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Case Report

The use of coblation technique for the debulking of juvenile angiofibroma

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Abstract

In this paper, we describe how we successfully debulked a large juvenile nasopharyngeal angiofibroma (JNA) in a 15-year-old boy using the coblation technique. The child had been complaining about recurrent epistaxis and persistent nasal obstruction for several months. JNA is a rare benign tumor that predominantly affects adolescent and young adult males. JNAs exhibit gradual progression, local expansion, high vascularity, and a notable tendency for persistence and recurrence. Due to their high vascularity, JNAs require surgical removal, and treatment commonly includes preoperative embolization and endoscopic methods. Complete tumor resection is the gold standard treatment. Tumor manipulation can lead to substantial bleeding due to its rich blood supply and lack of surface muscle fibers. Using the coblation technique for tumor debulking offers distinct advantages, including better control of blood loss, reduced thermal damage, improved visibility of the surrounding area, better postoperative recovery, and less resection of vital anatomical structures.

Keywords

coblation, juvenile nasopharyngeal angiofibroma, minimally invasive surgery, nasal tumor, nasopharynx

Introduction

Juvenile nasopharyngeal angiofibroma (JNA) is a rare, highly vascular, invasive tumor that is benign and not encapsulated. It primarily affects teenage boys[1] and is characterized by painless, constant nasal blockage and repeated nosebleeds. Juvenile nasopharyngeal angiofibroma accounts for a small percentage (0.05 to 0.5%) of all tumors in the head and neck region. It is believed to occur between one in 5,000 and one in 60,000 people per year in the United States. Macroscopically, JNA is a soft tumor with many lobes and a well-defined capsule. It is composed of fibrotic and vascular components, with the vascular portions being more noticeable towards the outer edges. There is a direct correlation between tumor size and the amount of fibrotic tissue.[2]

Previously, it was assumed that JNA originated from the nasopharynx, which is located at the base of the sphenoid bone. However, there is now extensive evidence supporting the theory that the tumor originates from the upper edge of the sphenopalatine foramen. The tumor then progresses beneath the mucous membrane and uses natural ostia, canals, and nerves, as well as bone erosion, to reach the infratemporal fossa, pterygoid canal, parasellar region, sphenoid basis, and orbit. Although JNA is noncancerous, it tends to cause local damage and can extend intracranially

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or intraorbitally in 10%–20% of cases. Additionally, there is a risk of significant hemorrhaging during surgery. A tumor biopsy is contraindicated because it can lead to extensive bleeding. The diagnosis is mainly based on clinical findings and diagnostic imaging.[3]

The etiopathogenesis of JNA is still unclear. The formation of tumors, primarily in males, can be attributed to the increased expression of androgen receptors in the tumor cells. Several studies indicate that JNA is a disease that relies on androgens for its growth.[4]

Surgical excision has emerged as the definitive and most effective therapeutic method. Various surgical techniques have been suggested, which are often determined by factors such as the tumor's size, location, and spread. The objective of surgery is to completely remove the tumor while minimizing complications and patient morbidity. This requires sufficient surgical exposure and proper patient selection.[5] Historically, non-endoscopic methods such as transpalatal, transmaxillary, lateral rhinotomy, and midface degloving were used. In 1996, Kamel first documented a surgical procedure called JNA resection, which is performed entirely using a transnasal endoscopic approach. The endoscopic method offers significant benefits in terms of visualization, estimated blood loss, and morbidity, making it highly advantageous. Additionally, preoperative embolization decreases intraoperative blood loss and should be considered for all eligible patients.

Endoscopic resection can be facilitated using image guidance, laser technology, coblation, or an ultrasonic scalpel.[6] The coblation technique was first introduced in 1997. Although this technique is patented, it is still considered relatively new in the field of soft tissue surgery. Currently, minimal data exists worldwide regarding the use of coblation for endoscopic debulking of JNA; only case reports are available.[7]

Treating juvenile angiofibromas can be challenging, and completely resecting extended tumors can lead to high morbidity rates and impaired quality of life postoperatively. In our paper, we propose that coblation technology could serve as a surgical tool for the debulking of the tumor.

Case presentation

A 15-year-old boy presented to the Otolaryngology Department of General Children's Hospital, Agia Sofia, with nasal congestion and recurrent epistaxis. A comprehensive evaluation of the head and neck area was conducted, which included nasal endoscopy, computed tomography (CT), and magnetic resonance imaging (MRI). The flexible nasal endoscopy revealed a rubbery vascular mass that protruded at the level of the nasopharynx ***(Fig. 1)****. Contrast-enhanced CT and MRI images demonstrated that the tumor occupied the right pterygopalatine fossa and extended to the nasal cavity, nasopharynx, right superior parapharyngeal space, ethmoid sinuses, right infratemporal fossa to the edge of the buccal space, right masticatory space, lower posterior part of the right orbit, and the sphenoid sinus* ***(Figs 2, 3)****. Also, the Holman-Miller sign was seen on the axial CT scan* ***(Fig. 2)****. It refers to the anterior bowing of the posterior wall of the maxillary antrum due to a space-occupying lesion in the pterygopalatine fossa, and it is often described as a pathognomonic feature in a juvenile nasal angiofibroma (JNA).[8]*

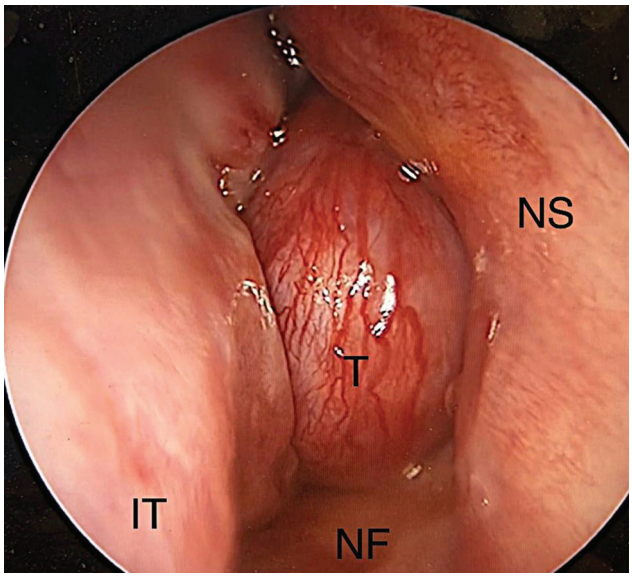

Figure 1. Pre-operative endoscopic image of the right nasal cavity revealed the presence of pathologic tissue, with high vascularity, filling up the nasopharynx and extending into the right nasal cavity. NS: nasal septum; NF: nasal floor; T: tumor; IT: inferior turbinate.

In July 2024, the patient underwent transnasal endoscopic surgery at the General Children's Hospital Agia Sofia after the main feeding artery was embolized at G. Gennimatas Hospital. The Coblator EIC5872-01 from Intelligent Medical was used to debulk the tumor. The Coblator has an integrated FLOW-IQ pump that provides a continuous supply of saline. The Coblator offers two modes: a 'med mode,' which is recommended for fine dissection, and a 'Hi mode,' which is recommended for debulking. We used the 'Hi mode.' The coblation technique induces tissue destruction while minimizing energy dispersion, resulting in reduced damage to surrounding tissues. There was minimal blood loss during tumor debulking. After debulking, the surrounding area was more visible, it was easier to identify several landmarks at once, and there was more space for instruments and tumor retraction ***(Fig. 4)****.*

A post-operative histopathological analysis verified the diagnosis of juvenile nasopharyngeal angiofibroma. The diagnosis was confirmed by identifying fragments of a mesenchymal fibroblastic/myofibroblastic hyperplastic lesion, some of which were lined by respiratory epithelium. These fragments contained crushed glands, medium-sized veins, arteries, and nerve bundles. These features are consistent with sinonasal tract angiofibroma WHO, 2020 ***(Fig. 5)****. Immunohistochemistry revealed heterogeneous nuclear expression of β-catenin (~25%) and focal expression of smooth muscle in the stellate/spindle cells. Based on the patient's medical history, there*

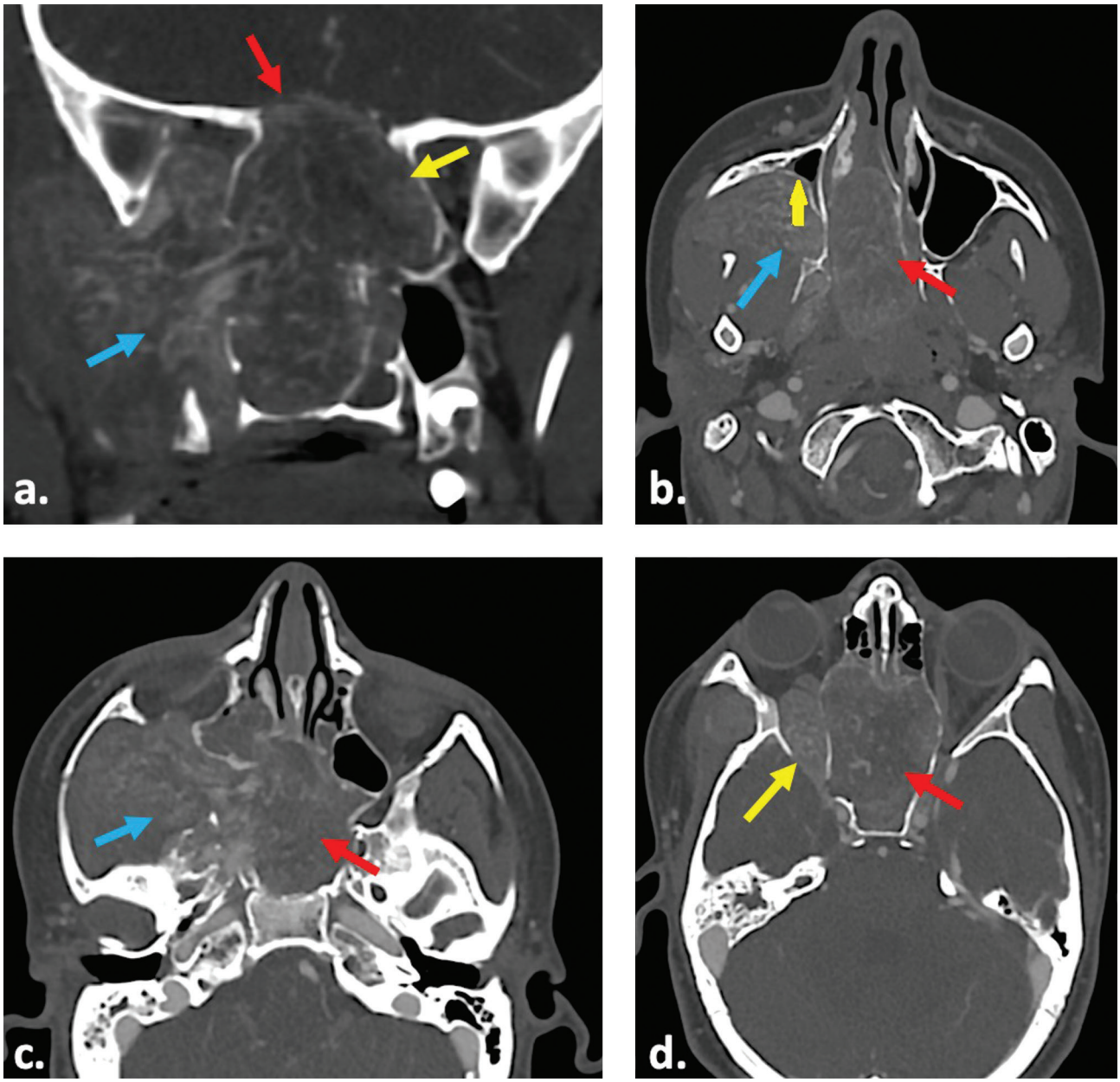

Figure 2. Computed tomography scan. (**a**) Coronal view. Tumor filling up the nasopharynx and extending cranially to the dura (red arrow), laterally to the orbital apex (yellow arrow) and the pterygopalatine/infratemporal fossa (blue arrow); (**b**) Axial view at the level of the inferior turbinate. Tumor filling up the right nasal cavity (red arrow) and the right pterygopalatine fossa (blue arrow). Anterior bowing of the posterior wall of the maxillary antrum, (Holman-Miler sign) (yellow arrow); (**c**) Axial view at the level of the sphenoid sinuses. Tumor extending to the masticator space (blue arrow) and filling up the sphenoid sinuses (red arrow); (**d**) Axial view at the level of the ethmoid sinuses. Tumor filling up the ethmoid sinuses (red arrow) and extending into the right orbit (yellow arrow).

were no previous instances of oncological disorders or similar cases in his family.

Staging of JNA is critical for defining the optimal treatment plan and predicting the outcome accurately. Currently, there is no globally accepted classification system. Multiple staging systems have been created to categorize the extent of the tumor, with the Radkowski[9] and Andrew's (a modified version of Fisch) classifications[10] being the most commonly utilized tools. Based on these features, the preoperative diagnosis was JNA at stage IIC according to Radkowski system ***(Table 1)****.*

Discussion

Currently, there is a discernible trend towards less invasive surgery. The efficacy of such surgeries has relied upon the skills and expertise of the surgeon, in addition to rigorous patient selection. The advancements in intranasal endoscopic surgery, along with the effectiveness of preoperative arterial embolization, has enabled the endoscopic treatment of certain cases of juvenile nasopharyngeal angiofibroma.[11] However, arterial embolization has the risk

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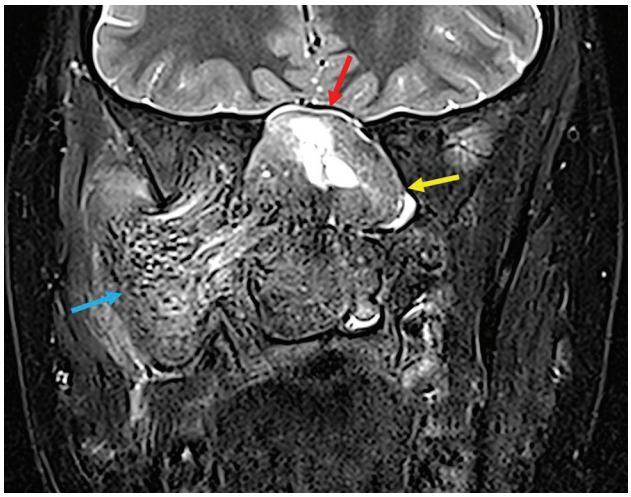

Figure 3. Magnetic resonance tomography of the head (T2-sequence, coronal view), revealing a tumor in the nasopharynx. The tumor extended cranially to the dura (red arrow), and laterally to the orbital apex (yellow arrow) and pterygopalatine/infratemporal fossa (blue arrow).

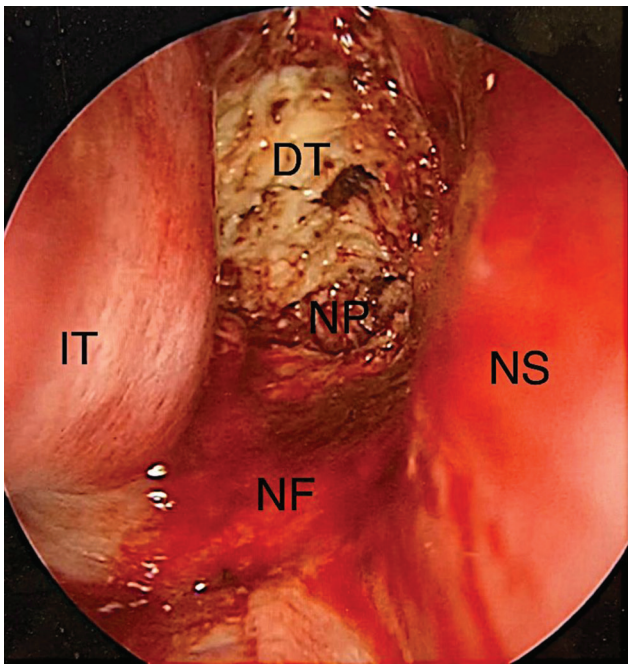

Figure 4. Endoscopic image showing the tumor after debulking via coblation technique. There was excellent visibility of the nasal floor, nasal septum and lateral nasal wall. The tumor was debulked to the level of the nasopharyngeal roof. NS: nasal septum; NF: nasal floor; IT: inferior turbinate; DT: debulked tumor; NP: nasopharynx.

of severe consequences, including iatrogenic thrombosis in the brain and inadequate reduction in blood flow to a tumor. This is particularly true for big tumors that receive blood supply from multiple sources. The advancement of endoscopic endonasal surgery now allows the ligation of sinonasal vessels, including the sphenopalatine artery, the

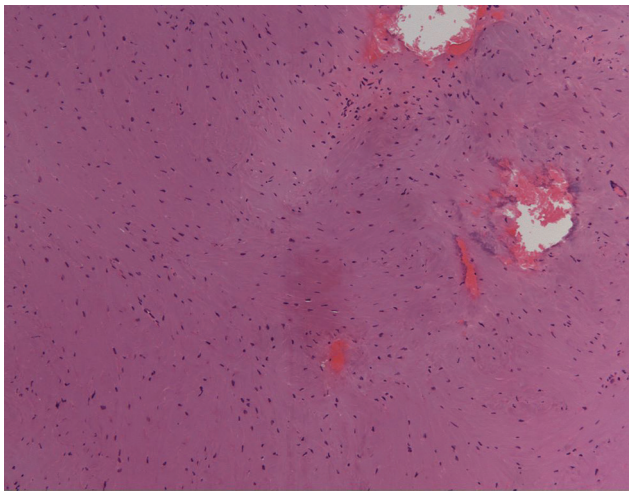

Figure 5. Histopathological result with features compatible with sinonasal tract angiofibroma.

maxillary artery, and the anterior and posterior ethmoidal arteries. This is achieved by expanding the surgical area by including the pterygopalatine and infratemporal fossa.[12] Furthermore, a newly developed coblation plasma technology has been found to be effective for accurate control of bleeding and removal of tissue at a low temperature in a saline-washed and smoke-free visual field. It utilizes a bipolar, radiofrequency electric current passed through normal saline to generate a plasma field composed of highly ionized particles. These ions have the capability to disintegrate the connections between cells, causing the tissue to dissolve at a temperature of around 70°C. Coblation induces targeted tissue destruction with minimum dispersion of energy, working at a relatively moderate temperature of around 60 to 70°C, resulting in reduced harm to surrounding tissues. On the other hand, traditional diathermy generates temperatures above 400°C. Although coblation generates low heat, it effectively seals small blood vessels throughout the process, hence reducing bleeding and other complications.[13]

Hemorrhage is unquestionably the most notable consequence of resecting juvenile nasopharyngeal angiofibroma. Based on our experience, the primary advantage of this technology in JNA resection is its ability to combine dissection, hemostasis, irrigation, and suctioning functions into a single device. As a result, there is a reduced requirement for extra devices, resulting in more effective removal of tissue with potentially shorter operative time and less blood loss compared to typical endoscopic treatments. Ruiz et al. noted that using coblation to debulk the tumor allowed for quicker and more efficient surgery. They found that the precise and controlled nature of coblation reduced the need for extensive blood transfusions, and they highlighted its role in minimizing intraoperative and postoperative complications.[1] This is due to the integrated irrigation and suctioning system that offers enhanced intraoperative visualization by facilitating the effortless and effective evacuation of blood. This feature is particularly crucial when

Table 1. Radkowski classification[8]

Stage	Tumor characteristics
Stage IA	Tumor limited to the nasal cavity and/or nasopharynx without bone destruction
Stage IB	Tumor involving the nasal cavity and/or nasopharynx with minimal bone destruction (e.g., pterygoid plate erosion)
Stage IIA	Tumor extending into the pterygomaxillary fossa, with minimal bone destruction
Stage IIB	Tumor involving the pterygopalatine fossa and/or infratemporal fossa, with bone destruction
Stage IIC	Tumor with intracranial extradural extension, without significant brain involvement
Stage IIIA	Tumor with intracranial intradural extension, without significant brain involvement
Stage IIIB	Tumor with intracranial intradural extension, with significant brain involvement

dealing with such extremely vascular malignancies.

Previous studies have described the use of coblation for debulking and safe tumor removal. Pierson et al. found that coblation-assisted debulking reduced blood loss and provided a clear surgical field. They concluded that coblation is a useful adjunct in the surgical management of extensive JNA, where the goal is to reduce tumor bulk and facilitate complete resection with lower risk. They emphasized that coblation helped reduce tumor size and pressure effects, leading to symptom improvement (such as relief from nasal obstruction and epistaxis) without increasing the risk of complications associated with more aggressive surgery.[14] Syed et al. emphasized that coblation was particularly useful for reducing the tumor size post-embolization. By utilizing coblation, surgeons were able to debulk the tumor while maintaining a bloodless field, making the subsequent resection or therapeutic interventions easier to perform.[15] The aim of effective coblation tumor resection is to debulk the tumor, in order to minimize the surgical morbidity, allowing for better endoscopic visualization and minimizing resection of other vital anatomical structures (nasal septum, lateral nasal wall, etc). Liu et al. demonstrated that coblation-assisted debulking was effective in reducing tumor size without causing significant injury to the surrounding tissues, which is crucial for avoiding complications and ensuring patient recovery.[16]

In our opinion, the coblation technique has several advantages. It allows the surgical team to safely debulk the JNA, creating more space for endoscopic tumor removal and improving endoscopic visibility. This results in less surgical morbidity and minimizes the resection of vital anatomical structures in the nasal cavity, such as the nasal septum and lateral nasal wall.

Conclusions

In conclusion, the management of JNA requires initiating treatment through surgical excision. Preoperative angiography and, if feasible, endovascular embolization of tumor feeders could be useful in most instances. All feasible blood-saving procedures should be utilized to assist surgery. The case report emphasizes the importance of using coblation-assisted transnasal endoscopic resection for the debulking of juvenile nasopharyngeal angiofibroma (JNA). Despite the high vascularity of INA tumors, this approach is capable of effectively dissecting and debulking JNAs. This technology enables surgeons to undertake surgery with minimum complications and low blood loss during the operation, even in non-embolized JNA tumors. So, the coblation technology could serve as a surgical tool for the debulking of the tumor, due to excellent hemostasis capabilities. The removal of the tumor is still being performed via classic endoscopic or external surgical techniques. Our case report provides more evidence supporting the effectiveness of coblation in the endoscopic management of JNA. However, additional research is necessary to thoroughly establish the safety, effectiveness, and possible constraints of the coblation approach in endoscopic debulking of JNA.

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Competing interests

The authors have declared that no competing interests exist.

Human subjects

Consent was obtained from the participant in this study. The General Children's Hospital Scientific Council issued approval.

Author contributions

Conceptualization: E.G. and A.L.; methodology: E.G. and A.L.; formal analysis: E.G. and A.L.; data curation: E.G., A.L., A.G., P.C., A.P., and V.R.; writing—original draft preparation: A.L.; writing—review and editing: E.G. and A.L.; supervision: E.G. and A.L. All authors have declared their participation in the design, execution, and analysis of the paper, and have approved the final version. Furthermore, there are no conflicts of interest associated with this

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