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Endoscopic Management of Sinonasal Vascular Tumors Without Embolization: Our Experience with Vessel Ligation

ABSTRACT

Objective: To present our surgical experience and technique in performing endoscopic sinus surgery for vascular sinonasal tumors without pre-operative embolization using intraoperative ligation of the external carotid artery or its distal branches.

Methods:

Design: Retrospective Series
Setting: Tertiary Private Teaching Hospital
Participants: Seven Patients

Results: Out of 7 patients (5 males, 2 females, aged 12 to 64 years old) with non-embolized vascular sinonasal tumors, 2 had juvenile angiofibroma, 3 had a benign vascular tumor (hemangiopericytoma, hemangioma and a vasoformative solitary fibrous tumor), and 2 had a malignancy (rhabdomyosarcoma, squamous cell carcinoma). Four (57.1%) had external carotid artery ligation, two (28.6%) had internal maxillary artery ligation and one (14.2%) had sphenopalatine artery ligation. The mean intraoperative blood loss was 2447.1 mL (range 900mL to 5,000mL) and average operation duration was 7.6 hours (range 2.9 hours to 14.5 hours). The average amount of transfused blood products was 1785.7mL (zero to 3,000mL). The average hospital stay was 7 days (range 2 to 13 days) with one post-operative complication (ICU admission for hypotension from intraoperative blood loss).

Conclusion: Intraoperative ligation of the ECA or its distal branches to disrupt the vascular supply of sinonasal tumors may provide a viable means of preventing excessive intraoperative blood loss in patients with non-embolized vascular sinonasal tumors.

Keywords: *Endoscopic approach; ligation of blood supply; non-embolized; vascular sinonasal tumors*

Vascular sinonasal tumors are neoplasms that include hemangiomas, angiofibromas and malignancies.[1] The most documented of these is the juvenile angiofibroma (JA), with a range of presentation of around 9-19 years of age.[2] Various techniques have been used to treat sinonasal vascular tumors, with open techniques being replaced by endoscopic techniques due to decreased operative time and morbidity.[2-3] More often than not, surgical excision involves preoperative super selective embolization (SSE) to decrease intraoperative blood loss,[3-6] making excision with SSE the gold standard of treatment for sinonasal vascular tumors.[7] However, SSE has

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its drawbacks, with complication rates as high as 20%, including such sequelae as blindness and stroke.[7] Aside from complications, the lack of ready availability and high costs of preoperative embolization pose challenges to both surgeon and patient.

There are other techniques to reduce intraoperative blood loss in non-embolized sinonasal vascular tumors, but these are rarely documented. They include intraoperative external carotid artery (ECA) ligation,[2] sphenopalatine artery (SPA) ligation,[8] and (ligation/s performed by Borghei *et al*.).[9] However, to the best of our knowledge, based on a search of HERDIN Plus, the ASEAN Citation Index (ACI), WHO Global Index Medicus (Western Pacific Region Index Medicus and Index Medicus of the Southeast Asia Region), Directory of Open Access Journals, MEDLINE (PubMed) and Google Scholar, there are no local studies on such other techniques to reduce intraoperative blood loss in non-embolized sinonasal vascular tumors.

In this paper, we report our surgical experience with endoscopic excision of sinonasal vascular tumors without pre-operative embolization, using intraoperative ligation of the ECA or its distal branches.

METHODS

With Institutional Review Board approval, this retrospective review of patient data considered for inclusion all patients who had a non-embolized vascular sinonasal tumor who underwent vessel ligation with endoscopic excision. Cases evaluated for possible inclusion were derived from our census of surgical procedures performed over the past 2 years (2019 March - 2021 January) at the Medical City.

The planned study population included all patients operated on by the authors with non-embolized vascular sinonasal tumors with intraoperative vessel ligation, from all age groups. Exclusion criteria included records with incomplete descriptions of intraoperative technique or lack of immediate postoperative outcome documentation.

An electronic chart review was performed to retrieve patient information. Information such as profile, diagnostic procedures, intraoperative findings, and postoperative course in the wards were retrieved from the Medical Information Documentation and Access System (MIDAS). Retrieved information were tabulated in a Microsoft Excel for Windows Version 2202 Build 16.0.14931.20118 (Microsoft Corp., Redmond WA, USA) Spreadsheet with specific alphanumerical coding. To protect patient confidentiality, all patient identifiers and associated data were only made accessible to the authors (PJ, GS, VPS). Alphabetical coding was assigned to patients included in the study.

Data were tabulated according to their age, sex, diagnosis, type of vessel ligation, operative blood loss, operative duration, and postoperative outcome. Measures of central tendency were used to present continuous variables while frequencies and percentages were used for categorical data.

RESULTS

A total of seven patients were operated on with non-embolized vascular sinonasal tumors using intraoperative vessel ligation during the study period. There were 5 males and 2 females, with ages ranging between 12 to 64 years old (median age 42 years; interquartile range 30 years). Of the seven patients, 2 had a diagnosis of JA (stages IIC and IIIA), 3 had a benign vascular tumor with specific diagnoses of hemangiopericytoma, hemangioma and a vasoformative solitary fibrous tumor, while 2 had a malignancy- rhabdomyosarcoma and squamous cell carcinoma stage III (T3N0M0).

Of the seven, four (57.1%) patients had external carotid artery ligation, two (28.6%) had internal maxillary artery ligation and one (14.2%) had sphenopalatine artery ligation. In addition, various techniques were employed intraoperatively for hemostasis, including use of epinephrine as a decongestant and vasoconstrictor, use of bipolar cautery and harmonic scalpel for dissection of the tumor, and application of adsorbable hemostatic dressing such as oxidized regenerated cellulose (Surgicel®) during the dissection.

Sevoflurane was administered to four out of seven patients (57.1%) while the remaining three patients (42.9%) received total intravenous anesthesia (TIVA) with propofol. The mean intraoperative blood loss of the patients was 2447.1 mL, with a largest recorded blood loss of 5,000mL and a lowest blood loss of 900mL. The average operation duration was 7.6 hours (SD=4.3), with the shortest finished in 2.9 hours and the longest taking 14.5 hours. The average amount of transfused blood products was 1785.7mL. with a largest amount of 3,000mL while one of the seven patients did not need blood transfusion. The average hospital stay was 7 days (SD=4.2), the shortest being 2 days while the longest was 13 days. Six out of seven patients did not experience post-operative complications (85.7%), while one experienced hypotension and was admitted in ICU due to intraoperative blood loss.

DISCUSSION

The results of our experience in endoscopic excision of non-embolized vascular tumors suggest that intraoperative ligation of the ECA or its terminal branches may be a viable alternative to embolization with a mean blood loss of 2447.1mL and an operative duration of 7.6 hours. These averages have a wide range with the lowest blood loss recorded at 900mL and highest at 5,000mL. Operative duration had a wide range as well with the shortest duration at 2.9 hours and the longest at 14.5 hours.

Our numbers are higher than those reported by Borghei *et al.* in

terms of blood loss, with 1,068mL for JA Stage IIA and 1,310mL for JA Stage IIB.[9] However, it is important to consider the higher staging of JA included in the present series at Stage IIC *(Figure 1)* with 2,000mL blood loss and IIIA with 4,300mL blood loss. There is an even bigger discrepancy in the blood loss between our current study and the study of Janakiram *et al.* who reported an average blood loss of 67.2mL and an average operative duration of 1 hour and 42 minutes.[8] Their study, however only included JNA with tumor sizes up to Radkowski Stage IIA.[8] The difference in included tumor sizes and surgeon skill may definitely play a part in the discrepancies in blood loss between our current study and these two studies.[8,9]

Compared to studies wherein preoperative embolization was performed, our current study also has higher blood losses and operative durations. Kilde *et al.* reported 2 cases of sinonasal hemangioma wherein preoperative embolization was performed with blood losses of 600mL and 1,000mL.[10] Gupta *et al.* also described intraoperative blood loss in patients that underwent preoperative embolization for high-stage JA with Radkowski Stage IIIa or greater with an average blood loss of 1,500mL.[6] Lim *et al.* described their experience with embolized endoscopic excision of various sizes of JA with an average blood loss of 1000mL and range of 700mL to 1,500mL.[5] In their study, tumors with Radkowski Stage I to III had an average operative time of 2 hours whereas a Radkowski Stage IV tumor had an operative duration of 6 hours.[5] Operative duration for the present series for similarly staged JNA tumors was more than twice the duration at 14 hours for JA Stage IIC and 10 hours for JA Stage IIIA.

For the case of sinonasal hemangioma included in our present study, a blood loss of 1,000mL was noted. No pre-operative embolization was performed. Instead, identification of the internal maxillary artery *(Figure 2)* and bipolar electrocauterization *(Figure 3)* was performed

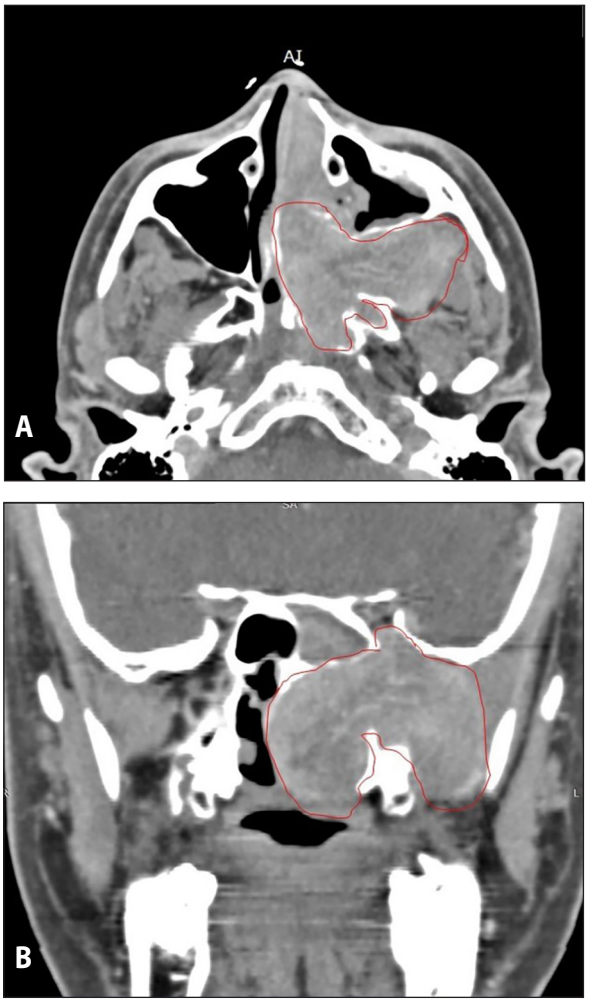

Figure 1. CT Scan of Radkowski Stage IIC JA; Axial cut A. and Coronal cut B. Occupying posterior half of nasal cavity, entire nasopharynx, pterygopalatine fossa, infratemporal fossa and floor of inferior orbital fissure.

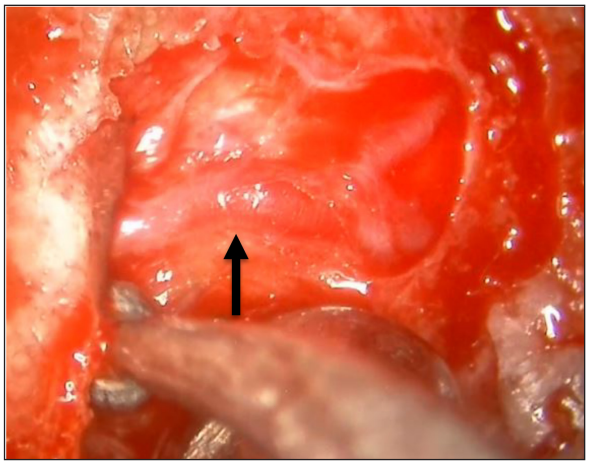

Figure 2. Internal maxillary artery prior to ligation: After performing a Caldwell-Luc procedure to enter the maxillary sinus, the posterior maxillary wall was drilled to identify the feeding internal maxillary artery (arrow).

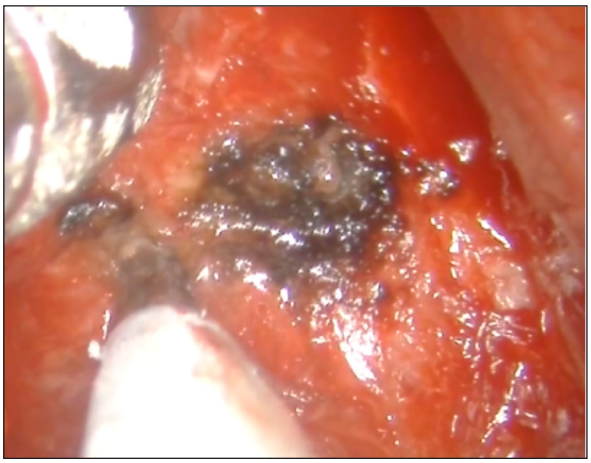

Figure 3. Internal maxillary artery after electrocautery: Bipolar electrocauterization of the internal maxillary artery prior to transection of the vessel (charred area).

prior to transection to cut off the blood supply and decrease blood loss. Dissection was carried out at the tumor attachment with a microdebrider, simultaneously using Surgicel® for hemostasis.

In our series, the vessel to be ligated or transected was selected by careful pre-operative evaluation of contrast CT scans to identify feeding vessels. For larger vascular tumors with more than one identified feeding vessel on the CT scan, external carotid artery ligation was performed through a 4cm horizontal incision over the lateral neck. After identification of the common carotid artery and its bifurcation, the external carotid artery was identified by tracing the superior thyroid artery. Ligation of the external carotid artery was performed distal to the superior thyroid artery with two silk 2-0 sutures. No electrocautery or transection of the artery was done after ligation.

Our experience in this series suggests that the steps mentioned for hemostasis in non-embolized cases may be acceptable compared to preoperative embolization in terms of blood loss without any post-operative mortality. Meticulous pre-operative planning with identification of feeding vasculature using CT scans is vital in determining the most appropriate vessel to ligate or transect. The combined use of bipolar cautery and harmonic scalpel in advanced stage JA tumors yielded successful outcomes without post-operative morbidity or mortality. The lack of financial resources or absence of facilities (instruments and equipment) for preoperative embolization should not prevent definitive treatment of sinonasal vascular tumors, by carrying out meticulous pre-operative planning and intraoperative measures needed to control bleeding.

Our study has several limitations. Despite being conducted in a tertiary hospital, the review of records over the past 4 years only retrieved data on endoscopic excision of non-embolized vascular tumors with vessel ligation starting in March 2019. This yielded a small sample size. The study was likewise performed retrospectively wherein various factors were not explicitly recorded such as specifics on the type of anesthesia used, patient position during the operation, whether supine or reverse Trendelenburg, and amount of decongestant used, to name a few. Performing a prospective study to include more patients and taking note of the aforementioned variables may provide a more controlled dataset to describe the differences in performing surgery without embolization. Furthermore, comparing patients operated on with and without embolization under the same surgeon can provide data for analysis between the two techniques.

The mean blood loss and operative duration in the current series still exceeds reported numbers for patients who underwent preoperative embolization. However, the outcomes wherein no mortality was reported (with one morbidity of transient hypotension and temporary ICU admission) suggest that ligation without embolization may provide physicians with an alternative surgical approach. Despite its not being the accepted gold-standard of treatment for vascular sinonasal tumors, our surgical technique may offer an alternative treatment when there is a lack of resources.

In conclusion, our initial series suggests that intraoperative ligation of the ECA or its distal branches to disrupt the vascular supply of sinonasal tumors may provide a viable means of preventing excessive intraoperative blood loss in patients with non-embolized vascular sinonasal tumors.

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