THE EFFECTIVENESS OF RADIOFREQUENCY ABLATION FOR THE SURGICAL MANAGEMENT OF JUVENILE NASOPHARYNGEAL ANGIOFIBROMA: REPORT OF A CASE SERIES.

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ABSTRACT

Juvenile angiofibroma is a fibrovascular tumour originating from the vascular structures of the posterolateral nasal wall. The endoscopic technique has become the approach of choice. Radiofrequency ablation is a minimally invasive procedure that generates thermal ablation through coagulation, dissecting, cauterizing, and aspirating the tissue with the same device. We describe our experience with a series of 3 cases of patients operated on for juvenile angiofibroma resection using radiofrequency ablation and evaluate the efficacy and usefulness of the treatment.

KEYWORDS

Juvenile nasopharyngeal angiofibroma, radiofrequency ablation, nasal endoscopy

Introduction

Juvenile angiofibroma is a fibrovascular tumour originating from the posterolateral nasal wall’s vascular structures, the pterygoid process’s root and the sphenoid bone. It occurs mostly in adolescent males. The incidence has been reported to be 0.05% of all head and neck neoplasms. Although histopathologically benign, they tend to spread and destroy adjacent structures. Currently, the treatment of choice is surgical resection, usually with preoperative embolization. Surgical resection techniques have evolved over the last 20 years. Initially, these nasal tumours were treated with external approaches such as lateral rhinotomy, trans palatine, trans maxillary and mid-facial cutdown. However, endoscopic techniques have gained ground and are now the choice approach because of better visualisation and access to the tumour without facial incisions. In 1996, at Cairo University in Egypt, Kamel described the resection of juvenile angiofibroma exclusively by the endoscopic transnasal route.

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Radiofrequency is a minimally invasive device that generates thermal ablation through coagulation. This tool creates an electric field between the two electrodes located in and around the tip. The energy is conducted through a conductive medium (saline solution). When the solution is introduced to the electric field, the electrolytes in the saline solution are stimulated, leading to denaturation of the proteins, resulting in ablation of the tissue with coagulation effects and limited adjacent thermal action.

Presentation of cases

Ethical considerations. The study was approved by the local ethics committee under Folio: F-2021-3601-023. We retrospectively evaluated 3 patients with the diagnosis of juvenile angiofibroma who were surgically treated with radiofrequency ablation in our department over a one-year period. The most relevant data were compiled in a table to synthesise and facilitate understanding of our findings. The variables analysed were patient sex, comorbidities, location, size, Chandler stage, Fisch stage, Radkowski stage, preoperative embolization, embolised arteries, operative time, trans operative bleeding, in-hospital stay, postoperative blood transfusion, postoperative bleeding, adjuvant treatment, follow-up time, recurrence, histopathology, and the need for reoperation. In addition, in-office endoscopic examination and contrasted enhanced computed tomography of the
nose and sinuses were performed before the surgical procedure (Figures A and B, respectively).

**Figure A** Contrast enhanced CT. Heterogeneous density tumour from the pterygomaxillary fossa in patients 1, 2 and 3 respectively.

**Figure B** Diagnostic nasal endoscopy. From left to right, tumor from the pterygopalatine foramen in patients 1, 2 and 3 respectively. S: nasal septum, CM: middle turbinate, IC: inferior turbinate, T: tumour.

Images were digitally documented. One day prior to surgery, patients were embolised by the interventional radiology service using polyvinyl alcohol as the embolising agent. Treatment consisted of endoscopic resection of the lesion, using radiofrequency ablation as the instrument for tumour dissection (figure C).

**Figure C** Trans-operative nasal endoscopy. Radiofrequency ablation can be seen. 1) Removing the periosteum on nasal lateral wall 2) Removing the periosteum and tumor resection in the left nostril 3) Coagulation in the right nostril. E: Sphenoid sinus. EA: Sphenopalatine artery, S: Nasal septum, MS: Maxillary sinus, T: Tumour.

Under general anaesthesia, with the patient in the supine position, the nasal cavity was visualised with rigid endoscopy at 0, 30, and 45 degrees and the tumour was identified. Depending on its location, techniques were performed to facilitate visualisation of the lesion, such as partial or complete resection of the inferior turbinate, uncinectomy, medial maxillectomy, anterior and posterior ethmoidectomy and sphenoidotomy. Dissection of the tumour was performed in a subperiosteal plane with radiofrequency (Coblator II®) until the complete liberation of the implantation area was achieved. Haemostasis of the surgical site was performed and verified with bipolar diathermy prior to completion of the procedure. Nasal packing was performed with a haemostatic matrix (surgiflo®) and a haemostatic sponge (gelfoam®). The patients have been discharged from the hospital an average of 3 days after the surgical procedure. During hospitalisation, a normal diet, analgesia, and post-surgical antibiotic coverage with systemic quinolones were prescribed.

The results were measured considering post-surgical bleeding, follow-up time, recurrence, and the need for reoperation. Due to costs and the limited availability of magnetic resonance imaging in our setting, all patients were followed up by in-office nasal endoscopy one week after discharge, at one month and every 3 months after that. We present 3 patients who underwent resection of juvenile angiofibroma using radiofrequency ablation. All patients were 27-28 years old and had no comorbidity at the time of surgery. The clinical presentation was recurrent episodes of epistaxis and nasal obstruction, both unilateral. The tumour location was unilateral in all 3 cases (2 patients on the right side and 1 patient on the left), and they were classified in the same Chandler and Radkowsky stage; III and II b, respectively. In the Fisch classification, one patient was classified as stage III and as it involved the orbit (superior orbital fissure), while the rest were stage II.

All patients were diagnosed with contrasted enhanced computed tomography of the nose and paranasal sinuses and in-office rigid nasal endoscopy. No tumour exceeded 4.5 cm in size. Preoperative embolization was performed in all patients one day prior to surgery. Trans-operative dissection was performed in all cases with Coblator II® radiofrequency. The average operative time was 4.5 hours (+/- 0.5 hours). Trans-surgical bleeding did not exceed 300 ml. No patient required postoperative transfusion; only one patient had postoperative bleeding resolved with anterior nasal packing.

At the time of writing this report, no patient had a recurrence of the lesion at 45, 49 and 43 months, respectively, during follow-up with office endoscopic control in 2 cases, and endoscopic and tomographic control in 1 case. Patient characteristics are summarised in Table A.

**Discussion**

Juvenile angiofibroma is a benign lesion characterised histologically by vascular endothelial bounded spaces in a fibrous stroma, typically affecting adolescent boys. In an initial phase, it extends through the sphenopalatine foramen into the nasopharynx and nasal cavity and through the vidian or pterygoid nerve into the sphenoid sinus floor. Lateral extension through the pterygomaxillary fissure leads to invasion of the infratemporal fossa, which may be completely occupied in advanced lesions. When expanded anteriorly, the posterior wall of the maxillary sinus is progressively pushed forward. Finally, it may extend intracranially through the superior and inferior orbital fissure or through the maxillary nerve (V2) into the parasellar region. The clinical presentation is characterised by unilateral nasal obstruction and epistaxis. In advanced lesions, malar oedema, proptosis, or headache appear, indicating invasion of the infratemporal fossa, orbit, or cranial fossa, respectively. On nasal endoscopy, a smooth, hyper vascularised lesion is observed, originating behind the middle turbinate. On contrast-enhanced CT and MRI, the diagnosis is based on three findings. The area of origin is at the level of the pterygopalatine fossa, the hypervascular appearance with contrast enhancement and its growth pattern.

Preoperative embolization was introduced in 1970, is preferably performed 24-48 hours before surgery and has dramatically reduced intraoperative bleeding, allowing for more accurate dissection. In addition, embolization achieves excellent vascularisation of the nutritional vessels of the maxillary artery and
**Table A** Clinical/demographic characteristics of patients with juvenile nasoangiofibroma treated with radiofrequency ablation.

|                        | Patient 1          | Patient 2          | Patient 3          |
|------------------------|--------------------|--------------------|--------------------|
| Age                    | 28                 | 27                 | 27                 |
| Sex                    | M                  | M                  | M                  |
| City of Origin         | Guerrero           | Queretaro          | Guerrero           |
| Comorbidities          | N                  | N                  | N                  |
| Side of tumour         | R                  | L                  | R                  |
| Localization           | FN, NF, FPM, SE    | FN, NF, FPM, SE, FOS | FN, FPM, SE       |
| Size (centimetres)     | 4.3 x 3.5 x 2.2    | 3.3 x 3.2 x 2.3    | 2.9 X 3.1 X 3.2   |
| Chandler stage         | III                | III                | III                |
| Fisch stage            | II                 | III a              | II                 |
| Radkowski stage        | II b               | II b               | II b               |
| Preop Embolization     | Yes                | Yes                | Yes                |
| Arteries embolised     | Maxillary          | Maxillary          | Sphenopalatine     |
| Surgical time          | 5 hours            | 4.3 hours          | 4.15 hours         |
| Trans operative bleeding (ml) | 200              | 300                | 200                |
| Surgical instruments   | RF/BC              | RF/BC              | RF/BC              |
| In-hospital stay (days)| 4                  | 3                  | 4                  |
| Postoperative blood transfusion | No               | No                 | No                 |
| Postoperative bleeding | No                 | No                 | Yes                |
| Antibiotics            | Qu3                | Qu3                | Qu3                |
| Follow-up (months)     | 45                 | 49                 | 43                 |
| Recurrence             | No                 | No                 | No                 |
| Histopathology         | JNA                | JNA multifragmentations | JNA             |
| Reintervention         | No                 | No                 | No                 |

JNA: Juvenile nasal angiolfibroma, BC: Bipolar electrical cautery, R: Right, FN: Nasal fossa, FOS: Superior orbital fissure, FPM: Pterygomaxillary fossa, L: Left, M: Male, N: None, NF: Nasopharynx, QU3: Quinolone third generation, RF: Radiofrequency ablation, SE: Sphenoid sinus.
its branches, as well as the ascending pharyngeal artery. The key steps, independent of the approach, are to minimise bleeding and achieve radical resection in a subperiosteal plane of dissection and extensive reaming of the sphenoid base.

Postoperative surveillance is based on outpatient endoscopic examination and periodic imaging studies, which should be performed for at least three years. These play an important role in the early detection of recurrences. When properly planned and performed, the endoscopic surgical technique has a residual lesion rate of 0-17%.

Endoscopic resection can be performed with various instruments such as the microdebrider, laser, ultrasonic scalpel and radiofrequency ablation, the latter being a tool that offers the ability to dissect, cauterise and aspirate tissue in a single device, as well as creating a limited zone of thermal injury and decreasing the amount of bleeding for better visualisation, thus being of great utility in nasosinusual vascular tumours. Furthermore, given the vascular nature of juvenile angiofibroma, the ability to perform haemostasis and tissue ablation with the same instrument is theoretically beneficial for tumour resection. Importantly, final trans-operative bleeding is significantly reduced with preoperative embolization, and radiofrequency ablation has been used even without embolization before the surgical procedure. However, there are few studies on radiofrequency ablation treatment in patients with juvenile angiofibroma, most of them being case reports and case series. Furthermore, to date, there are no randomised control studies due to the low frequency of this condition.

In one case series, Cannon et al. reported four patients with juvenile angiofibroma in Radkowski stages IIb, IIa, Ia and Ia with estimated bleeding of 350, 300, 75 and 100 ml, respectively, who were embolised prior to surgery. In a second series, Ruiz et al. reported 3 patients in Radkowski stages IIb, Ic and IIb, with estimated bleeding of 150, 400 and 130 ml, respectively, with only the first patient undergoing selective embolization 48 hours prior to the surgical procedure. In another report, Ye L et al. analysed 12 patients undergoing traditional endoscopic treatment with cautery versus 11 patients treated with radiofrequency ablation, finding mean estimated bleeding of 420 ± 27.56 ml and 121.64 ± 21.11 ml, respectively, all in stage I of the Fisch classification, which also underwent selective embolization 24 hours prior to surgical treatment.

In our case series, we observed 3 patients in stage II of the Fisch classification and III in the Chandler classification who were selectively embolised 24 hours prior to the surgical procedure, with estimated bleeding of 200, 300 and 200 ml. Therefore, we suggest radiofrequency ablation as a useful treatment tool based on our results and the findings reported in other case series.

Likewise, our case series used ciprofloxacin as a post-surgical antibiotic treatment. However, no statistically significant reduction in the incidence of infection, endoscopic scores and symptoms has been demonstrated. Therefore the use of antibiotics after endoscopic nose surgery and sinuses is not routinely recommended to date.

Due to the results reported by McLaughlin et al., who found no statistically significant difference in operative time, mean estimated bleeding, transfusion rate, in-hospital days and recurrence rates when comparing two cohorts of 16 patients undergoing traditional endoscopic surgery with cautery versus 13 patients treated with radiofrequency ablation, all of whom had previously undergone selective embolization, randomised control trials including a larger number of patients should be performed. An important point to consider is radiofrequency ablation, which has cost up to $1,100 US dollars to perform a tonsillectomy in one paediatric study. It should be noted that the cost of using such an instrument is difficult to study, as it varies from institution to institution. Although our sample is limited, the outcome so far has been encouraging. At present, none of the patients have had a recurrence, even considering that all the patients have already passed the 3-year follow-up since the surgical procedure and only one patient had bleeding as a postoperative complication. Follow-up of patients should continue in the long term because of the recurrence reported for angiofibroma in different studies.

Radiofrequency ablation has been useful in various otorhinolaryngological procedures. For example, it has effectively resected nasal inverted papilloma, paraganglioma, hemangiopericytoma, lobulated capillary haemangioma, ossifying fibroma and oncocytic adenoma.

Conclusions

Radiofrequency ablation is a very useful tool for the surgical management of juvenile angiofibroma because it allows a single instrument to perform a subperiosteal dissection plane, controlling small and medium calibre vessels, and aspiration, thus allowing better visualisation of the surgical field. However, further comparative studies (randomised and non-randomised) including a larger number of patients should be performed to demonstrate statistically significant differences in operative time, mean estimated bleeding, transfusion rate, in-hospital days and recurrence rates between patients treated with radiofrequency ablation and those undergoing traditional endoscopic treatment with bipolar or monopolar cautery.

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Conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

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