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Midline Anterior Craniofacial Approach for Malignancy: Results of En Bloc Versus Piecemeal Resections

ABSTRACT—Thirty consecutive cases of midline anterior craniofacial procedures for the treatment of malignant neoplasms arising from the paranasal sinuses were reviewed. Posterior and lateral base craniofacial procedures were specifically excluded. This review compares the results, in terms of survival and major complication rate, between en bloc and piecemeal resections. The average follow-up was 4 years and 3 months. Sixteen patients were treated with an en bloc resection. The major complication rate was 31%. One-year survival rate was 94% for the en bloc resection group, 67% for patients with positive margins, and 100% for patients with clear margins. Three-year survival for en bloc resection dropped to 56, 33, and 67%, respectively. Fourteen patients were treated with piecemeal resections. The major complication rate was 21%. One-year survival rate was 83% for the piecemeal resection group, 60% for patients with positive margins, and 100% for patients with clear margins. Three-year survival dropped to 70, 60, and 80%, respectively. Although it is considered desirable to obtain an en bloc resection in some craniofacial procedures, we conclude that a piecemeal resection is a viable alternative in situations where an en bloc procedure is difficult to obtain safely.

The combined craniofacial approach to the anterior skull base permits complete excision of many of the malignant tumors of the paranasal sinuses. Most surgical teams attempt en bloc resections of these neoplasms because of the general belief that such a technique is associated with maximal survival.¹⁻⁵ This rationale is founded on the concept that surgical violation of the tumor predisposes to spread of the cancer through lym-

phatic or vascular channels. Furthermore, there is concern that tumor removal is more likely to be incomplete with a piecemeal as opposed to an en bloc resection. Generally, an en bloc resection is attempted even though the tumor has usually been surgically violated by taking biopsies for preoperative planning. Despite universal acceptance for the en bloc concept, we are unaware of any work that directly compares the outcomes

of en bloc and piecemeal resections in the management of malignant neoplasms encroaching or invading the anterior skull base.

Traditionally, at our institution en bloc resections have been attempted in all patients with malignant anterior skull base tumors. Some patients, however, underwent piecemeal removal of their neoplasms when the location or size of their tumors precluded such an en bloc approach. This decision, at least initially in the series, was made intraoperatively when it became obvious that an en bloc resection could not be done safely. Occasionally a piecemeal resection was planned preoperatively for the same reasons.

To help define survival in patients who undergo piecemeal resections and to compare these results with en bloc resections, the last 30 cases of anterior craniofacial resections for malignant cancers arising from the paranasal sinuses were evaluated. Our hypothesis was that survival and major morbidity would be comparable between the two groups.

MATERIALS AND METHODS

Thirty patients underwent midline anterior craniofacial surgery for malignant cancers arising from the paranasal sinuses at The University of Iowa Hospitals and Clinics from May 1985 through May 1996. The medical records of these patients were retrospectively reviewed. Eighteen patients were male and 12 were female. Patient ages ranged from 24 years to 77 years, and the average age was 55 years. Sixteen patients underwent an en bloc resection, while 14 patients underwent a piecemeal tumor removal. The average age was 53 years for the en bloc group and 56 years for the piecemeal group. Squamous cell carcinoma was the most common lesion seen in both groups, although a wide variety of pathology was encountered (Table 1).

All procedures involved a combined neurosurgical and otolaryngological approach. A lumbar subarachnoid drain was used intraoperatively to enhance brain relaxation. The cranial exposure was achieved via a bifrontal craniotomy. The surgical approach used for resection of the facial portion of the tumor was dictated by the size and location of the tumor below the anterior cranial fossa. The facial osteotomies were made before performing the final bone cuts through the floor of the anterior cranial fossa. When the piecemeal approach was used, the tumor was removed in pieces, leaving the most dangerous parts (i.e., tumor adhering to the carotid arteries) for last. Once a gross total excision was accomplished, the margins were assessed pathologically with frozen and permanent sections. The resection margin was extended until there was no evidence of neoplasm on frozen sections taken at the surgical margins. Permanent pathology was used to define whether the margins

were truly positive or negative for tumor. Reconstruction was meticulous and always included vascularized tissue flaps such as pericranium, temporalis muscle, and/or free vascular tissue transfers.

ILLUSTRATIVE CASES

En Bloc Resection

A 31-year-old female suffered from frequent sinus infection. A computed tomography (CT) demonstrated an intranasal mass and an endoscopic biopsy was performed. The pathological findings were consistent with sinonasal undifferentiated carcinoma. She was referred to our institution for further treatment. A magnetic resonance (MR) scan demonstrated a tumor in the left ethmoid and maxillary sinuses (Fig. 1). An en bloc resection was performed using a craniofacial approach in November 1990. A gross total resection was accomplished and ultimately all margins were verified to be negative for neoplasm. There were no complications and the patient was discharged on postoperative Day 12. She underwent a course of radiation therapy and currently is free of disease.

Piecemeal Resection

A 55-year-old man presented with right-sided nasal stuffiness and congestion. A right maxillary and ethmoid mass was biopsied and found to be squamous cell carcinoma. The patient was referred to our institution for further treatment. An MR scan demonstrated a large mass in the right maxillary and ethmoid sinuses (Fig. 2). Because of the size of the lesion and its proximity to the orbital apex and carotid artery, a piecemeal resection of the tumor was performed in April of 1994. Although a gross total resection was accomplished, permanent pathology sections demonstrated a positive margin. The patient became somnolent on the second postoperative day, but no reason for his neurological decline could be detected. Ultimately he recovered completely and was discharged on postoperative Day 21. He was treated with radiation therapy and is currently well without evidence of disease.

RESULTS

Length of Hospitalization

Hospitalization ranged from 5 to 47 days for the entire series. The groups undergoing en bloc and piece-

Table 1.

	<i>Skull Base Pathology</i>	<i>No. of Patients</i>
En Bloc	Squamous cell carcinoma	4
	Undifferentiated carcinoma	3
	Esthesthioneuroblastoma	3
	Adenoid cystic carcinoma	2
	Fibrosarcoma	2
	Adenocarcinoma	1
	Melanoma	1
Piecemeal		14
	Squamous cell carcinoma	6
	Adenocarcinoma	3
	Adenoid cystic carcinoma	2
	Esthesioneuroblastoma	1
	Fibrosarcoma	1
	Melanoma	1

meal resections were hospitalized for 5 to 47 days and 10 to 46 days, respectively. Mean and median hospitalization days were 22 and 18 days for all patients, 23 and 18 days for the en bloc group, and 21 and 17 days for the piecemeal group, respectively.

Complications

A total of 8 patients (27%) had major postoperative complications (Table 2). Five patients (31%) were from the en bloc group, while three patients (21%) were from the piecemeal group. The five patients with complications from the en bloc group had a total of eight complications (three patients had two complications), while the three patients with complications from the piecemeal group had a total of four complications.

Of significance, three patients required a total of five operations to treat their complications. All three patients were from the en bloc group. The first patient developed postoperative hydrocephalus that required a ventriculoperitoneal shunt. Subsequently the shunt became infected and was replaced with a ventriculostomy. After successfully treating the cerebrospinal fluid (CSF) infection with antibiotics, a new ventriculoperitoneal shunt was inserted. Thus, this patient required three operations to treat his postoperative complication. The second patient developed a postoperative epidural hematoma that required evacuation. The third patient developed a wound infection that resulted in osteomyelitis necessitating bone flap removal.

Figure 1. (A) Coronal gadolinium enhanced MR scan demonstrating a neoplasm situated in the left maxillary and ethmoid sinuses. (B) Sagittal-enhanced MR scan. The tumor is depicted by the arrowheads. The sphenoid sinus is obstructed and filled with mucous (arrow).

Figure 2. (A) Coronal MR scan of right ethmoid and maxillary neoplasm. (B) Axial MR demonstrates the proximity of the tumor to the orbital apex and carotid artery.

Positive Margins

Eight patients had positive margins as determined by permanent pathological analysis. Three patients (38%) were from the en bloc group, while five (63%) were from the piecemeal group.

Survival

Group Survival

One- and 3-year survival data were assessed. Twenty-eight patients were available for follow-up at 1 year, and 18 patients were available at the 3-year mark. Two patients were operated on within a year, and 12 patients were operated within 3 years of preparation of this manuscript and were unavailable for follow-up at those times. No patients were "lost" to follow-up. For all pa-

tients in this study, there were 23 survivors at 1 year (82%) and 12 survivors at 3 years (63%).

Survival: Margins

Survival was calculated for patients with pathologically verified positive margins and compared with patients who had negative margins. For patients with positive margins, 5 of 8 (63%) survived 1 year and 3 of 7 (43%) survived 3 years. For patients with negative margins, 20 of 20 (100%) survived one year and 9 of 11 (82%) survived 3 years.

Survival: en bloc Resections

One- and 3-year survivals for patients treated with en bloc resections were 15 of 16 (94%) and 5 of 9 (56%), respectively. In this group, patients with positive margins had a lower survival, with 2 of 3 (67%) surviving 1 year and 1 of 3 (33%) surviving 3 years. Patients with negative margins had a better survival, with 13 of 13 (100%) surviving 1 year and 4 of 6 (67%) surviving 3 years.

Survival: Piecemeal Resections

One- and 3-year survival for patients treated with piecemeal resections were 10 of 12 (83%) and 7 of 10 (70%), respectively. In this group, patients with positive margins had a lower survival, with 3 of 5 (60%) surviving for both 1 and 3 years. Patients with negative mar-

Table 2. Complications

Procedure	Patient	Type
En bloc	1	Epidural hematoma
	2	Pneumonia
	3	Hydrocephalus/shunt infection
	4	Wound infection/osteomyelitis
	5	Wound infection/flap necrosis
Piecemeal	6	Wound infection
	7	Wound infection/pontine hemorrhage
	8	Gastrointestinal hemorrhage

gins had a better survival, with 7 of 7 (100%) surviving 1 year and 4 of 5 (80%) surviving 3 years.

DISCUSSION

The combined intracranial and facial approach to paranasal sinus malignancies that extend into the cranial vault is well accepted.⁶⁻¹¹ The relative rarity of this entity and the pathological diversity in this location, however, confounds statistical analysis of treatment outcomes. An en bloc extirpation typically follows completion of circumferential osteotomies while piecemeal tumor resection involves either an initial internal debulking or the progressive removal of sections of tumor until the lesion is completely excised. The en bloc approach has been almost universally accepted as the preferred treatment for anterior skull base malignancy despite a lack of studies comparing the survival and morbidity of this technique to the results obtained with piecemeal resection.

It is our practice to perform en bloc resections for relatively small, centrally located neoplasms. Larger tumors or those that approach vital structures such as the carotid artery are removed in a piecemeal fashion. The size bias between our treatment groups would be expected to favor the en bloc approach. Nevertheless, it was our belief that the improved access and visualization of the tumor margins attained with the piecemeal technique increased the safety of the procedure and the probability of achieving a total tumor resection. This retrospective study was performed to assess the results obtained using these two approaches.

As expected, the end result of the surgery (i.e., positive or negative margins) was the most important indicator of survival regardless of the surgical method. Patients with a piecemeal resection and negative margins tended to do as well as patients treated with an en bloc resection with negative margins. A higher percentage of patients with piecemeal resection were left with positive margins as opposed to those treated with an en bloc technique. The reason for this discrepancy is most likely related to the difference in size and location of the tumor in the two groups. The 1- and 3-year survival for patients with either positive or negative margins was similar for the two surgical groups.

A myriad of complications are associated with anterior craniofacial procedures. A recent manuscript focusing on this issue reported a complication rate of 40%.¹² In another study, 43 complications occurred in 28 out of 71 (39%) patients.¹³ Our 31% complication rate with the en bloc approach compares favorably with a rate of 39 to 40% in the above two reports in which an en bloc procedure was used. Eighteen percent of our en bloc group had more than one complication as compared to 13 and 21% in Deschler et al's¹² and 21% in

Shaw et al's¹³ reports. Within our piecemeal group, a complication rate of 29% is lower than the en bloc rates shown above, and only one patient developed more than one complication. Another large difference between the piecemeal and en bloc groups in regard to complications is the number of complications that required operative treatment. In the en bloc group, four additional surgeries were required to manage the complications while no additional surgeries were needed in the piecemeal group. The 3-week length of hospitalization in these patients is probably related to the relatively high complication rate.

Clearly there is increased survival when margins are clear; however, this report provides new information that shows survival is dependent on margins, but is independent of the procedure. This indirectly states that violation of malignant paranasal neoplasms during craniofacial resection does not result in decreased survival. Also, this report shows a decreased complication rate for piecemeal resections as well as a higher reoperation rate for en bloc procedures. We therefore would recommend piecemeal resections for combined anterior craniofacial resections of paranasal sinus malignancies in situations where an en bloc resection is difficult to obtain.

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