

Clinical research of intraoperative image-guidance in endoscopic nasocular operation

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Abstract

- **AIM:** To evaluate the availability and our experience of intraoperative image-guidance in endoscopic nasocular operation.
- **METHODS:** Seven cases of endoscopic nasal surgery with intraoperative image-guidance were retrospectively reviewed, including 3 cases of optic nerve injury; 3 cases of foreign object of optic behind the eyeball; 1 case of retrobulbar tumor (angioma).
- **RESULTS:** The preoperative preparatory time would take 15 minutes, including coordination, head holder localization, conventional instrument registration. In our cases, the localization accuracy between 3-D image landmarks of navigation system and actual anatomical landmarks was less than 1.3mm. The optic nerve and other anatomical points could be orientated accurately in intraoperative procedures. No complication occurred.
- **CONCLUSION:** Nasal endoscope combined with image-guidance systems provides accurate anatomical localization of anterior skull base with enlarged operation field. It is possible for surgeons to observe important anatomical structures during endoscopic surgery. It could increase the effectiveness and decrease surgical complications, especially in complicated cases.
- **KEYWORDS:** operation on orbit; image-guidance systems; nasal endoscope

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INTRODUCTION

Because the orbital complex, narrow space, a number of vital organs, so anatomical localization is very important for orbital surgery. Recently, technology for computer-assisted surgery was introduced and popularized to improve the overall safety of orbital surgery. This technology allows a direct comparison of intra-operative anatomy with preoperative image information. In this study, a Medtronic, Inc navigation System for navigation was used during transnasal endoscopic surgeries.

MATERIALS AND METHODS

Materials Since August 2008 to December 2009, 7 cases of endoscopic nasal surgery with intraoperative image-guidance were retrospectively reviewed, including 3 cases of optic nerve injury; 3 cases of foreign object of optic behind the eyeball; 1 case of retrobulbar tumor (angioma). 6 males, 1 female, aged 23-61 years, mean age was 45 years.

Methods

Equipment image-guided system Medtronic, Inc; Nasal endoscope: STOZE Inc, Germany; Power system operation: Medtronic XPS3000, Inc.

Preparing for surgery A high-resolution CT spiral scan with serial 1mm thick slices on a horizontal plane was obtained 1 or 2 days before surgery. The image data was transferred to a computer workstation via an optical disk to generate 3-D data, from which nine to eleven reference markers were selected for calibration before the surgical procedure. At the beginning of each case, a special headset was placed on the patient's head, which permitted attachment of a reference flame with light-emitting diodes for optical tracking. The navigation functions were activated immediately after the position of the head was determined. The position of the tip of the inhaler was displayed on the workstation's screen indicating the location of the target and its adjacent normal structures, confirming the proposed operative field. In all cases, transnasal endoscopic surgery was performed as done previously.

RESULTS

Seven cases were successfully performed surgery without complications. Imaging signs and physical anatomical landmark error ≤ 1.5 mm. Optic nerve injury in 3 patients, 2

patients with preoperative visual acuity: no light perception and after-operative visual acuity: light perception. One patient with preoperative visual acuity: 0.1 and after-operative visual acuity: 0.5. Three cases of foreign body in orbit: foreign body was successfully removed no significant changes in visual acuity. One case of tumor resection, prognosis was good.

DISCUSSION

Because of the complexity of eyeball, orbit and sinuses, eye trauma often appeared with head trauma. Orbital surgery through nasal cavity has many advantages: more efficient, less damage and faster recovery. Application and development of nasal endoscopy promoted the rapid development of orbital surgery^[1,2]. Because the optic nerve is very delicate, and endoscopic surgery is two-dimensional image, so image guidance for surgery is very important. In this study, we used Medtronic Inc Stealth Station™ system. Image guide system is to use electromagnetic or infrared signals to determine the precise location in surgery. System uses special computer software, the CT of MRI images of patients before surgery reconstruction, and through electromagnetic induction position on the operation instruments for precise positioning. Doctors operated under the guidance of three-dimensional images. It is important to calibrate before surgery which has an effect on the accuracy of the navigation system. Medtronic Inc Stealth Station™ system demanded a one to one match of reference marks and points in the three-dimensional reconstruction image. In all cases of present study, the average time for preparation is 15 minutes. Because the optic nerve in optic foramen is limited, and prone to fracture, optic nerve injury is a kind of so common traumatic eye disease^[3]. Current traumatic optic neuropathy treatment is still much controversy, but most scholars believe that surgical treatment can improve the efficiency in a clear imaging diagnosis of optic canal fracture, cavity deformation, hematoma compression or early high-dose hormone treatment fails.

Li *et al*^[4] found that surgical treatment of traumatic optic neuropathy is important. Transnasal endoscopic optic canal decompression is commonly used in clinical surgery. In recent years, a lot of successful cases at home and abroad have been reported, with fewer traumas, clear vision and less scar^[5,6]. Image guide system further reduces surgical risk, increase the success rate. Optic nerve trauma are usually associated with compound fractures, loss of normal anatomic marks^[7], endoscopic surgery can not accurately determine the local anatomy. Image guide system can help

doctors determine the exact anatomical location, provide accurate three-dimensional images. It reduces serious complications, improve surgical accuracy and safety.

Patients with optic nerve injury accept VEP examination to evaluate visual function and to judge results of operations, some scholars have reported that accuracy was 90%^[8]. But VEP is not the criteria to decide whether surgery, even if it results very poor, we believe that should not give up easily. When doctors found fractures, fracture fragments on the optic nerve compression or disc edema, the patient should undergo surgery as soon as possible. Accurate identification of the optic canal is the key to successful operation^[9]. After surgery, although visual acuity may be better, but optic nerve atrophy is still possible.

Orbital foreign body can lead to a variety of dysfunction. It can affect eye movement, diplopia occur and affect the optic nerve blood supply, leading to optic atrophy^[3]. Because the orbital space narrow, and the orbital tissue loose, so doctors are easy to slip foreign body, likely to cause tissue damage. With system's help, doctors can avoid the optic nerve and other vital organs, operate safely and quickly.

There are some problems associated with the clinic application of the navigation system: 1) Pre-operative image examination can not reflect changes in the operation completely. 2) A loose headset can distort the correspondence of one to one matching of reference points and dislocate the structure during surgery. 3) The navigation system required more expenses for instruments and increased the cost of an in-patient. Therefore, doctors need to evaluate comprehensively, select treatment options, in order to achieve better clinical results.

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