Minimally Invasive Endoscopic Resection of Anterior Skull Base malignant Neoplasm

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Purpose: The objective of this study was to review clinical outcomes of minimally invasive endoscopic resection (MIER) for anterior skull base (ASB) malignant neoplasms.

Study Design: Retrospective.

Materials and Methods: Data analysis was performed on all patients undergoing MIER from October 2010 to October 2014.

Results: Thirty-one patients with mean age of 54 years underwent MIER. Malignant tumors were managed endoscopically in all cases. Most common histopathologies were squamous cell carcinoma (ten), sinonasal undifferentiated carcinoma (eight), esthesioneuroblastoma (five), and mucosal melanoma (three). Surgical resection (MIER) with curative intent was performed in all cases. Multilayered skull base reconstruction was performed in most patients. American Joint Committee on Cancer tumor staging was used. Twenty five patients were disease free, three patients were dead from disease, and three patients were alive with disease.

Conclusions: This study validated technical feasibility of MIER for different anterior skull base malignant neoplasms. Patients were able to avoid adjunct craniotomy and its complications. MIER resulted in low complication rate and acceptable disease- free survival in patients with advanced tumors.

Keywords: MIER, skull base, malignant neoplasms, endoscopic sinus surgery

INTRODUCTION

Malignancies of the nasal cavity and paranasal sinuses represent a rare, yet challenging, disease process. The most common histopathological types of sinonasal malignancy include squamous cell carcinoma, adenocarcinoma, and olfactory neuroblastoma. While prognostic factors differ among histological types, the fundamental goal of any oncologic procedure is to resect the tumor burden while obtaining adequate margins. [1] Traditionally, craniofacial resection has been employed in the surgical management of such malignancies. However, as endoscopic excision of inverted papilloma, juvenile nasopharyngeal angiofibroma, and benign sinonasal lesions have demonstrated similar recurrence rates to open approaches, these techniques have begun to be implemented for selected sinonasal malignancies at some institutions. [2] Early results of these evolving techniques are promising, but significant controversy exists. [3,4] It is argued that the endonasal approach does not permit the surgeon to obtain acceptable oncologic results, and is, therefore, not an acceptable application for malignant sinonasal disease. Concern has also been expressed regarding the ability to obtain adequate margins, hemostasis, and reconstruction through an inherently limited surgical approach. [5]

Minimally invasive surgery for neoplasms of the anterior skull base has revolutionized the treatment of these diseases. The relative effect of endoscopic procedures, however, has not been described in terms of disease-specific and global health-related quality of life (QoL). [6]

In recent years, endoscopic endonasal techniques have been applied to the treatment of sinonasal malignancies. Comprehensive anatomical knowledge is essential to preserve oncological principles and minimize surgical morbidity.

The bones that form the anterior cranial base are pneumatized and the sinuses provide surgical corridors for the endoscopic endonasal approach to the skull base. During endoscopic endonasal resection of sinonasal malignancies, usually, the intranasal portion of the tumor is first debulked to provide visualization of the

margins and assess the extent of the tumor. Afterwards the tumor is completely removed and the margins of resection are defined. Sinonasal malignant neoplasms that invade the skull base can be resected accordingly to oncological principles using endoscopic endonasal techniques. [7]

PATIENTS AND METHODS

Retrospective chart review was performed on 31 patients undergoing MIER from October 2010 to May 2014 at Mansoura University hospital. Data collected included patient demographics, tumor characteristics (histopathology, TNM staging according to American Joint Committee of Cancer), and surgical data (intraoperative findings, skull base defects, reconstruction, surgical margins, complications), and postoperative therapies. Patient outcomes were assessed, including recurrences, salvage surgery, and long-term status (disease free, alive with disease, dead of disease, dead from other causes).

RESULTS

Patient Demographics

The mean age for the 31 patients was 54 years

(Range, 34 to71 years). 20 male and 11 female, the mean follow-up was 37.2 months (range, 12 to 76 months). Table 1

SITE OF ORIGIN AND EXTENT OF TUMOR

The most common site of origin (epicenter) of the tumor was the nasal cavity and maxillary sinus (59 %) and the ethmoid sinuses (28 %). Tumors originating from the sphenoid sinus (10 %) or frontal sinus (3 %) were less common, Skull base erosion in all patients. Tumors extended to intracranial cavity in 5 patients, skull base reconstruction with nasoseptal flap and middle turbinate rotational flap technique for (7patients). Surgiceal and gelfoam were added for further support.

Tumor Characteristics

The histopathology for the 31 cases is shown in Table 2. The staging was T3N0MO and T4N0M0 in 20 (64.5%) and 11(35.5%) patients, respectively. Previous surgery was performed in 3 patients.

Surgical Parameters and Adjunct Therapies

Twenty-seven patients (87%) were treated for curative intent, whereas 4 cases (13%) were managed for palliative intent. Adjunct procedures performed included orbital decompression (5 patients), endoscopic orbital exenteration (one patient), and staged craniotomy (2 patients).

Thirteen major complications were encountered in 13 patients (%). The complications and their management are listed in Table 3.

Postoperative cerebrospinal fluid (CSF) leaks were noted in 7 cases (%). Skull base reconstruction was performed in 7 cases. Reconstruction was multilayered in all these 7 cases. Nasoseptal flaps were used in 7 cases.

Postoperative radiation therapy was utilized in 7 patients.

Postoperative radiochemotherapy was employed in 9 patients.

Seven patients developed recurrences. Recurrences were classified as local in 3 patients, regional in two patients (cervical nodes), and distant in two patients (one hepatic and one2 bony) metastases. Two skull base recurrences were managed by craniotomy and endoscopic-assisted craniotomy. One recurrence of SCC on the lateral nasal wall was salvaged by endoscopic resection with orbital exentrations dissection. (Figs. 1-5)

Table 1 Demographic and tumor Characteristics of 31 Patients Who Underwent Endoscopic Resection of Sinonasal Cancer Characteristic Value

Treatment	No. (%) of patients
Sex	
Female	11
Male	20
Mean follow-up, mo	37.2
Prior treatment	5
Tumor stage	
T stage, %	
T1	
T2	
T3N0M0	20
T4N0M0	11
Previous surgery	
No	28
Yes	3
Margins	
Negative	26
Positive	5
Adjuvant treatment	
None	15
Postop. radiation therapy	7
Postop. chemoradiation therapy	9
Recurrence	
Local	3
Regional	2
Distant	2
Disease-specific survival	
3-year	77.5%

Table 2 Tumor Histopathology for the 31 Cases

Histopathology	Number	Percentage
Squamous cell carcinoma	10	32,3%
Sinonasal undifferentiated carcinoma	8	25,8%
Olfactory neuroblastoma	5	16,1%
Mucosal melanoma	3	9,7%
Adenocarcinoma	2	6,45%
Adenoid cystic carcinoma	2	6,45%
sarcoma	1	3,2 %

Table 3 Major Complications and Their Respective Management

Complication	No. (%)	Management
Cerebrospinal fluid leak	7 (22, 58%)	Bed rest and lumbar drain and nasoseptal flaps
Pneumocephalus with mental status changes	2 (6, 45%)	Conservative and neurological consultation
Meningitis	2 (6, 45%)	Intravenous antibiotics
Deep vein thrombosis	1 (3, 2%)	Anticoagulation
Diminution of vision	1 (3, 2%)	High dose of corticosteroids

Fig 1 Ct scans of squamous cell carcinoma of nose and paranasal sinuses preoperatively

Fig 2 Ct scans of same patient postoperatively

Fig 3 Erosion of the medial orbital wall and protrusion of the orbital contents

Fig 4 Erosion of the medial orbital wall with intact periosteum

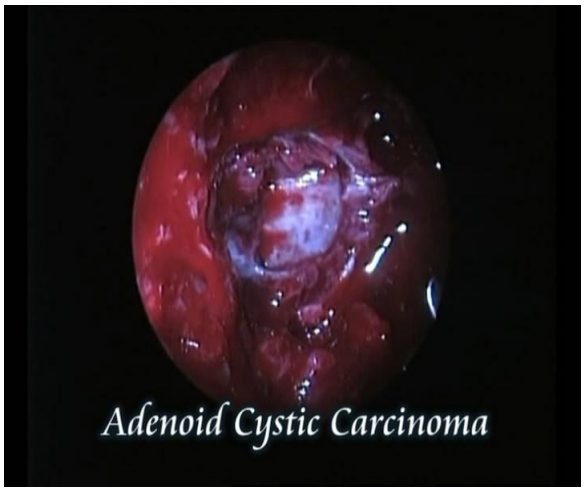

Fig 5 Bone graft closing skull base defect in cribriform plate of ethmoids

DISCUSSION

As the endoscopic techniques have been more widely applied for tumor resection, several criticisms have been leveled at MIER, including violation of the concept of en bloc resection and a short track record The notion of en bloc resection, although a worthy objective, is rarely achievable. Generous margins are often not possible given proximity to critical structures, and the delicate ethmoid septations prevent the specimen from holding together as a single large piece. Moreover, multiple endoscopic series, employing the piecemeal approach have not demonstrated compromise in survival. [8]

Ganly et al., CFR ''is not without significant morbidity.'' [9]

Endoscopic resections of sinonasal cancers should be performed by surgeons who have extensive experience in 2 areas: endoscopic techniques and surgical oncologic principles. Lack of expertise in either area should alert the surgeon to an alternative management strategy. [10]

Endoscopic approaches to the skull base and sinonasal regions offer several advantages. In addition to excellent visualization, endoscopic approaches eliminate or significantly reduce the need for craniofacial soft-tissue dissection, skeletal disassembly, and brain retraction for tumor access and resection. These advantages are probably the impetus for the increasing adoption of endoscopic approaches for surgical management of sinonasal and skull base tumors. [5]

The surgical objectives of complete tumor removal must be balanced with the goal of minimizing adverse impact on QOL of patients. (Decreasing intraoperative complications and minimizing long-term patient morbidity and hospitalization time compared to the open techniques). [4,11]

Interestingly, the Italian series, like most European reports on sinonasal cancers, included a relatively large number of patients with adenocarcinoma (37%), which is less common in the United States and has a relatively better prognosis than squamous cell carcinoma, melanoma, and sinonasal undifferentiated carcinoma. [12] They also described a shift in their selection of the surgical approach in the latter part of their study, extending the indications of exclusively endoscopic approach to include selected patients with skull base invasion and "focal" dural infiltration. In our series squamous cell carcinoma, sinonasal undifferentiated carcinoma and olfactory neuroblastoma were the most common pathology.

Successful separation of the intracranial and sinonasal compartments and elimination of potential cross contamination are critical components to the success of MIER with low complication rate. Multilayer skull base reconstruction was employed in a majority of the cases with an acceptable CSF leak rate of 6.5 %. [8]

In our series 22.5% of patients developed CSF rhinorrhea, they were managed successfully with nasoseptal flaps and multilayer closure.

Important contraindications of MIER include extensive dural and/or parenchymal tumor infiltration and lateral extension over the orbital roof; a bifrontal or subfrontal craniotomy should be planned for these cases. Patients with extensive facial soft-tissue, lacrimal pathway, or anterior frontal sinus involvement may also be better managed by an open technique. A combination of endoscopic and external approaches may be offered for some cases.

Relative contraindications include highly vascular tumors, extensive bilateral disease, and significant orbital or infratemporal fossa involvement; the decision to employ MIER in these cases must be individualized based on surgeon experience. [8] We think that infratemporal fossa tumors can be accessed endoscopically especially if there is no carotid sheath affection.

MIER results in overall improvement in20-item Sino-Nasal Outcomes Test score (SNOT-20) SNOT-20 scores, with greater change being noted in females and in patients with benign tumors. Prior smoking and chemoradiation strongly predict decreased improvement in sinonasal QOL after surgery. [13]

Revenaugh etal suggest a potential role for MIER in the comprehensive management algorithm of SNUC in appropriately selected patients. Patient outcomes including local and regional recurrence, distant metastases, and overall and disease-free survival were comparable to a treatment strategy using traditional craniofacial resection. [14]

MIER of ASB neoplasia did not differ significantly from traditional CFR in operative time, estimated blood loss, hospital stay, or complication rate. Survival and recurrence rates were similar also. This early experience suggests that MIER is a viable alternative for the surgical management of ASB lesions in appropriately selected patients. [15]

MIER is not without complications, in our series we have 13 major complications especially CSF rhinorrhea, pneumocephlus, meningitis, deep venous thrombosis, and diminution of vision. Hanna etal [10] reported Postoperative cerebrospinal fluid (CSF) leakage in 4 of 120 patients (3%). The CSF leak in 3 patients resolved spontaneously, and the fourth patient underwent successful endoscopic repair. One patient had meningitis, which resolved with antibiotic therapy. Other less common complications included epiphora in 2 patients and dacryocystitis in 1 patient. Zhong etal [16] reported high incidence of complications 87 of 178 patients, including cerebrospinal fluid rhinorrhea, intracranial infections, diabetes insipidus, etc.

Eighty-five cases with complications recovered through proper medical and nursing care, except for 2 cases of death. The 3-year disease-free survival rates were 86.8% in the endoscopic group and 67.7% in the open group (p=0.047); however, the patients in the endoscopic group had lower T stages (p = 0.0068) and lower ASA scores (p=0.03). In carefully selected patients, endoscopic approaches demonstrate survival rates comparable to those of traditional surgery, and fewer perioperative complications. [17]

Endoscopic endonasal resection performed with or without a transcranial approach, when properly planned and in expert hands, has an accepted role with precise indications in the surgeon's armamentarium for the treatment of sinonasal and skull base malignancies. [18]

In patients with high-grade malignancies, a carefully constructed multimodal treatment plan, incorporating surgery, radiation therapy, and chemotherapy, is necessary to maximize patients' outcomes. Postoperative endoscopic follow up is a mandatory step to follow up patients with thorough examination of all corners to detect early recurrences and to clean extensive crustations. Surgeons should be prepared for external approach at any time as a complementary or alternative one.

CONCLUSIONS

This study validated technical feasibility of MIER for different anterior skull base malignant neoplasms. Patients were able to avoid adjunct craniotomy and its complications. MIER resulted in low complication rate and acceptable disease- free survival in patients with advanced tumors.

The central concepts on surgical oncology must remain paramount; regardless of the surgical approach. All cases should be presented at the tumor board to devise an optimal strategy for each individual case. The surgeon must be comfortable incorporating endoscopic and traditional open approaches, if required for specific case scenarios. Selection of surgical approaches to the anterior skull base is based upon balancing risk reduction with maximizing extent of resection.

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