nostril, two-three and four-hand technique.

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Position of surgeons: Surgeons are positioned in front and to the side of the patient's head.

They work under observation of endoscopic screens. Ultrasound aspiration, laser and coagulation systems are positioned above the patient's feet.

Surgical tools: Bayonet instruments used in microsurgical techniques have been replaced by straight instruments so that they can be inserted along the endoscope and rotated in all directions. The tip of many instruments is the same as in microsurgical pituitary surgery, except for some tools and curved instruments.

In the endoscopic technique, there is a narrow working space, so the classic bipolar coagulation often cannot be used, but a special bipolar punch can be used. We perform endonasal coagulation with monopolar suction coagulation and more recently with the Tallio laser. The Tallio laser is a very effective tool for many neurosurgical procedures and brings many improvements in endoscopic surgery, especially in hypertrophic turbinates, polipathologies, nasoseptal flaps and dural coagulation and cutting.

Discussion

The introduction of endoscopic endonasal surgery in the early 1990s [1,2] suddenly showed the possibility of approaching pituitary patology with many advantages over microsurgical procedures. In fact, the microsurgical procedure was performed with a microscope outside the surgical field, looking forward through a long tunnel (speculum) and finally seeing the sella turcica. No view was possible outside the nasal speculum. The endoscope is inserted into the surgical field and can be advanced as far as the surgeon needs. We can reach any approach and always look around the corners, with the ability to use an angled endoscope and increase the view of the surgical field.

With this new perspective, we soon found that it was possible to reach not only the sellar region, but the entire skull base contents in the nose. So we did a lot of anatomical studies. Thank you to the great laboratory of Professor Manfred Tschabitscher at the College of Vienna, we did many cadaveric studies [3,4]; then in Pittsburgh, together with Dr. Jho, we studied and showed the anatomy of the cavernous sinus with different endoscopic surgical approaches [5-7]; and with Prof. Tschabitscher and Dr. Jho, we were the first in the world to show that the ventral craniovertebral junction, C1 and C2 could be reached by an endoscopic endonasal approach [8,9]. All these anatomical studies opened new important perspectives, and today these operations are routinely performed in most endoscopic skull base centers around the world.

Even though the endoscopic technique has broadened the indications for endonasal skull base pathology, this technique always requires a previous cadaveric study in the laboratory in order to have a precise knowledge of the anatomy from an endonasal point of view. Since the first procedures, we have learned to deal with intraoperative hemorrhage. Intraoperative hemorrhage can be frustrating because the surgeon cannot see anything during the procedure. Therefore, close collaboration with the anesthesiologist is essential. We use local nafazoline and ropivacaine-cottonoid, without epinephrine. The anesthesiologist provides controlled hypotension and good analgesia. For carotid hemorrhage and intracranial hemorrhage, we use Floseal and carotid neck compression. In the initial procedures, the surgeon must learn to move the endoscope gently in the nose to reduce nasal hemorrhage by performing precise movements to reduce bleeding and operative time. Multitasking instruments are very useful in this operation. An aspiration coagulation system is always used, and recently the introduction of the tallium laser has improved coagulation efficiency. The tallium laser is suitable for coagulation and incision during the nasal and endosellar periods and proves to be very efficient in coagulation and incision of the dura sellaris. Both instruments complement each other, shortening surgical time and improving outcomes and surgical comfort during surgery.

Many improvements have been made as the technique has evolved. Since the first procedure, a Mayfield head holder has not been used, allowing the head to be moved as needed during the procedure. Magnetic neuronavigation with a flatter transmitter under the patient's head has always been used so that the head can be free of any reference frame. Mitaka's pneumatic endoscopy holder is very useful. It is very easy to maneuver, but once it is fixed, it is very stable. This tool is very useful because it allows a wide range of positions and can always be placed in both nostrils with a comfortable and plastic movement without fatigue of the surgeon. The presence of the Mitaka holder improves the space for hand movements in a very narrow surgical field.

In this procedure, it is important to improve ergonomic principles [10]. Xu et al. reviewed 50 articles on ergonomics in endoscopic skull base surgery to highlight the importance of adopting best practices. Even though the endoscopic procedure is less invasive and traumatic for patients, it is technically challenging for surgeons.

The assessment of the operating room must be carefully planned beforehand. In figure 1, we have shown our surgical planning for endoscopic endonasal skull base surgery.

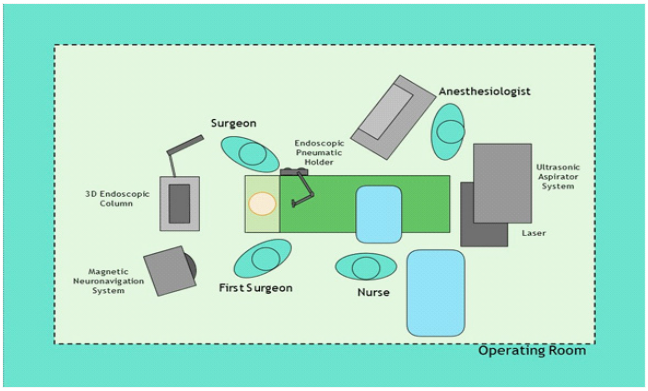

Figure 1: Operating room assessment for endoscopic skull base surgery.

Teamwork is very important to optimize preoperative and operative times. After anesthesia, all technical devices were placed. First, magnetic neuronavigation planning is performed. The neuronavigation screen is placed in front of the surgeon on the left side. Then the pneumatic endoscope holder is placed to the left of the patient. The endoscope column with two screens is placed in front of the surgeon. Disinfection of the surgical field (nose and right paraombelical region) and draping of the patient are performed. The endoscope holder is covered with a special sterilization device.

The first surgeon is placed on the right side of the patient, and the second surgeon is placed on the left side. In the endonasal phase of the procedure, we usually use the freehand endoscope technique, and if we have enough space, usually after opening the sphenoid sinus we attach the endoscope to the pneumatic holder to have both hands free and to reduce surgeon fatigue and the risk of accidental mishandling. We have found this technique to be very helpful and can change the procedure at any time. In the last 8 procedures, we have used 3D endoscopes in endosellar and intracranial phases. Once the endoscope is attached to the mount, the surgeon doesn't have to change the screen. This is because with 3D glasses, it can be very uncomfortable to look from the screen to the nose or the surgical field. We found the combination of the endoscopy holder and 3D endoscopy very helpful (Figure 2). The 3D view was very helpful in improving depth perception and preserving important neurovascular structures. Depth perception is the limit of the 2D camera, and with the 3D endoscope we can now overcome this limit [11]. In the intracranial phase of the procedure, we found the 3D vision very useful, similar to microscope vision and with the possibility of a really similar microscopic procedure.

Figure 2: Holder arm with 3D endoscope technique.

Conclusions

Endoscopic endonasal skull base surgery is still a difficult procedure. Many improvements have been made over the years, but the ergonomics and surgical instruments aren't yet mature. In our experience, accurate assessment of the operating room improves surgical ergonomics and surgical outcomes. The pneumatic endoscope holder has been routinely used since 2010 because it reduces surgeon fatigue and improves precise two-, three-, and four-handed procedures in a very narrow surgical field. In addition, the endoscope holder is very useful in 3D endoscope procedures because the surgeon doesn't have to move the 3D glasses from the screen to the patient's nose to insert and move the freehand endoscope technique. The 3D technique has been used in the last 8 procedures and has improved our depth perception, with a true microscope-like view and better control of the lesion and neurovascular structures.

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