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RISK AREAS IN ENDOSCOPIC SINUS SURGERY: A REVIEW OF 175 COMPUTED TOMOGRAPHY SCANS OF THE SINUSES AMONG PATIENTS WITH NASAL POLYPOSIS*

EMILIO ROMEL G. ACOSTA, MD**
GIL M. VICENTE, MD, FPSO-HNS***

ABSTRACT

OBJECTIVE

This study aims to determine the types and frequency of occurrence of anatomic variations of high-risk areas in CT scans of the paranasal sinuses as they relate to sinus surgery among patients with nasal polyposis.

DESIGN

Descriptive/Cross Sectional

SETTING

Tertiary Government Medical Center

SUBJECTS

Pre-operative computed tomography scans of the paranasal sinuses of patients with nasal polyposis

RESULTS

Among one hundred and seventy-five CT studies reviewed, eight types of variations relevant to endoscopic sinus surgery were noted. These were: asymmetric ethmoid roof (19.4%), deep olfactory fossa/high lateral lamella of the cribriform plate (Keros III) (15%), Onodi cells (8.2%), dehiscent lamina papyracea (2.5%), extensive sphenoid pneumatization (1.1%), asymmetric sphenoid septum attached to the carotid canal (1.1%), dehiscent carotid canal in the sphenoid sinus (0.5%), dehiscent optic nerve in the sphenoid sinus (0.2%). The anterior ethmoid artery (0.8%) and posterior ethmoid artery (1.4%) were also identified.

CONCLUSION

We reviewed the pre-operative CT scans of 175 patients with PNS disease (nasal polyposis) and noted the high-risk areas where injury may occur during surgery. These anomalies are identifiable in the pre-operative CT scan and should be used as a guide in planning and execution of safe endoscopic sinus surgery.

*1st Place, PSO-HNS Descriptive Research Contest, November 29, 2000, Punta Baluarte, Calatagan, Batangas

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INTRODUCTION

Endoscopic sinus surgery, while offering advantages over conventional surgery of the paranasal sinuses, is not without its hazards[1,2,3,20]. Mosher, a surgical anatomist, in a presentation in 1929, stated that surgery in the ethmoids is one of the easiest ways to kill a patient[1]. This remains true today despite the advances in imaging, equipment and surgical techniques.

Complications of endoscopic sinus surgery (ESS) may be major or minor and may involve the orbit, the brain, and major vascular structures (internal carotid artery and cavernous sinus). Some of the more serious complications include blindness, meningitis, intraorbital hemorrhage, intracranial injury, brain abscess, and major epistaxis have been reported to occur in 0.75% - 10% of cases [3,4].

Complications happen partly because surgical landmarks differ among patients. This is due to the fact that the paranasal sinuses (PNS) are subject to varying degrees of pneumatization and differentiation[4]. Endoscopy, while allowing excellent visualization of the lateral nasal wall, is limited in its view of the frontal sinus and recesses, maxillary sinus and ostia, ethmoid bullae, and posterior ethmoid and sphenoid sinuses [5]. The CT scan, with its capacity to allow precise delineation of extent of disease and delicate bony anatomy (Fig. 1), plays an important role in providing the surgeon a road map prior to ESS [5-8,19,21]

A careful examination of the pre-operative CT

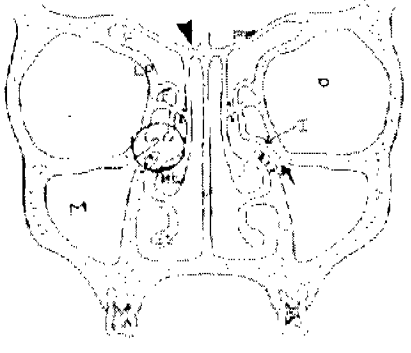

FIGURE1. Line diagram of coronal section at the level of the ostiomeatal unit (OMU). F = frontal, E = ethmoid, M = maxillary sinus, It = inferior turbinate, Mt = middle turbinate, LP = lamina papyracea, FE = fovea ethmoidalis , O = orbit, large arrowhead = cribriform plate, encircled area = OMU : I = infundibulum, arrow = maxillary sinus ostium leading into the hiatus semilunaris, dots = uncinate process.

scan should be done and the surgeon should note anatomic variations that may predispose patients to complications [4,7,9,10]. It is also important to look for other variations that either contribute to the pathology (obstruction of the ostiomeatal unit/OMU) or may interfere with the planned surgery. These include septal deviations, agger nasi cells, concha bullosa, paradoxically curved middle turbinates, uncinate variants, giant ethmoid bullae, and Haller cells [5,7,8].

Ohnishi *et al*[11], based on surgery done on 190 patients, identified main high-risk areas in the ethmoid labyrinth where they think surgical complications are most likely to happen. These are:

1. lamina papyracea
2. roof of the ethmoid sinus near the anterior ethmoid artery
3. lateral lamella of the cribriform plate
4. ethmoid roof near the posterior ethmoid artery
5. the area between the sphenoid and posterior ethmoid sinuses.

Meyers *et al*[6], also identified maxillary sinus hypoplasia, fovea ethmoidalis abnormalities, sphenoid sinus wall variations, and Onodi cells as anatomic variants identifiable in CT scans that are relevant to ESS. It is the objective of this paper to attempt to identify the aforementioned areas in pre-operative CT scans.

Foreign literature focusing on anatomic features and variations of the PNS

as seen in CT scans abound. None however, has been done for Filipino patients. This study aims to ascertain the presence and prevalence of anatomic variants relevant to ESS in CT scans of the PNS of patients with nasal polyposis.

OBJECTIVES

General:

1. To determine the types and frequency of anatomic variations of the PNS relevant to ESS in CT scans of patients with sinus disease.

Specific

1. To determine the frequency of the following anatomic variations among CT scans of the PNS of patients with nasal polyposis:
   a. dehiscent lamina papyracea
   b. ethmoid roof variation – asymmetry, depth
   c. Onodi cells
   d. sphenoid sinus variations - pneumatization
      -carotid and optic nerve canal dehiscence
      -septum variations
2. To identify the anterior and posterior ethmoid arteries as they course through the ethmoid labyrinth.
3. To discuss the significance of these variations as they relate to risks of complications in endoscopic sinus surgery (ESS)

SIGNIFICANCE

1. Knowledge of the more common anatomic variants would alert the sinus surgeon on what to look for/watch out for when doing their surgeries.

2. Accurate identification of these variants would potentially reduce the risks of intra-operative complications by enhancing pre-operative planning of sinus surgery.

3. No such study has been done among local patients.

4. To provide a springboard from which further studies may arise.

METHODS

I. DESIGN Descriptive/Cross-sectional

II. SETTING Outpatient clinic of the Otorhinolaryngology department of a tertiary hospital

III. MATERIALS The pre-operative PNS CT scans of 175 patients diagnosed to have nasal polyposis. These are previously unoperated upon cases.

IV. PROCEDURE The CT scans of the study population were systematically evaluated by the author according to the guidelines proposed by Stammberger and by Mason et al. (see Appendices A and B). Emphasis was given to the previously enumerated variants deemed relevant to ESS. The CT scans were reviewed in two separate occasions to minimize intra-observer variability.

The presence or absence of normal landmarks and anatomic variants previously enumerated were noted and tabulated. Each feature was counted as one (1) feature independent of any other variant present in the same subject. The left and right halves were counted separately for a total of 350 nasal cavities evaluated.

The ethmoid roof height was obtained by measuring the distance from the cribriform plate of one side to the apex of the fovea ethmoidalis of the frontal bone of the same side. These were then grouped according to Keros' classification (Fig 2).

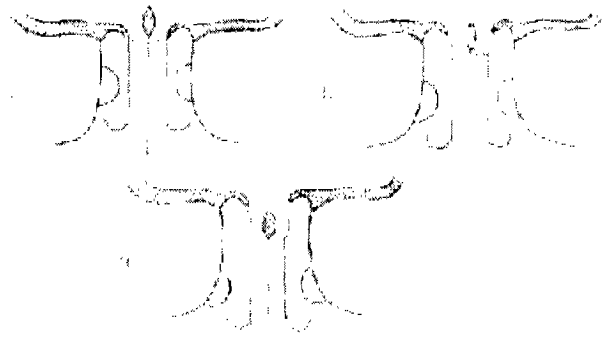

FIGURE 2. This schematic drawing shows the three different types of olfactory fossa according to Keros. In Type I the height of the lateral lamella is from 1-3 mm. Type II = 4 -7 mm, Type III = 8 – 16 mm. (from Stammberger, Functional Endoscopic Sinus Surgery, 1991)

Additionally, asymmetry of the ethmoid roofs was noted by comparing both sides in the same patient and measuring the difference (the total number in this case was 175 CT scans as each nasal cavity was not evaluated independent of the other).

The frequencies of occurrence of the anatomic variants were computed as a percentage of the total number of cases seen.

RESULTS

The CT scans reviewed numbered 175 for a total of 350 nasal cavities or sets of paranasal sinuses. The age range was from 6 – 77 years old with a mean of 68.3. Most of the subjects were from the 2nd – 5th decade of life, with a male:female ratio of 1.96:1 or approximately 2:1. The diagnosis of all subjects was of nasal polyposis. The most commonly affected sinuses were the maxillary and ethmoids, followed by the frontal and sphenoid sinuses.

The anatomic variants seen (arranged from anterior to posterior) were:

A. High-risk areas
   1. Dehiscent lamina papyracea 9 (2.5%)
   2. Ethmoid roof
      a. Keros types :
         I 12 (3.4%)
         II 284 (81%)
         III 54 (15%)
      b. asymmetric ethmoid roof : 34 (19.4%)
         right higher than the left 8 (4.5%)
         left higher than the right 26 (14.9%)
   3. Onodi cell 29 (8.2%)
   4. Extensive sphenoid pneumatization 4 (1.1%)
   5. Carotid canal in sphenoid sinus
      a. bulge in sinus, no dehiscence 11(3.14%)
      b. dehiscence 1 (0.2%)
   6. Optic nerve canal in sphenoid sinus
      a. bulge in sinus, no dehiscence 8 (2.2%)
      b. dehiscence 1 (0.2%)
   7. Sphenoid sinus septa
      a. absent 42 (24%)
      b. single, median 43 (24.6%)
      c. single, asymmetric 77 (44%)
      d. multiple/subseptations 13 (7.4%)
      e. septum attached to the carotid canal 4 (1.1%)

B. Anterior ethmoid artery 3 (0.8%)
Posterior ethmoid artery 5 (1.4%)

DISCUSSION

There is a great amount of variation in the anatomy of the paranasal sinuses and the nasal cavity. Some of these are seen more frequently among patients with disease of the PNS [7]. These variants are thought to contribute to the pathogenesis/ pathology of PNS disease through their obstructive effect on the ostiomeatal unit (OMU) and interference with normal drainage pathways. However, there appears to be a lack of consensus among examiners as to the definite clinical significance of these variations [5]. More importantly, noting the presence and relationships of these anatomic divergences may serve as a surgical road map – delineating high-risk areas in the conduct of endoscopic sinus surgery.

High- risk areas

Lamina papyracea

This is the medial wall of the orbit and is also the lateral wall of the ethmoid sinus. It is a thin and quite fragile structure, which normally protrudes into the surgical field [11]. Also, dehiscence may occur which, by itself, may not be significant but if the periorbita is violated, damage to orbital contents (medial rectus and superior oblique muscles, ciliary nerve, optic nerve) may occur [3,11,12] (Fig. 3). This may lead to orbital fat herniation, hematoma, emphysema, diplopia, and blindness secondary to retinal artery compression and optic nerve ischemia or direct optic nerve injury[9]. Meyers *et al* reported dehiscence of the lamina papyracea in 2 of 400 CTs they reviewed. In our study, this was noted in 9 of 350 orbits (2.5%) (Fig. 4).

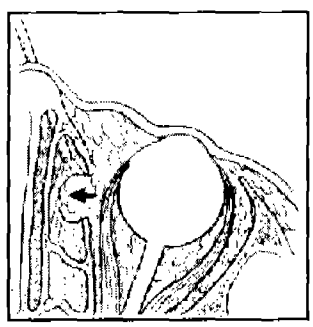

FIGURE 3. Orbital fat herniation through a traumatic defect in the lamina papyracea

FIGURE4. Coronal CT scans showing dehiscence of the lamina papyracea (arrows).

Ethmoid Roof

Keros [10,13] in his dissections of 450 skulls, classified the olfactory fossae in 3 types based on the distance between the cribriform plate and the roof of the ethmoid. The findings of the current study paralleled his in that type II was the most common (81%), followed by type III (15%) and lastly, type I (3.4%). Among these, type III is at greatest risk for intracranial injury. This is because the olfactory fossa is deep and the lateral lamella of the cribriform plate is high and thin [10]. Injuries are more likely to happen when the surgeon works medial to the superior attachment of the middle turbinate in the attempt to avoid the lamina papyracea. As a consequence, the surgeon works more medially, reaching the area where the anterior ethmoid artery crosses through the ethmoid [3,9] (Fig. 5).

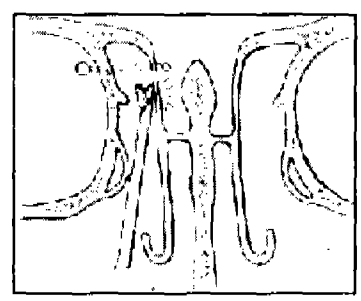

FIGURE 5. This figure shows a high ethmoid roof and the site of probable penetration of the lateral lamella of the cribriform where the ethmoid artery crosses through.

It is this region where the lateral lamella of the cribriform is said to be weakest [10]. Thus, identification of the ethmoid artery (anterior and posterior) in the ethmoids is helpful in avoiding damage to the most injury-prone part of the roof of the ethmoid sinus [11]. In this series, the anterior ethmoid artery and its canal was seen coursing through the ethmoids below the roof in 3 cases (0.8%) (Fig. 6) while the posterior ethmoid artery and its canal was identified in 5 cases (1.4%).

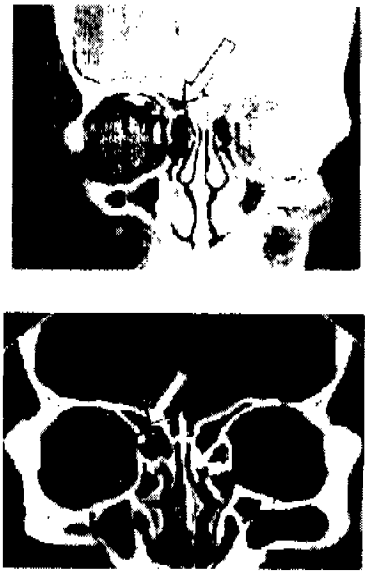

FIGURE 6. Coronal CT scans showing the anterior ethmoid artery and its canal crossing through the ethmoid sinus (arrows).

The anterior vessel was seen a slice or two (slice thickness = 2mm) from the most anterior part of the middle turbinate, approximately 2 mm below the fovea ethmoidalis. The posterior ethmoid artery was identified 2 – 3 slices from the beginning of the vertical attachment of the middle turbinate. Careful dissection around the arteries is necessary as transection could often result in retraction into the orbit with its consequent intractable intraorbital hemorrhage.

Injury to this may also result in CSF leaks (.1 – 1%) which may lead to meningitis or brain abscess formation which has a mortality rate of 20-30%[11,15].

Asymmetry of the ethmoid roof is also said to contribute to intracranial injuries [7,15]. Maniglia *et al*[4] noted that more CSF leaks occur on the right side of a patient operated upon by a right-handed surgeon. The authors attributed this to the awkward position of the surgeon, preventing adequate visualization of surgical landmarks. Another contention is that asymmetry in roof height might be a factor. Right-handed surgeons commonly start on the left nasal cavity and this may lead to under- or over-estimation of the height on the right. A difference in height of the ethmoid roofs was noted by Dessi *et al*[15] in 15 of 150 scans (10%) with the right fovea lower than the left in 8.6%. In our study asymmetry of the roof was seen in 34 cases (19.4%), with the right lower in 26 cases (14.7%) (Fig 7). Care, therefore, must be taken not only in approaching the lateral wall of the ethmoid labyrinth where the orbit lies, but along the roof as well.

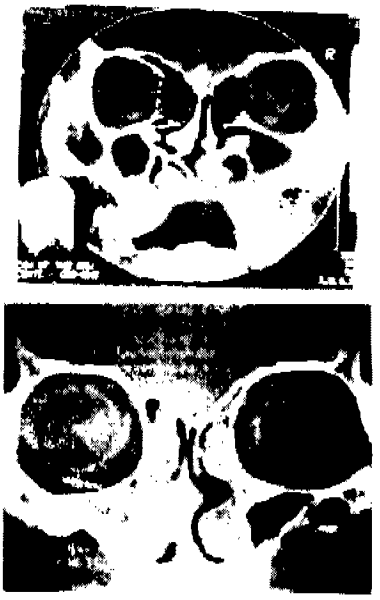

FIGURE 7. Coronal CT scans showing asymmetric ethmoid roof height .

Onodi Cells

These are posterior ethmoidal cells that have extended posterosuperiorly and/or laterally beyond the sphenoid sinus and may lie in close relationship to the optic nerve [7,16] (Fig. 12).

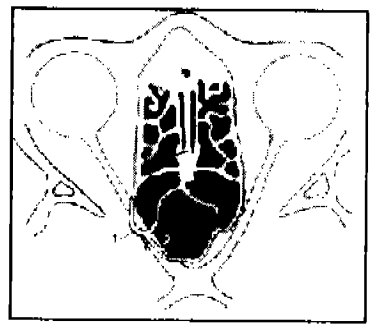

FIGURE 12. Schematic illustration showing the relationship of the optic nerve to the posterolateral wall of an Onodi cell and the sphenoid sinus. 1 = optic nerve bulging into an onodi cell; and 2 = optic nerve bulging into the sphenoid sinus (from Stammberger, Functional Endoscopic Sinus Surgery, 1991).

The reported incidence of this structure ranges from 3.4 – 14% [6]. In this review, onodi cells were seen in 29 cases (8.2%) with the optic nerve creating an impression in 2 cases (0.25%). Knowing this relationship pre-operatively is of importance if the sphenoid is to be approached via the ethmoid. Searching for the anterior wall of the sphenoid sinus behind the furthermost point of the posterior ethmoid might lead to injury to the optic nerve [10,11].

Sphenoid Sinus

Sphenoid sinus pneumatization is quite variable and protrusion of surrounding structures occurs in different degrees [16] (Fig. 8). Extensive aeration into the clinoids, dorsum sellae and pterygoid processes may predispose some of these structures to injury during surgery [17].

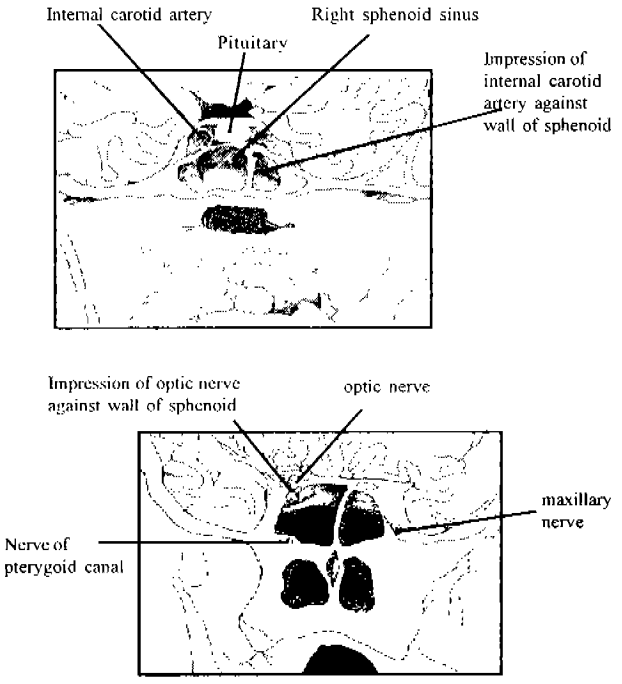

FIGURE 8. Schematic drawing of coronal sections through the spheoid sinus showing the various structures surrounding it.

The more important of these entities as they relate to sinus surgery are the optic nerve and internal carotid artery. The former is seen adjacent to the posterosuperior wall of the sphenoid while the latter courses just below the nerve. In well pneumatized sphenoids, these may project into the sinus covered by a thin bony shell. The bony covering may be naturally dehiscent or be absent [6,11]. Thus, injury to these structures may happen in cases where sphenoidectomy needs to be done [10].

Elwany *et al*[18], in their dissection of 93 cadaver heads, noted the following:

1. carotid artery impression seen in 34 sinuses (18.2%)
2. dehiscent carotid canal in 9 sinuses (4.8%)
3. optic nerve impression in 54 sinuses (29%) with no dehiscences.

Meyers *et al*.[6], in their review of 400 CT scans noted bulging of the carotid artery in the sinus 15% of the time, bulging of the optic nerve in 3 cases (0.75%), and a freely coursing optic nerve in 2 cases (0.5%). In this series, the carotid was seen to make an impression on the sphenoid sinus wall in 11 cases (3.14%) and was dehiscent in 2 (0.5%). The optic nerve was protruding in the sinus in 9 cases (2.2%) and uncovered in 1 case (0.2%) (Figs 9, 10).

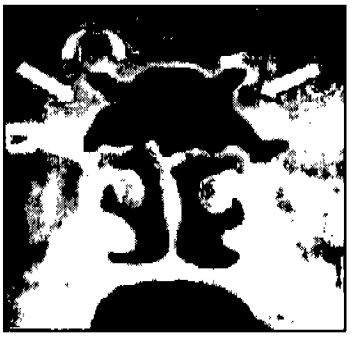

FIGURE 9. Extensively pneumatized sphenoid. Note the impression of the carotid canals (straight arrows) and the optic nerves (curved arrows) into the sphenoid sinus.

FIGURE 10. Axial CT scan showing the left optic nerve coursing through the sphenoid sinus without any bony covering (arrow).

The direction and insertion of the septa in the sphenoid sinus is also important. The intersinus septum may be absent, single, or with subseptations/ multiple, median or asymmetric. It may deviate laterally and insert into the bony canals of the carotid or the optic nerve[10]. Grasping and torsion applied on the septum can thus result in carotid avulsion or production of an aneurysm [6]. In this study, the septum was seen to be attached to the carotid canal in 4 cases (1.1%) (Fig 11). Meyer *et al*.[6] reported this occurrence in 1% of their cases.

From the preceding, we see that variations are myriad and add to the complexity of the preoperative evaluation and planning as well as in the conduct of sinus surgery. It is thus imperative that these high-risk areas be identified prior to surgery in order to avoid potentially disastrous complications.

FIGURE 11. Axial CT showing an asymmetric sphenoid septum attaching to the carotid canal on the right.

CONCLUSION

In summary, we reviewed the pre-operative CT scans of 175 patients with PNS disease (nasal polyposis) and noted the high-risk areas where injury may occur during surgery. These anomalies are identifiable in the pre-operative CT scan and should be used in as a guide in planning and execution of safe endoscopic sinus surgery.

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APPENDIX A

PREE-OPERATIVE CONSIDERATIONS (Stammberger 1991)

1. What is the condition of the ethmoid infundibulum?
   - Is it almost atelectatic?
   - Is the uncinate immediately adjacent to the lamina papyracea or is the infundibulum wide?
   - At what angle does the uncinate process stand to the lamina papyracea?
   - Will I be able to resect the uncinate process directly at its anterior attachment, or is there a real risk of injuring the orbit by carrying the knife too far laterally because of the narrowness of the infundibulum?
   - Would it be safer in the given case to resect the uncinate process in "strips" from its free posterior margin anteriorly?
2. What are the relationships of the uncinate process superiorly, particularly to the frontal recess?
   - Is there a recessus terminalis?
   - Can I see whether the frontal recess opens medially or laterally into the uncinate process?
   - What is the position of the frontal sinus?
   - Is it symmetrical?
3. Is the ethmoid bulla small or large?
   - Is it pneumatized?
   - Is there a lateral sinus?
   - What is the relationship of the medial wall of the orbit to the middle turbinate?
   - Can it be distinguished, does it bulge unusually strongly against the ethmoid?
   - Are there bony defects from the previous operation?
4. Are there abnormalities in the course of the roof of the ethmoid?
   - Can the bony margins be identified precisely?
   - To what extent does the roof of the ethmoid project over the cribriform plate?
   - Is the olfactory fossa shallow or deep?
   - Do the ethmoid cells extend supraorbitally?
   - Are the right and left sides symmetrical?
5. What is the relationship of the posterior ethmoidal cells to the sphenoid sinus?
   - Are there Onodi cells?
   - Is the optic nerve involved within them?
6. To what extend is the sphenoid pneumatized?
   - Are the internal carotid artery and optic nerve prominent and is there a suspicion that their bony cover may be dehiscent?
   - Is the clinoid process well pneumatized?
   - Are the bony attachments over the carotid and the optic nerve?
7. If the patient had previous surgery:
   - What was removed?
   - Can I identify the middle turbinate or its remnants?
   - Is there evidence of a bony defect or scar formation in the lamina papyracea, the periorbita and/or the roof of the ethmoid, the dura, and cribriform plate?

APPENDIX B

STEPS EMPLOYED IN READING PNS CT SCANS (Mason et al,1998)

1. Orientate coronal cuts anterior to posterior, check sides; identify the ethmoid bulla
2. Lamina papyracea – is it eroded? Middle turbinate present? Concha bullosa or paradoxical middle turbinate?
3. Frontal recess – site and size of agger nasi cells, insertion of the uncinate process.
4. Height of the skull base – asymmetry of the skull base and cribriform plate. Height of the posterior skull base – from roof of maxilla to posterior skull base
5. Sphenoid – degree of asymmetry of sphenoid intersinus septum. Onodi cell, carotid dehiscent, optic nerve.
6. Staging of pathology, plan procedure, features of atypical infection or neoplasia.

From Mason, J.D.T, N.S.Jones, R.J. Hughes, & I.M. Holland. A systematic approach to the interpretation of computed tomography scans prior to endoscopic sinus surgery. *The Journal of Laryngology and Otology.* October 1998, 112:986-990.

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Clinical Efficacy of Gentamicin, Betamethasone, Tolnaftate, and Clioquinol (Quadriderm) in the Management of Acute Otitis Externa in Adults*

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ABSTRACT

OBJECTIVE: To determine whether Quadriderm ointment is effective in treating acute external ear infections

- To identify the common causative organism in the test population
- To assess the rapidity with which the clinical symptoms of acute otitis externa are controlled
- To determine whether weekly administration of the drug is sufficient to control the infection
- To determine whether Quadriderm ointment causes significant changes in the hearing threshold among patient included in the study

DESIGN: Descriptive Study

SETTING: Multicenter Clinical Trial

RESULTS: A total of 17 subjects (8 males and 9 females) were included in the study. Seven out of 14 patients noted resolution of symptoms as early as the second day of treatment while complete resolution was noted in all 14 patients at day 4. No signs of inflammation was noted in all patients during their follow up on the seventh day of treatment. None of them required a second instillation of the drug. Pseudomonas aeruginosa and Staphylococcus aureus are still the most common causative organism isolated from our subjects. Post-treatment pure tone audiogram revealed no significant changes in hearing thresholds in any of the subjects. There was no complaint of worsening of symptoms during the treatment period.

CONCLUSION: We conclude that Gentamicin Sulfate, Bethametasone propionate, Clioquinol and Tolnaftate combination (Quadriderm Ointment) is an effective drug for the treatment of acute otitis externa in adults.

INTRODUCTION

Acute Otitis Externa also know as "swimmer's ear" or "jungle rot" accounts for a majority of otolaryngologicvisits. This is especially true for tropical countries like ours because of the warm and humid climate. Various factors have been implicated in its causation. It usually begins with the breakdown of skin's protective function followed by infection. The commonly reported causative microorganisms are Pseudomonas aeruginosa and Staphylococcus aureus but certain other bacteria are also implicated in its causation. Fungal infections oftentimes coexist. Fungal infections of the ear canal are commonly associated with ear canal moisture, warmth, and prior treatment of a bacterial infection with topical antibiotic therapy. Otitis Externa, therefore, can be regarded to as a mixed bacterial and fungal infection and management should be effective enough to target both.

In most cases, this is a fairly easily treatable condition but the infection has a tendency to recur and at times become chronic. Contemporary management consists of cleansing the ear canal and administration of topical antibiotics or antibiotic-steroid preparations. Usually treatment is done empirically without the benefit of culture since majority of patients with this condition is already tormented by pain. It is often impractical, time-consuming and difficult to make a precise diagnosis under such condition. Thus, treatment used in this condition needs to be effective

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against a broad range of microorganisms.

Antibiotics either singly or in combination with steroids or an antifungal agent in the form of drops or suspension are commonly used because of the ease of application. Since otitis externa are often characterized by diffuse involvement of the ear canal a topical drug preparation that will cover the areas involved would be ideal. Moreover, various studies have shown that fungal growth does occur in patient treated with antibiotic or antibiotic-steroid otic drops in as early as the third day of treatment. Addition of an antifungal agent is often warranted. However, most antifungal otic drops cause sensitization and may even add more insult to the already injured canal skin. Cost of treatment is another factor here.

GBTC cream combines betamethasone valerate, an extremely active anti-inflammatory agent; gentamicin sulfate, a highly effective broad-spectrum antibiotic; tolnaftate, a non-sensitizing topical fungicidal agent; and clioquinol, a useful drug for the treatment of mixed dermatologic infections and gram positive bacteria. This drug combination have been proven to be highly effective than its individual components in treating mixed dermatologic infections. Whether this drug will prove effective in treating inflammatory conditions of the external ear (otitis externa) is the prime objective of this study.

MATERIALS AND METHOD

PATIENTS

Inclusion Criteria:

1. patients 18 years of age and above
2. there should be an informed consent
3. patients with signs and symptoms consistent with acute otitis externa
4. patients with external ear infections of not more than 2 weeks
5. no history of prior otitis externa treatment within 36 hours
6. there should be no middle ear disease (i.e. otitis media)

Exclusion Criteria:

1. patients below 18 years of age
2. perforated tympanic membrane regardless of size
3. invasive otitis externa requiring systemic antibiotic therapy
4. self-medication therapy for otitis externa prior to therapy within 36 hours
5. known allergy to any of the component drug
6. patients who was lost to follow-up during the 1-month clinical trial period

All patients who satisfied the above criteria and have consented with the procedure are included in the study. The patient's history is carefully reviewed taking note of the signs and symptoms.

A system of grading pain/ tenderness was discussed and agreed upon with the patient:

Grade 0 no pain
Grade 1 *mild*: dull pain when tension is applied to straighten the canal
Grade 2 *moderate*: pain with pressure on the tragus or pressure on the concha underneath the lobule
Grade 3 *severe*: persistent pain even without manipulation

The ear canal is gently swabbed with a cotton pledget to obtain specimen for culture and sensitivity testing. Once specimen is already available for culture cleansing of the ear canal is done next.

Initial otoscopic examination is done by the OPD Resident and findings were recorded in the patient's chart. The tympanic membrane is carefully assessed for the presence of any perforation. A system of grading the edema of the ear canal is formulated:

Grade 0 no hyperemia, no edema
1 hyperemia of the external auditory canal skin
2 minimal swelling of the canal
3 moderate swelling but canal is still patent
4 marked swelling with obliteration of the external auditory canal

A pre-instillation pure tone audiometry is done. All patients are provided with a 10g tube of GBTC cream. The Resident then places around 1.0 cc of the ointment in a syringe connected to an 18-gauge intravenous catheter. The cream is instilled inside the ear canal starting at the tympanic end and is gradually drawn to fill the entire canal with the cream.

A checklist or form was given for the patient to fill up and record the progress of his/her symptoms on a daily basis. A translation of the grading system in the vernacular is given to ensure comprehension and compliance (Appendix A).

Patient is asked to follow-up on the third day of treatment for re-evaluation. Appearance of any new symptom or sign or progression of the symptoms warrant termination of therapy. An alternative otic preparation is given in this case. If no adverse effects were noted patient was sent home and ask to follow-up on the seventh day from the initiation of treatment.

On the seventh day the remaining GBTC cream are suctioned out. Otoscopic re-evaluation

done. A post-treatment pure tone audiometry is likewise done and results are compared with that of the initial otoscopic results and pure tone audiogram. If patient is already asymptomatic and the ear canal appears healthy treatment no further application of GBTC cream is required. However, if there are still signs and symptoms of inflammation a second instillation of the ointment is done. Any patient with signs and symptoms of inflammation of ear canal is given a second, a third, and a fourth application of the cream. At the end of one month treatment is terminated regardless of the status of the ear canal.

Any patient who failed to follow-up during the specified date is automatically eliminated from the study. Attention is given on any progression of symptoms or changes in pure tone audiogram.

RESULTS

A total of 17 patients were included in the study consisting of 8 males (47 %) and 9 females (53 %). Their age ranged from 28 to 64 years (mean= 31 yrs).

	No. of patients
Male	8(47%)
Female	9(53%)
TOTAL	17

All patients have ear pain as their presenting complaint: 5 with grade III pain, 8 with grade II pain and 7 with grade I pain (Table 1). Ten patients noted complete resolution of pain as early as day 2. In 3 patients pain persisted until day 3. On day 4 onwards none of the subjects experienced pain.

Initial otoscopic examination of the ear canal showed moderate swelling of the canal in 2 patients. In 6 patients minimal swelling were noted while only hyperemia of the canal is apparent in the remaining 9 patients (Table 2). On day 7 of treatment the ear canal of all 18 patients appeared to be healthy. There were no signs of inflammation such as pain, erythema nor swelling of the ear canal. None of them required a second instillation of GBTC cream.

Culture and Sensitivity results revealed Pseudomonas aeruginosa as the primary offending organism followed by Staphylococcus aureus which accounted for 50% and 38% of cultures, respectively. Proteus mirabilis was accounted for 12% of culture reports. All three organisms are susceptible to gentamicin.

No significant changes in the pre- and post-therapy pure tone audiograms were noted. None of the subjects complained of vertigo or tinnitus.

Table 1. Grading of Pain

Patient	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	+	0	0	0	0	0	0
2	+	0	0	0	0	0	0
3	+++	++	+	0	0	0	0
4	+	0	0	0	0	0	0
5	+	0	0	0	0	0	0
6	+++	+	0	0	0	0	0
7	++	0	0	0	0	0	0
8	++	0	0	0	0	0	0
9	++	0	0	0	0	0	0
10	+++	++	+	0	0	0	0
11	+++	+	0	0	0	0	0
12	++	+	0	0	0	0	0
13	++	0	0	0	0	0	0
14	+++	+	+	0	0	0	0
15	++	0	0	0	0	0	0
16	++	0	0	0	0	0	0
17	++	0	0	0	0	0	0

Table 2. Otoscopic Findings

Patient	Initial P.E	Week 1	Week 2	1 month post-treatment
1	+	0	0	0
2	++	0	0	0
3	+++	0	0	0
4	++	0	0	0
5	+	0	0	0
6	++	0	0	0
7	+	0	0	0
8	+	0	0	0
9	++	0	0	0
10	++	0	0	0
11	+	0	0	0
12	++	0	0	0
13	+	0	0	0
14	+++	0	0	0
15	+	0	0	0
16	+	0	0	0
17	+	0	0	0

DISCUSSION

Otitis Externa (OE) represents a spectrum of inflammatory changes in the external auditory canal typically of an infectious origin. The external auditory canal, with its protective and self-cleansing mechanism intact, is usually quite resistant to infectious process. It is only when a local insult of any nature results in disruption of the integrity of the epithelium that infectious organism may gain access to the underlying tissues and cause an inflammatory response of varying degrees.

Bacterial pathogens isolated from subjects with otitis externa generally includes Pseudomonas aeruginosa, Staphylococcus aureus, Streptococcus species, and various gram-negative enteric bacilli, while Staphylococcus epidermidis and diphtheroids

are among the most frequently recognized colonizers of external auditory canal.[3] Fungi and yeast may also cause otitis externa but these organisms usually cause superficial infections with less inflammation and swelling. Mixed bacterial and fungal infections are not uncommon, and cultures from the canal are usually not necessary in the typical case of otitis externa. The skin-lined external auditory canal may also be affected by non-bacterial inflammatory conditions that commonly involve the skin in other parts of the body. Otitis externa, therefore, may also be regarded as a mixed dermatologic condition.

Pain is the most common complaint among our subjects followed by itchiness, fullness, or decreased hearing. Depending upon the initial presentation the patient may reveal different stages. Senturia and colleagues have proposed a staging system that divides the disease process into preinflammatory, acute inflammatory (mild, moderate, severe) and chronic stages. In our experience, patient comes to the clinic during the acute inflammatory stage of the disease usually in the mild to moderate range.

Although otitis externa causes considerable discomfort it usually responds to ototopical antibiotic therapy. The objectives of treatment of otitis externa are to resolve the infection while promoting restoration of the external auditory canal to its normal state. The key in the management is meticulous cleansing of the external auditory canal and use of otic drops. Otitis Externa is usually treated empirically without the benefit of cultures. Thus, a treatment used needs to be broadly effective against the usual pathogen.

The distribution of pathogen isolated in this study generally reflects the types of organism long known to be associated with otitis externa. Pseudomonas aeruginosa and Staphylococcus aureus were the most common pre-therapy pathogen. Proteus mirabilis was the third most common pathogen isolated in our subjects.

The most common therapy for otitis externa is a topical agent containing antibiotics (usually an aminoglycoside) and a corticosteroid. These medications are thought to reduce the inflammation and treat the underlying pathogen. However, these medications require three to four administrations per day and as with other forms of medications, compliance decreases with the number of daily administration. Compliance may also be affected by the stinging or burning, which commonly occurs following administration of otic medications.[6] In the study presented herein, GBTC cream is given on a weekly basis was used in 14 subjects with acute otitis externa.

GBTC cream is a highly effective topical dermatologic agent in ointment form which provides a complete range of therapy in treating a large number of dermatologic conditions of mixed etiology.[7] It is a combination of four agents with distinct pharmacologic effects: bethametasone 17-valerate, 0.1% gentamicin sulfate, 1.0% tolnaftate and clioquinol. All four components have been used extensively in clinical practice for many years, demonstrating their safety and efficacy. To date, no serious systemic side effects from local application of this drug have been reported.

In this study, we tested whether GBTC cream will prove effective and safe in treating infections of the skin-lined external auditory canal. The ease with which ototopical antibiotics drops are applied into the external auditory canal cannot be overemphasized. The cream form was used here since this form has lesser viscosity and is easier to instill than the ointment form of the drug. Moreover, it will eliminate the need for frequent instillation of the drug and assure patient compliance.

Gentamicin sulfate is one of the active components of GBTC. It is one of the most commonly used antibiotic ear preparation. Gentamicin is known for its ototoxic potential but is still widely used because of its broad spectrum of activity and its low cost. There are various animal studies that prove its ototoxic effect. In humans, however, ototoxicity from ototopical medications is extremely rare.[2] Most cases of ototoxicity in humans occurred during prolonged treatment without medical control and in patients with extensive tympanic membrane perforation.[1] The reason for this seeming contradiction between evident ototoxicities in animal models and clinical safety in humans revolves on interspecies variability of the round window anatomy.[8]

Patients with tympanic membrane perforation were automatically excluded from this study. Although tympanic membrane involvement in acute otitis externa is common resultant ototoxicity from systemic absorption through the skin is far less with topical application of GBTC cream. . In the study by Lancaster et al[9] they concluded that there is systemic absorption of gentamicin that would ultimately be absorbed into the perilymph. This absorption is decreased in otitis externa owing to the inflammation, edema, and thickening of the skin and tympanic membrane. Absorption is even less if drugs are given at a lower concentration. GBTC contains only 0.1% gentamicin sulfate in contrast to 0.3% gentamicin otic drops used in various ototoxicity studies.

The other components of Quadriderm ointment which include Bethamethasone propionate, Tolnaftate and Clioquinol have long been proven to be effective and safe. No ototoxic effect had been reported yet in any of these drugs.

Each component of Quadriderm makes a significant contribution to the efficacy of the product in treating infections of mixed etiology. In fact, there is evidence to support the claim that there is a

synergistic interaction among the antimicrobial components, with Quadriderm having greater antimicrobial activity than its individual active ingredients alone.

In this study, the efficacy and safety of Quadriderm ointment in treating acute otitis externa had been described.

CONCLUSION

We found that Gentamicin Sulfate, Bethametasone propionate, Clioquinol and Tolnaftate combination (GBTC cream) is a cost-effective and efficacious drug for the treatment of acute otitis externa in adults.

RECOMMENDATIONS

We recommend that a comparative study be conducted on the clinical efficacy of standard ototopical antibiotic solutions versus that of GBTC cream in treating acute otitis externa.

We also recommend that an ototoxicity study GBTC cream be done utilizing Transient-evoked Otoacoustic Emissions to test for the ototoxic effect to the inner ear.

Lastly, we recommend that a study be conducted regarding its (GBTC cream) future use in the management of chronically draining post-mastoidectomy cavities.

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APPENDIX A

Patient's Checklist

NAME:
AGE:
SEX:
ADDRESS:
LEGEND:

Grade 0 no pain (walang sakit

Day	Pain/ Tenderness (Sakit)	Otoscopic Findings
1		
2		
3		
4		
5		
6		
7		

Grade I mild; dull pain when tension is applied to straighten the ear canal (bahagyang sakit kapag hinihila ang tainga)

Grade II moderate; pain when pressure is applied on the tragus or pressure on the concha underneath the lobule (masakit kapag pinisil ang ilalim ng tainga)

Grade III severe; persistent pain without manipulation (masakit kahit hindi ginagalaw ang tainga)

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LOCALLY PRODUCED BIOCERAMIC ORBITAL PLATE USED TO RECONSTRUCT ORBITAL FLOOR DEFECT: A PRELIMINARY REPORT*

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ABSTRACT

There has been a growing interest in the use of porous alloplastic implants for reconstructive surgeries. Porous polyethylene (Medpore) and hydroxyapatite are two of the more popular and successful orbital implants that revolutionized orbital reconstructive surgery. However due to their prohibitive cost, the authors in cooperation with the Department of Science and Technology have explored the use of a locally manufactured low cost (P 25) synthetic bioceramic porous biphasic calcium phosphate as a prospective orbital implant material for orbital floor fracture reconstruction. The implant's composition of 77% tricalcium phosphate and 23% hydroxyapatite is similar to bone. The implant was used to reconstruct an orbital floor defect. Implant behavior was monitored clinically and radiographically. Post-operatively, the implant was stable. There were no signs of migration, encapsulation nor resorption. Neither was there any sign of local tissue infection. The bioceramic biphasic calcium phosphate ceramic implant has a great potential as bone graft substitute.

KEY WORDS: Orbital plate Implant, Porous Biphasic Calcium Phosphate, Calcium Phosphate hydroxyapatite, Osteoinduction, Osteoconduction, Biocompatibility

INTRODUCTION

Trauma or tumors can cause large gaps within the skeletal system. A surgeon faced with filling-in a large gap within the bone has several alternatives: autografting, allografting and biomaterials.

Autografting or autogenous bone grafts have traditionally been used as the reconstructive material of choice since the 1950's. However, it has been criticized for its disadvantages such as donor-site morbidity, increased operative time, unpredictable resorption and remodeling and sometimes donor availability.

Allografting or using cadaver bone has several major disadvantages. These include immune response rejection, possible acquiring of AIDS or other infectious diseases and difficulty in obtaining the specimen due to religious beliefs and local customs[1]

Biomaterials or bone substitutes have been used for almost a century from cow horn to plaster of Paris[2] to metals and alloplastics. The early 60's ushered the introduction of alloplastics such as Supramid, Teflon, silicon and Methyl Metacrylate. Due to its availability and ease of handling, it became the surgeon's preference[3]. The primary concern in the use of alloplastics, with its solid nonporous structure, is the late complications such as fistula formation, infection, implant displacement, its propensity for encapsulation and hemorrhagic cyst formation[4,5,6].

Such drawbacks initiated the birth of porous alloplastics such as coralline hydroxypatite in 1986 and porous polyethylene "Medpor" in 1991. This new generation orbital implant substitutes are capable of inducing osteoconduction and osteoinduction. Numerous publications document their successful use. However, their use is limited by their cost. It is for such purpose that this study was done and it aims to examine and introduce an effective, locally made low cost synthetic porous biphasic calcium phosphate orbital plate implant manufactured by the Department

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of Science and Technology which possesses the same characteristics of the commercially available orbital bioceramic implants. Preliminary animal studies done by the authors using these implants have been very successful[7]. The authors are now doing the clinical trial and are presenting here the first use of the locally made synthetic porous biphasic calcium phosphate orbital plate in a human subject.

OBJECTIVES

1) To demonstrate the biocompatibility and structural characteristics of porous biphasic calcium phosphate ceramic orbital plate in a human subject.

2) To be able to demonstrate the stability of synthetic porous biphasic calcium phosphate in a human subject.

3) To demonstrate that a locally produced synthetic porous biphasic calcium phosphate ceramic orbital plate has a potential as a low cost alternative to commercially available orbital plate implant.

MATERIALS

Porous Biphasic Calcium Phosphate implants are manufactured by the Department of Science and Technology. These are ceramic powders of hydroxyapatite and tricalcium phosphate compacted to a given shape to produce a green form. This green form is then sintered at a high temperature furnace, from 1100°C - 1300°C to produce a dense ceramic material. To create porosity, a homogenizing technique is performed which mixes a homogenizing substance (naphthalene) with the ceramic. The mixture is then sublimated with the naphthalene removed leaving a macroporous form of ceramic. These are then milled to produce polished orbital plates measuring 2 cm in diameter and 1 mm thick, weighing 0.95 grams (fig 1). The pore size ranges from 27 – 370 um with the average pore size at 198 um (fig 2) measured by Jeol JSM T 20 scanning electron microscope (fig 3). The porosity is approximately 60%. X-ray diffraction analysis using the Shimadzu X-ray diffractor (fig 4) showed the implant composition consisting of 77% Tricalcium Phosphate [Ca3 (PO4) 2] / 23% Hydroxyapatite [Ca10 (PO4) 6(OH) 2] with no impurities noted (). Implants were sterilized using ethylene oxide before implantation.

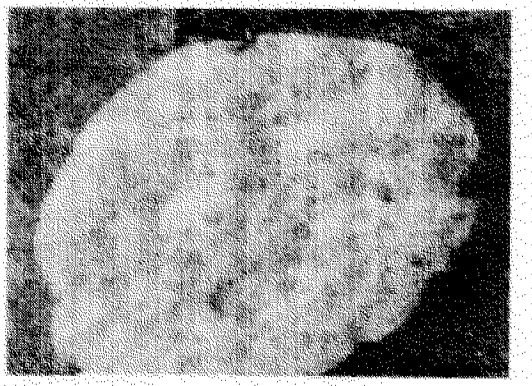


Figure 1. Biphasic calcium phosphate ceramic implant

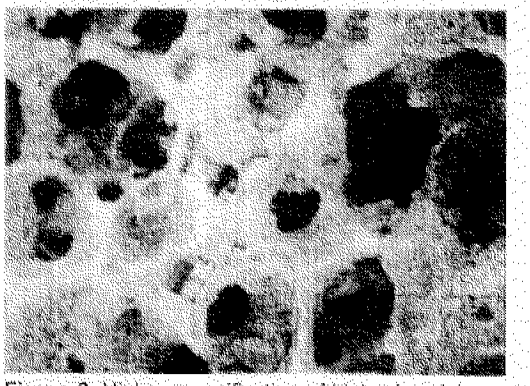


Figure 2. Higher magnification of biphasic calcium phosphate ceramic implant showing its pore-size (198 microns).

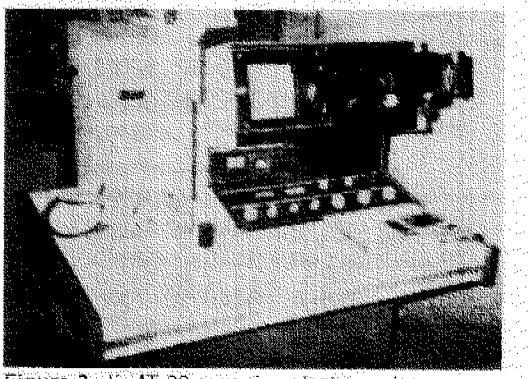


Figure 3. JCMT 20 scanning electron microscope used in measuring pore size.

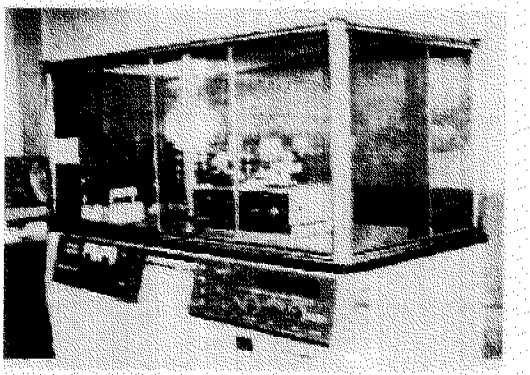


Figure 4. Shimadzu x-ray diffractor used in chemical composition analysis of biphasic calcium phosphate ceramic implant.

PRE – OP ASSESSMENT

General patient criteria holds that any patient with blowout fracture or any traumatic fracture that involved the floor of the orbit and has subsequently no hematologic, metabolic or other systemic disease that might impede wound healing and that no local bone or soft tissue infection or reaction be present within 12 months of proposed surgery is included.

Our human subject is a 19 year old Asian male who sustained a right tripod fracture (fig 5) with inferior orbital floor involvement (impure blowout). Ophthalmologic examination was essentially unremarkable.

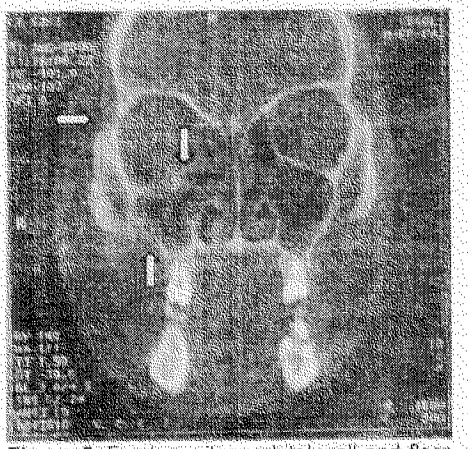


Figure 5. Fracture sites: orbital wall and floor, right; and maxillary, right.

POST – OP ASSESSMENT

Patient was examined by the senior surgeon/ author in a weekly basis after hospital discharge and then subsequently at monthly intervals for a possible two-year follow up. During each follow-up visit, patient will be examined for stability of the onlay graft, maintenance of symmetry, contour, quality of skin cover and signs of local tissue infection. Postoperative CT scan was scheduled at 1, 3, 6, 12, 18 and 24 month post op by at least 2 investigators to detect any signs of implant migration, encapsulation and resorption.

OPERATIVE TECHNIQUE

Patient underwent general anesthesia. Infracilliary, eyebrow and gingivobuccal incisions were done to explore the fracture site. Intra-operative care of the implant required shaping it with a diamond-tipped burr attached to a high-speed water-cooled electric drill. After shaping, the sculpted implant was cleansed with saline irrigation and brushed to evacuate debris (fig 6). A less desirable but alternative method utilizes scalpel coning of the implant.

The senior surgeon exposed all the fracture sites. There was a 1.5 x 2-cm bone gap or defect at the medial side of the right orbital floor with entrapment of periorbital fascia and extensive fibrosis (fig 7). The size and shape of the elevated subperiosteal pocket provided a snug conforming envelope for the implanted onlay graft (from top to bottom – inf. orbital periosteum – implant – orbital floor) (fig 8,9,10). The implants were not fixed with any suture or wire. Hemostasis and local irrigation of povidine iodine and saline irrigants was completed prior to insertion of the implant. Other fractures were treated accordingly. Post-operatively, patient was given antibiotics and regular post-operative care the department routinely gives to trauma patients after open reduction with internal fixation of facial bone fractures.

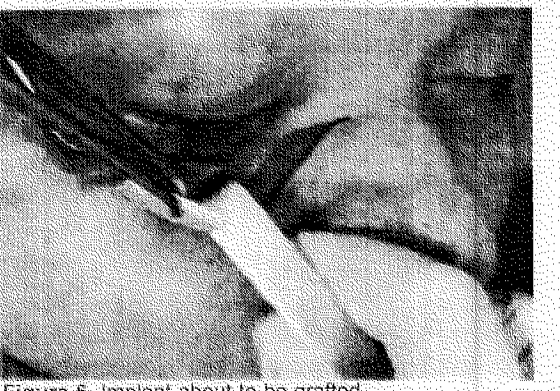


Figure 6. Implant about to be grafted

Figure 7. Bone defect noted intra-operatively

RESULTS

Patient morbidity was broken down to intra - operative, early post - operative (1 week – 6 months) and late post – operative (6 months – 2 years) period. Intraoperatively, the porous biphasic calcium phosphate onlay procedure was performed as expected with little blood loss and less operative time

as compared to surgeon's previous experience on autogenous bone grafting (i.e. rib, iliac and calvarial bones). Length of hospital stay was unremarkable (3 hospital days). There was no blood transfused and no early complications were noted. Patient underwent CT Scan before discharge to confirm the location of the plate and to serve as baseline in future monitoring (fig 11). On subsequent follow-up, patient was clinically unremarkable. There was good wound healing and no infection noted. There was likewise no ophthalmologic symptom. Figures 12 to 15 shows the six-weeks-post-operative CT scan of the orbit and it revealed implant stability. There were no signs of migration, encapsulation nor resorption, its density remains the same. Implant margins were clear. Soft tissue wound healing was unremarkable. Patient was asked to continue regular follow-up.

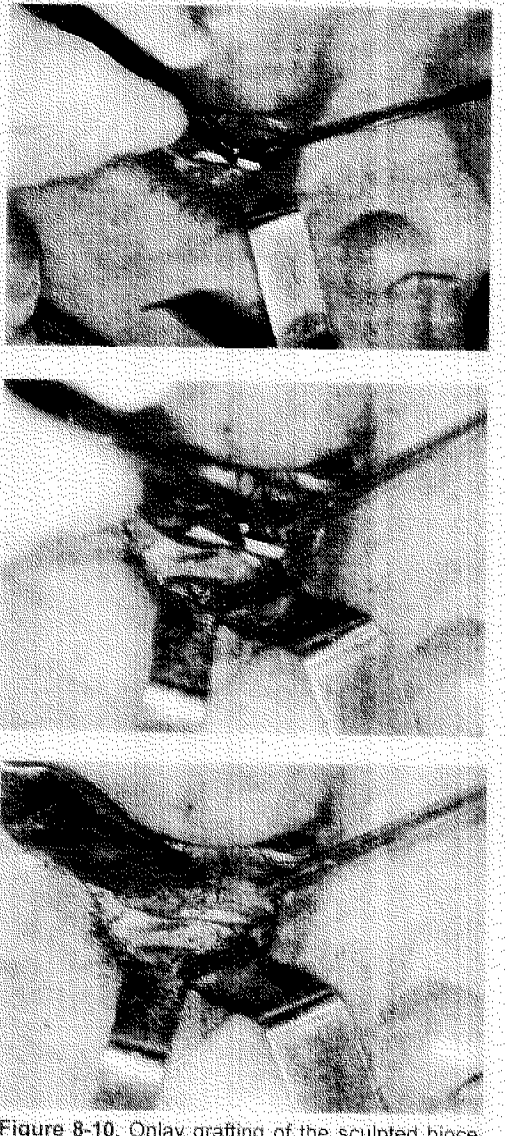
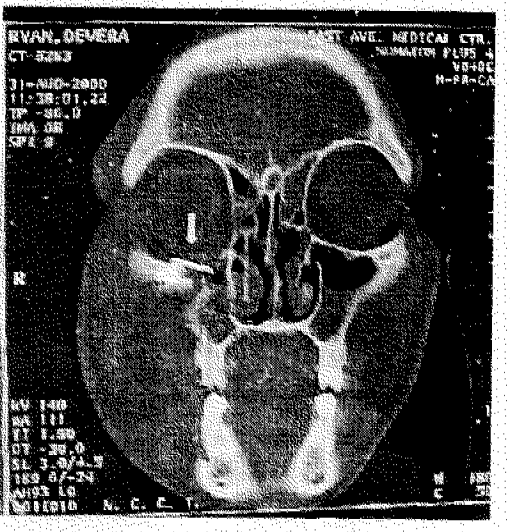
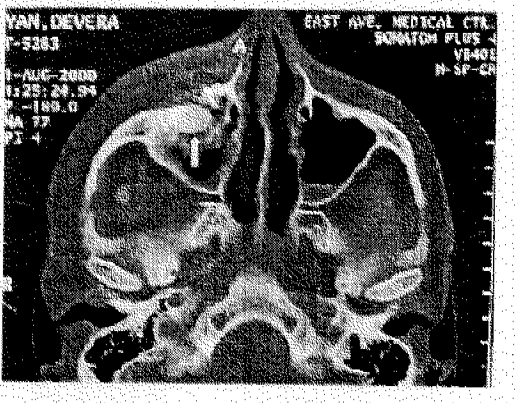


Figure 8-10. Onlay grafting of the sculpted bioceramic implant





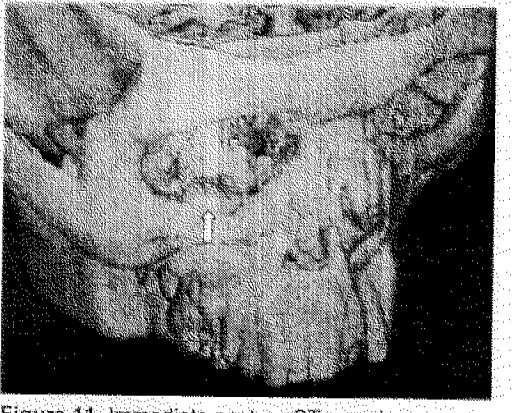
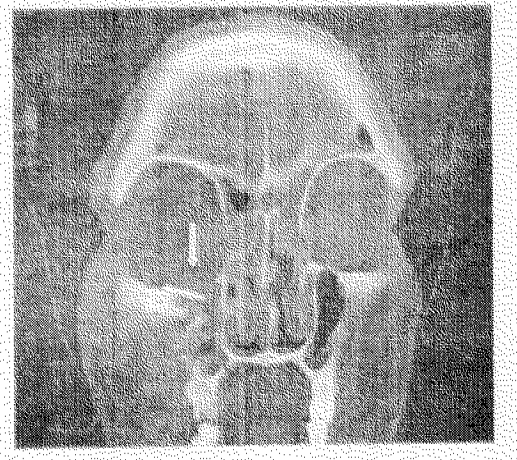


Figure 11. Immediate post-op CT scan in coronal, axial and 3-dimensional views showing the bioceramic implant covering the bone defect



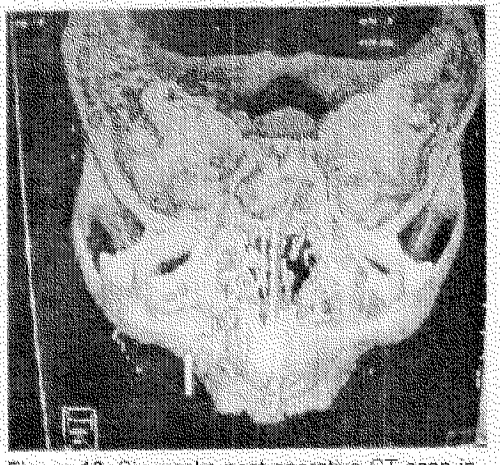
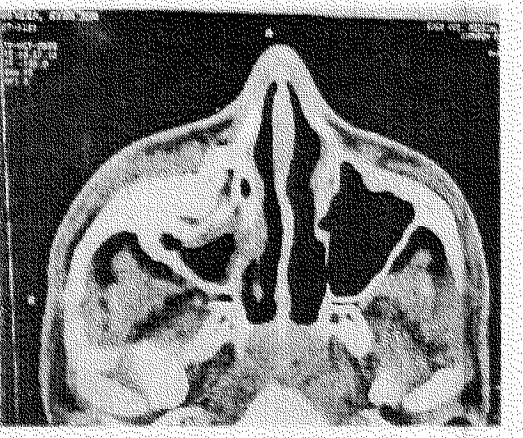
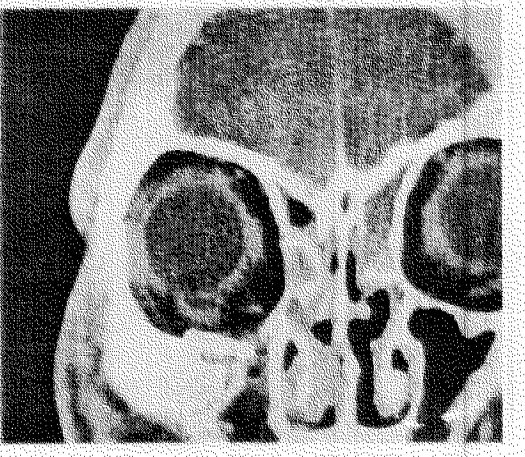


Figure 12. Six weeks post operative CT scan in coronal, axial and 3-dimensional views showing the bioceramic implant. Images revealed a stable implant; no migration, resorption nor encapsulation.





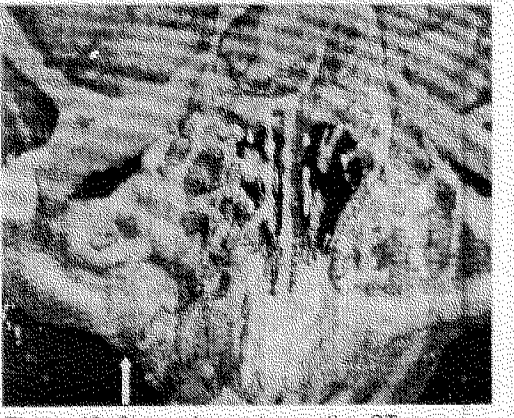


Figure 13. Six weeks post operative CT scan contrast enhanced in several cuts showing surrounding soft tissue with no signs of infection, encapsulation nor resorption.

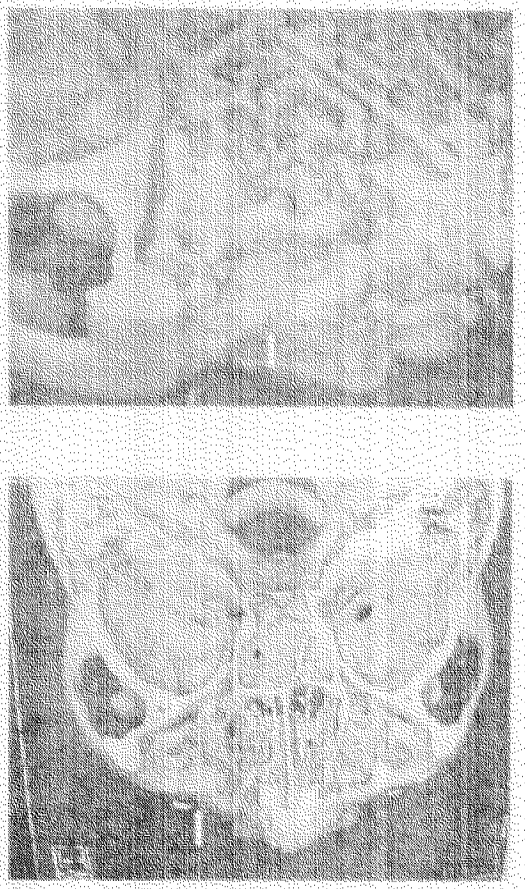


Figure 14. Closer look at the 3-dimensional cuts after six weeks showing the implant with new bone growth making it hardly distinguishable from natural bone.

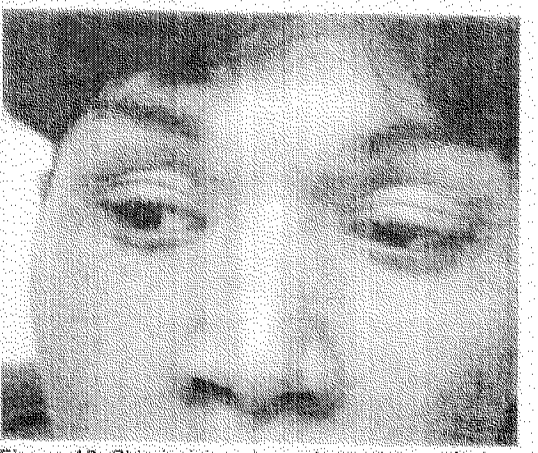


Figure 15. Skin incision six weeks post operatively showing normal wound healing process.

DISCUSSION

Development of a safe, affordable and effective bone grafting substitute could potentially alleviate many problems associated with human bone graft materials. Voluminous amount of time, money and effort has been spent in search for this alternative.

Alternatives to autogenous bone grafts have, in recent years, included Calcium Phosphate ceramics, osteogenic proteins and composites of these two. Of the calcium phosphate ceramics, hydroxyapatite [Ca10 (PO4) 6(OH) 2] has been studied most extensively. Hydroxyapatite has the advantages of being biocompatible, architecturally similar to bone and osteoconductive[8]. In a study by Passuti et al., hydroxyapatite was also proven to have osteoinductive properties by its induction of multinucleated cells (bone precursors) after grafting it on a chick chorioallantoic membrane[9]. Its drawback includes weak mechanical strength and brittleness. It is generally considered to be minimally resorbable.

Tricalcium phosphate [Ca3 (PO4) 2] is a biocompatible osteoconductive resorbable ceramic that has the theoretical advantage of being a bone graft substitute that is gradually replaced by bone. Resorption rate of Tricalcium Phosphate varies depending on porosity and has ranged from 30% - 85% in 6 months[10,11]. It is advantageous to have an implant that resorbs with simultaneous bony ingrowth, thereby maintaining its original volume during the entire sequence from implantation to complete replacement by bone. By combining the two ceramics, hydroxyapatite and calcium phosphate, we could theoretically have an implant with superior quality that is stable, not easily resorbed, almost the same in composition with natural bone and has the capacity of osteoinduction an oasteoconduction.

In our animal studies[4], histomorphic analysis showed 30 – 40% of the biphasic calcium phosphate implant was covered with new bone formation at one month and 50 – 60% at three months. The authors postulate that the porous ceramic framework initially functions as an osteoconductive scaffolding which subsequently degrades as remodeling occurs. These properties could compensate over the hydroxyapatite material that remains unremodelled even after a long period of implantation.

Pore size is thought to be a critical factor in osteoconductive potential of an implant. Adequate porosity leads to rapid invasion of the intertrabecular spaces of the biomaterial by loose connective tissue which would then proliferate to form woven bone and later deposition of lamellar bone which is similar to the typical early stages of embryonic bone formation or of bone fracture healing. Klawitter and associates in their study showed that minimum pore size of 100 micron is generally required to achieve bony ingrowth[12]. Our implant has an average pore size of 198 microns (fig 2). This pore size could very well promote osteoconduction (as documented by the histopathologic findings in our preliminary animal studies).

Toth et al., studied interspinal bone fusion characteristics of calcium phosphate and suggested that minimum amount of porosity to be set at least 30% (to encourage vascularization as well as to provide proper channels for scaffolding and bone conduction)[13]. The porosity of our implant is 60%. In fact, this vascularization was noted as early as 1 month in our preliminary animal studies.

An ideal implant should resist migration. Therefore being vascularized helps in anchoring of the implant. Porosity also allows viable tissue insinuation within the graft and limits its tendency to encapsulate. In the findings of Harvey et al., as well as several authors[8,14], micromotion at the bone implant interface does not inhibit bone ingrowth as proven by their successful mandibular grafts. In cases where stability is crucial, our implant tolerates suture fixation. Wire or screw fixation of porous calcium phosphates must be avoided since such fixation could fracture the implants. Furthermore, onlays beneath inadequate soft tissue coverage should be avoided. It could lead to tissue necrosis and delayed complications like persistent post-operative drainage, show-through of the onlay and possible implant migration[15].

The unique chemical composition of porous biphasic calcium phosphate bioceramics suits the inorganic component of human bone. In studies made by Aoki, subcutaneous implantation of bioceramic in rabbits showed resistance to degradation with a rate of 1 micron/year, which is 100-micron/100years[16].

The mechanical properties of calcium phosphate ceramics are currently the limiting factor in their widespread utilization. Table 1 gives us a simplified view of the mechanical properties of calcium phosphate implants and bone, although relatively similar, bone have much more complex mechanical constant. This could pose a problem when it is utilized on weight bearing areas of the skeleton. However, several authors[17,18] have used it on the mandible, knee and tibia and results were comparable to those implants used in the other non-weight bearing areas. Much research is currently being conducted to improve its mechanical properties. In the dental field, the primary application for ceramics include the filling of pockets and augmenting of deficient mandibular or maxillary ridges, either due to trauma, benign diseases or congenital defects[1].

The bioceramic porous biphasic calcium phosphate implant is a biocompatible onlay bone graft substitute. It is a lot cheaper (at P25) as compared to the more expensive porous polyethylene "medpore" (P8-10,000) and hydroxyapatite (P19,550). Unanswered questions relating to the present study include:

1) Is the biphasic calcium phosphate eventually resorbed completely?

2) Is the biphasic calcium phosphate entirely replaced by new bone overtime with maintenance of the original implant volume?

3) What is the long-term fate of this new bone?

Studies are currently underway in an attempt to answer these questions.

CONCLUSION

Our paper was able to show initially biocompatibility and structural characteristics of porous biphasic calcium phosphate ceramic orbital plate in a human subject. Our orbital plate implant provides a stable platform for orbital soft tissues and is capable of inducing physiological bone formation and healing. It is also resistant to bioresorption. Biphasic calcium phosphate offers the surgeon an alternative to autogenous bone tissue and probably is one of the best biologic alternative materials available for maxillofacial surgery today. This study demonstrate that a locally produced synthetic porous biphasic calcium phosphate ceramic orbital plate has an excellent potential as low cost alternative to commercially available orbital plate implant.

RECOMMENDATION

The authors plan to conduct long term studies of clinical trials and a possible side by side comparison on all available commercial implants. As well as the possibility of using it on other sites.

TABLE 1: Simplified of the Mechanical Propoerties of the Bone and Calcium Phosphate System

Material	Compressive Strength	Modulus
Calcium Phosphate		
Dense	3-130 psi*	5-15 psi
Porous	1-10 psi	
Bone		
Cancellous	6-9 psi	2 psi
Cortical	20 psi	

*psi-pounds per square inch

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LE FORT I OSTEOTOMY DOWN FRACTURE WITH MIDLINE PALATAL SPLIT VIA MIDFACIAL DEGLOVINGFOREXCISION OF JUVENILE ANGIOFIBROMA*

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ABSTRACT

This is a report of a surgical approach to excise an extensive case of a Juvenile Angiofibroma in a 16 year old male. The approach consists of a midfacial degloving followed by a Le Fort I osteotomy down fracture combined with a midline palatal split. This technique facilitated an adequate access to a large nasopharyngeal angiofibroma with excellent cosmetic and functional results.

INTRODUCTION

Various approaches may be used for excision of Juvenile Angiofibromas. This can range from endoscopic to transantral approach either via midfacial degloving or lateral rhinotomy that can be combined with a transpalatal access (1,3,4,6). Presented with a more extensive lesion, the surgical team decided Le fort I osteotomy with a midline palatal split through a gingivobuccal incision would be a more appropriate approach that provided not only an ample access to the mass but also resulted in no external scarring nor functional deficiencies post-operatively.

OBJECTIVE

1. To describe and illustrate an approach for excision of Juvenile Angiofibroma (Le Fort I Osteotomy Down Fracture with Midline Palatal Split via Midfacial Degloving)

2. To cite advantages and disadvantages of this alternative approach for Juvenile Angiofibroma

CASE REPORT

A 16 year old male consulted the Philippine General Hospital Emergency Room for epistaxis (Figure 1). Review of history revealed nasal congestion accompanied by recurrent massive epistaxis occurring for a span of two years. Anterior and posterior rhinoscopy revealed a red smooth fleshy mass occupying the nasopharynx and oropharynx. The rest of the otolaryngologic exam was essentially normal. CT Scan of the paranasal sinuses showed an enhancing nasopharyngeal mass invading the left side of the sphenoid sinus with extension to the oropharynx and posterior end of both nasal cavities (Figure 2a and 2b). The assessment was Juvenile Angiofibroma and excision was immediately scheduled. No Angiography with embolization was ordered due to financial constraints.

SURGICAL TECHNIQUE

The initial incision is a gingival incision along the inferior free border of the alveolus from one maxillary tuberosity to the opposite side(Figure 3).

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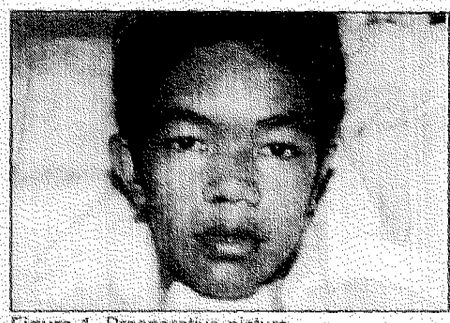

Figure 1. Preoperative picture

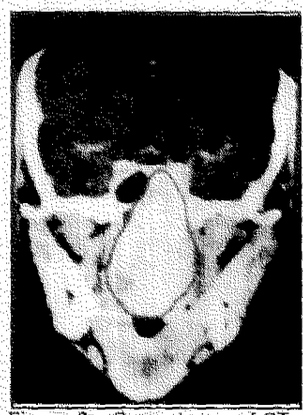

Figure 2a. Coronal view of CT Scan shows a naso pharyngeal mass with extension to the left sphenoid sinus and oropharynx.

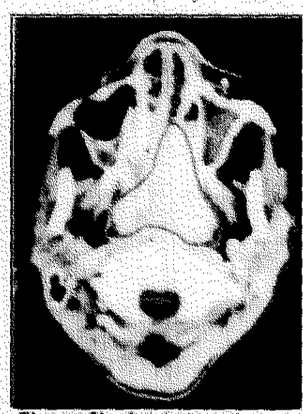

Figure 2b. Axial view shows extension and blockage of both nasal cavities.

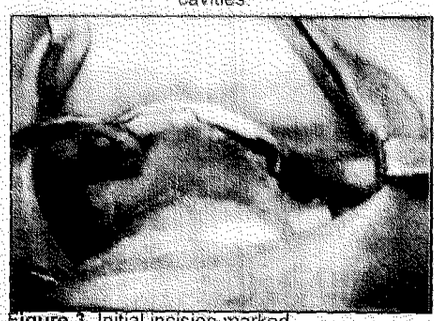

Figure 3. Initial incision marked

Normally a gingivobuccal incision is used however the incision was modified since the patient is edentulous. Mucosa was then elevated in a subperiosteal plane to expose the pyriform aperture, zygomatic process and anterior wall of the maxilla on both sides up to the level of the inferior orbital foramen (figure 4). The inferior orbital nerves were visualized and preserved. Mucosa was also elevated from the anterior nasal spine, maxillary crest, nasal floor and lateral wall of the nose. A Le Fort I osteotomy was done using an osseous scalpel (Figure 5 and 6).

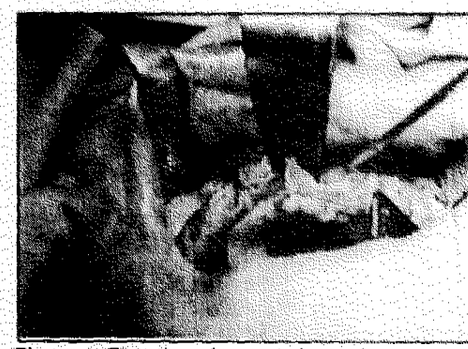

Figure 4. Elevation of mucosa in a subperiosteal plane to expose pyriform aperture, zygomatic process and anterior wall of maxilla on both side.

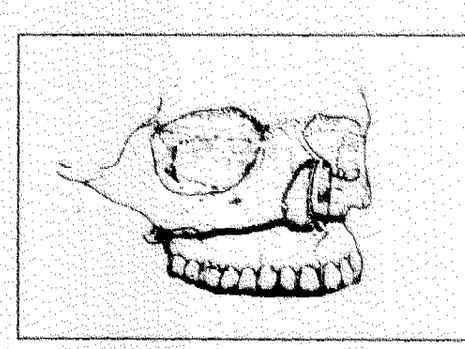

Figure 5. The Le fort I Osteotomy

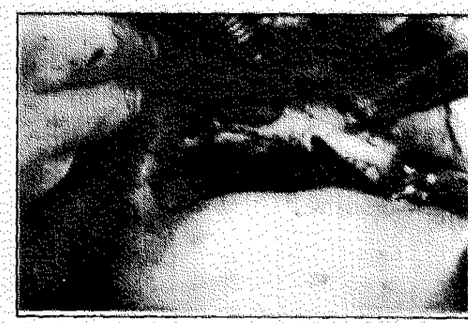

Figure 6. Le Fort osteotomy was done using an osseous scalpel

Osteotomy of the maxillary and palatine crest was also done using a double guarded osteotome. Lastly, the pterygomaxillary fossa was osteotomized using a curved chisel. By using a heavy bone hook the osteotomized palatal segment was down fractured and mobilized exposing the nasal floor and medial maxillary sinus wall, (Figure 7and 8). Part of the medial wall of both maxillary sinus were also removed to gain additional exposure. A midline palatal split was performed to access the retropalatal component (Figure 9). Excision of mass was done using mostly finger dissection but at times using the periosteal elevator (Figure 10). The mass was removed in its entirety and measured 9x5-cm (Figure 14). Examination of the sphenoid sinus was done revealing a dehisced anterior wall and no residual mass. There was no note of CSF leaks (Figure 11). The palate was reduced and fixed using titanium microplates and screws. A total of 4 plates were used, a pair on each side of the nasomaxillary buttress and another pair along the zygomaticomaxillary buttress (Figure 12). Two penrose drains were placed bilaterally. The gingival mucosa was sutured back including the hard and soft palatal mucosa completing the procedure (Figure 13). Packing was done using nasal strip with antibiotic ointment. No posterior packing was needed.

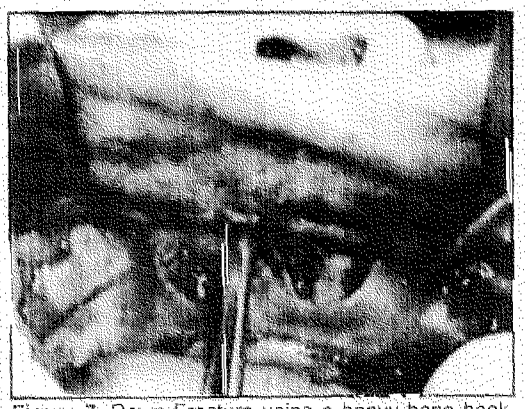

Figure 7. Down Fracture using a heavy bone hook

Figure 8. Palatal segment separated exposing the nasal floor and medial maxillary sinus wall

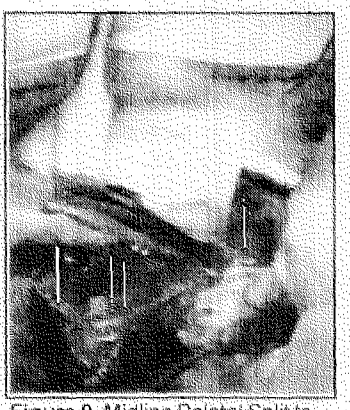

Figure 9. Midline Palatal Split to expose retropalatal component

Figure 10. Excision of mass using finger dissection

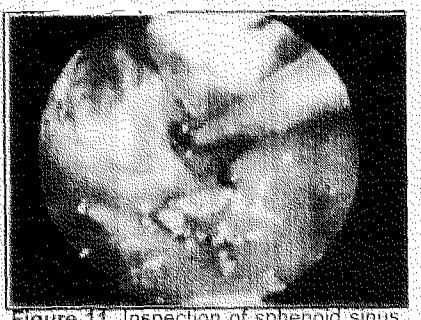

Figure 11. Inspection of sphenoid sinus shows no residual mass. Note the dehisced anterior wall

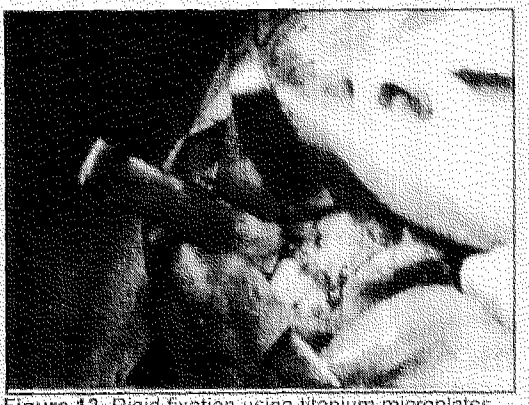

Figure 12. Rigid fixation using titanium microplates

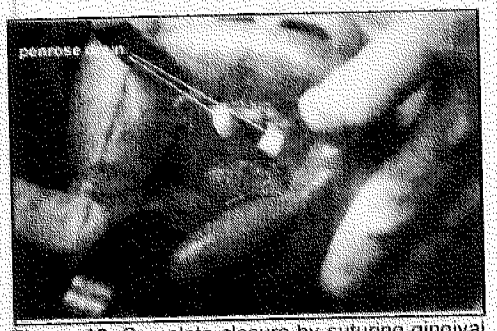

Figure 13. Complete closure by suturing gingival and palatal incisions

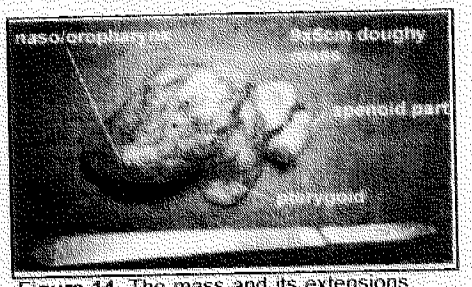

Figure 14. The mass and its extensions

DISCUSSION

The advantages of this technique include a wide access for extensive Juvenile Angiofibroma (2,5,7,8). The wide access is sufficient enough not only for better manipulation for excision but also for visualization of the cavity for assessment of residual mass. The Le Fort I osteotomy offers sufficient access for lesions situated midline behind the midface such as the case presented(7). The Lefort I osteotomy may also be combined with facial disassembly for bigger tumors extending into the infratemporal fossa, or the skull base(8). It also results with no external scar and minimal functional impairment (7). Patient was sent home 1 week post-operatively (4days after decanulation). The disadvantage includes cost issues since this approach needs titanium plates for reconstruction, and equipment dependency to achieve a good osteotomy(high precision osseous scalpel). A tracheostomy may be essential in this operation since intermaxillary fixation maybe needed in order to restore occlusion when a midline palatal split is performed. However, overall excellent cosmetic outcome outweighs these disadvantages. Other approaches such as a lateral rhinotomy and transpalatal access may give unsightly scars and velopharyngeal insufficiency respectively and may not offer sufficient exposure for a more complete excision.

CONCLUSION

The Le fort I osteotomy down fracture with midline palatal split via midfacial degloving is an excellent approach to big juvenile angiofibromas since it offers a big exposure to facilitate complete excision with good postoperative cosmesis (Figure 15,16 and 17) and function.

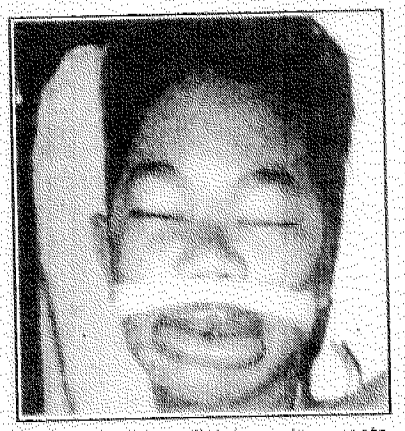

Figure 15. Immediately post-op. note swelling of face and lips

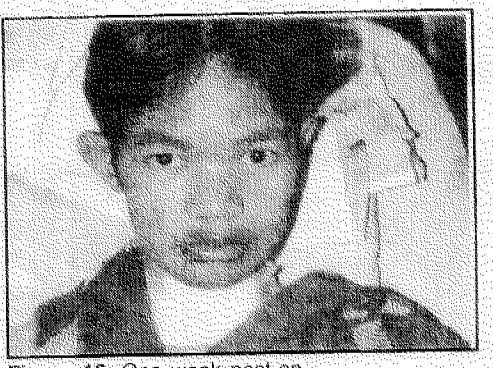

Figure 16. One week post-op

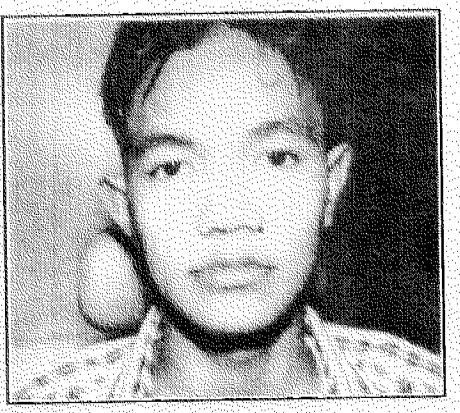

Figure 17. Four months post-op. Take note absence of external scar

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LARYNGEAL AMYLOIDOSIS IN A 40 YEAR OLD FEMALE*

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JOSEPH ARNOLD DARVIN, MD**
VIRGILIO R. DE GRACIA, MD***

ABSTRACT

Amyloidosis affecting the head and neck region is uncommon and is mostly in the form of localized amyloidosis. The larynx is considered to be the most common site of involvement and accounts for 0.2% to 0.5% of benign laryngeal tumors. When the larynx is involved, treatment is directed in improving the voice and maintaining the airway.

In this paper, we are reporting a 40-year-old woman who complained of hoarseness for 7 years with a soft tissue deposition on the left false cord. Biopsy of this soft tissue and histological examination revealed laryngeal amyloidosis. Tracheostomy under local anesthesia and excision of the amyloid under general anesthesia were done. However, after a month post-operatively, we noted a recurrence of the mass. Considering the rarity of this disease, this paper aims to emphasize on how important it is to recognize laryngeal amyloidosis in order to achieve an appropriate diagnosis and plan therapy properly. Local surgical excision is the treatment of choice for laryngeal amyloidosis.

INTRODUCTION

Laryngeal disease is associated with a variety of signs and symptoms, several mechanisms were mentioned in the pathogenesis of these diseases namely: infectious, inflammatory or neuromuscular.[1] Relation between the severity of symptoms and the morbidity associated with the process is often poorly correlated.

Hoarseness is one of the most common complaints among ENT patients. Accurate diagnosis and treatment depend upon the early detection of the voice pathology. The spectrum of these problems would range from a benign lesion to a life-threatening problem.

Localized laryngeal amyloidosis is not a common laryngeal disease and accounts for about 1% of all benign laryngeal tumors.[2] The importance of this lesion lies in its possible confusion with invasive squamous cell carcinoma. There is a risk of missing concomitant systemic amyloidosis or exhaustively investigating for this when it is not present because of the inability to understand the nature of the disease.

The larynx is the most common site of involvement by any amyloid in the head and neck and localization in the larynx is twice as frequent as in any other part of the respiratory tract.[3] The supraglottic larynx, especially the false vocal cords, is the region most often involved, but the true vocal cords and subglottis are not spared. Laryngeal amyloidosis as a presenting finding, is generally a localized process and is not associated with systemic diseases.[3] Nonetheless, even when amyloid is apparently restricted to the larynx, further work-ups should be done to rule out the possibility of a systemic cause. The therapy of choice for idiopathic, localized, or organ limited amyloid deposits without underlying disease is local excision.

CASE REPORT

Patient is V. Q., 40 year old female from Tanauan, Batangas admitted with a chief complaint of hoarseness.

History started 8 years PTA, when she developed on and off hoarseness. Her voice was described to be rough in character. No other associated signs and symptoms were noted except for occasional coughing for which she was given unrecalled mucolytics. No consultation was done nor medications taken.

7 years PTA, because of on and off hoarseness and relatives' advice, the patient sought consult with an ENT specialist who noted a "laryngeal cyst" for which she was given steroids for 1 week. On follow-up, her voice was noted to have improved thus her medicine was discontinued. However about 2 months after, she was again noted to be hoarse with no other associated signs and symptoms. No

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follow-up consultation was made.

6 months PTA, the patient's hoarseness became persistent. She complained of voice fatigue and occasionally gasps for air during a lengthy conversation. No other associated signs and symptoms were noted. No consult was done.

One month PTA, the patient noted an increase in the roughness of her voice. No stridor, dyspnea, odynophagia, dysphagia, foreign body sensation were noted. Consultation with an ENT specialist was done and the specialist noted a bulging mass over the false cord on indirect laryngoscopy. She was subsequently advised to undergo videolaryngoscopy (Figure 1) and upon examination, a smooth nodular mass was noted over the left glottic and supraglottic. She was then advised to undergo biopsy and was subsequently admitted.

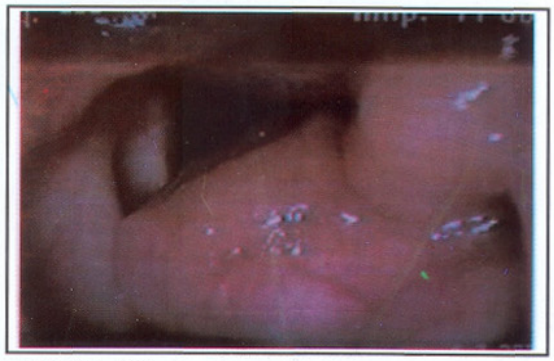

FIGURE 1. Videolaryngoscopic finding pre-operatively

The patient's past health history was unremarkable except for occasional hyperacidity for which no maintenance medications were taken. No previous history of voice problem was reported. Family history revealed diabetes in her maternal grandmother and uncle. The patient is a non-smoker, a non-alcoholic beverage drinker and works as a sales agent for an insurance company for the last 2 years. She claimed that she does not use much of her voice on her work or at home.

Otoscopy, anterior rhinoscopy, oropharyngeal as well as head and neck examinations were all normal. Indirect laryngoscopy showed a narrowed airway due to the presence of a smooth, firm, nodular mass on the left vocal fold which crosses the midline. The arytenoids as well as the true vocal cords were not visualized. An initial impression of left vocal fold mass to consider laryngeal new growth was made. She was then scheduled for excision biopsy of left vocal fold mass. Tracheostomy was also contemplated prior to the procedure to establish the airway because the mass was already blocking the trachea. Diagnostics requested consist of complete blood count, ECG, Chest x-ray and protime which were all normal. She was started on Ferrous sulfate 1 capsule to be taken daily.

On her 1st hospital day, the patient initially underwent tracheostomy under local anesthesia, after which a direct laryngoscopy under general anesthesia with microexcision of left vocal fold mass was made. Intraoperative findings revealed a laryngeal mass involving the left arytenoid extending through the length of the false cord arising from the ventricle crossing the midline. The excised mass was then sent to the laboratory for histopathologic examination. After excision of the mass was done, the true vocal cords were noted to be smooth and pale. Initially, nothing was to be taken per orem but her diet was later shifted to general liquids. She was started on Ketoprofen drip 1 amp IV q 12°, Cefuroxime 750mg IV q 12°, and NSS nebulization q 6°. Post-operatively, patient had 3 episodes of vomiting and was given Metoclopromide 10 mg IV. Secretions were ordered to be suctioned as needed.

On the 2nd hospital day, she was started on regular diet; IVF was discontinued. Tracheal dressing was regularly changed and the inner cannula of tracheal tube was ordered to be cleansed every shift. There was good air entry and there were no signs of subcutaneous emphysema. She was also encouraged to ambulate. Cefuroxime IV was also shifted to Cefuroxime axetil 500 mg PO 1 tablet BID.

On the 3rd hospital day, the patient was started on Nimesulide 100 mg 1 tablet BID. Due to irritative coughing, tracheal tube balloon was ordered to be deflated and the nurses were instructed to gently suction secretions. Changing of tracheal dressing was regularly done.

On the 4th hospital day, patient complained of persistent coughing and throat itchiness, for which she was subsequently given a single dose of Butamirate citrate tablet 50 mg PO. A repeat videolaryngoscopy (Figure 2) was scheduled which then revealed the following findings: mobile cord, mild edema of the left true and false cords and slight swelling on left arytenoid. The tracheostomy tube was then removed. No difficulty of breathing nor stridor

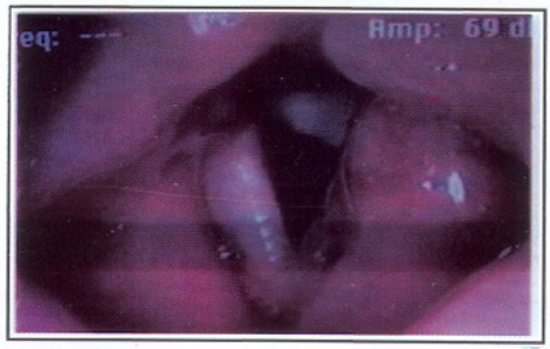

FIGURE 2. Videolaryngoscopic finding 4 days post-operatively

was noted. Her voice was noted to be clear with no sign of hoarseness. She was also started on Methylprednisolone 16mg 1 tablet OD and Ambroxol 75 mg 1 capsule OD. Nebulization was also discontinued.

On the 5th hospital day, patient's condition improved and was sent home with the following medications: Cefuroxime axetil tablet 500 mg 1 tablet BID, MethylPredisone 16 mg 1 tablet OD, Fusafungine 1 oral spray QID, and Ambroxol 75 mg 1 capsule OD. Official biopsy result of the left arytenoids and left ventricle were consistent with a laryngeal polyp with hyaline / amyloid changes in the stroma. Hematoxylin and eosin staining (Figure 3 and Figure 4) showed a stroma with small cystic spaces containing rounded, faintly eosinophilic and what appears to be laminated deposits, a few of which have central calcifications. Congo red staining was then

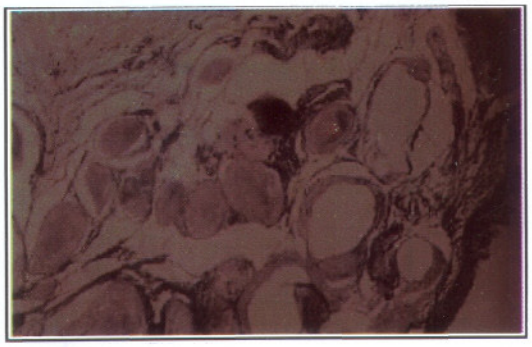

FIGURE 3. Micro-sections revealed fragments of loosely fibrous tissue, lined with stratified squamous epitheleum (H & E staining)

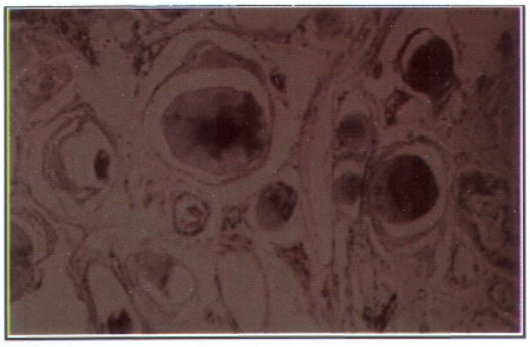

FIGURE 4. Small cystic spaces containing rounded, faintly eosinophilic, laminated deposits with few calcifications (H & E staining)

suggested. The slides were then brought to another institution for staining and it revealed a salmon pink appearance (Figure 5 and Figure 6) of the amyloid tissue on light microscopy, and an apple-green birefringence on polarized light. These findings were compatible with laryngeal amyloidosis. The patient was then advised to have regular monthly check-up with the attending physician.

1 month post-operatively, a repeat videolaryngoscopy (Figure 7) done revealed a recurrence of a laryngeal mass, approximately 1/3rd of the size of the L true vocal cord, smooth, nodular, non-ulcerating and located on the previous excision site. The patient did not complain of any hoarseness or stridor. No medication was given and the patient was advised to have a monthly examination to monitor the growth of the lesion.

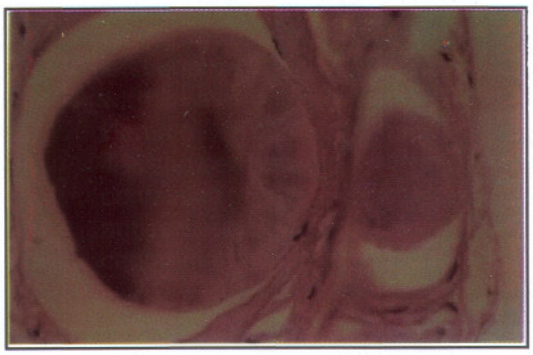

FIGURE 5. Higher magnification of amyloid material on H & E stain

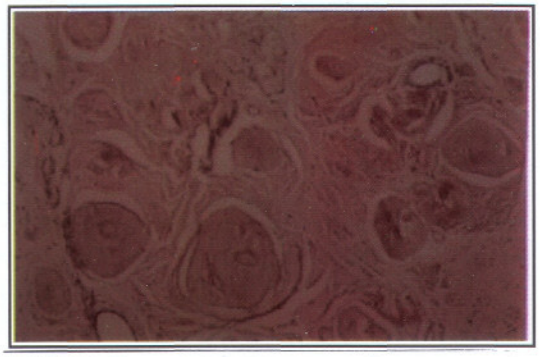

FIGURE 6. Congo-red staining which shows the salmon-pink amyloid tissue

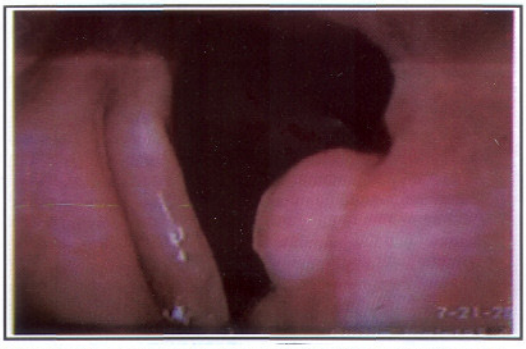

FIGURE 7. Videolaryngoscopic finding 1 month post-operatively showing recurrence of a noduar amyloid deposit on Left false cord

3 months post-operatively, a follow-up videolaryngoscopy (Figure 8) showed a slight increase in the size of the mass which became pedunculated. An occasional complaint of foreign body sensation in the throat was noted. No hoarseness or stridor was reported. She was then advised wide excision of the amyloid mass.

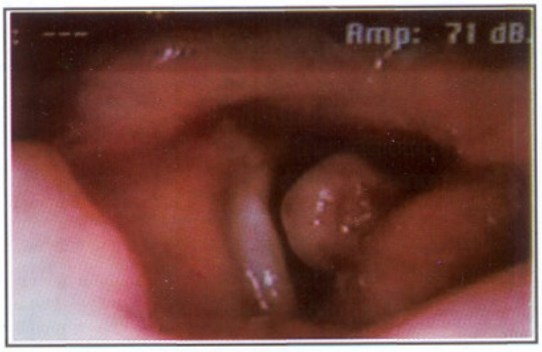

FIGURE 4. Videolaryngoscopic finding 4 months post-operatively showing an increase in the size of the pendunculated amyloid mass on the left false cord

DISCUSSION

Given this case, we come up with these differential diagnoses:

A. Tuberculosis

Chronic granulomatous lesions of the larynx may display a diffuse or localized soft tissue thickening. There may be irregularity associated with thickening. Tuberculosis of the larynx is usually secondary to pulmonary tuberculosis and commonly affects the posterior structures of the larynx, however all areas of the cords may be involved.[1] Diffuse swelling or a localized irregular mass may be found, depending on whether the pathologic process is an acute, exudative, or a chronic productive. There are 2 routes of infection by which tuberculosis could infect the larynx. The first is though direct extension and this is always a complication of a disease in the lungs, with the sputum serving as the vehicle by which the organisms reach the larynx. Another route has also been reported, in which the larynx becomes involved through hematogenous route from distant primaries rather than direct spread from the airway.[4] The latter theory can account for the incidence of negative chest involvement with laryngeal tuberculosis. In its early stages, tuberculosis is often asymptomatic and as the infection progresses, hoarseness (which is the most common clinical manifestation), cough, and sore throat develop. The diagnosis is confirmed with the identification of granulomatous inflammation, caseating granulomas, and acid-fast bacilli on histopathologic examination of biopsied laryngeal tissue.[5] Pre-operatively, we cannot totally rule out this disease entity.

B. Laryngeal Malignancies

Cancer of the larynx is one of the most common malignancies of the head and neck. Squamous cell carcinoma is a malignant epithelial neoplasm whose constituent cells are derived from squamous epithelium grossly they may appear warty, papillary, or as exophytic masses - fleshy, fungating masses often with areas of ulcerations. By incidence, glottic carcinoma is the most common, followed by supraglottic and rarely subglottic tumor.[1] Supraglottic tumors are more likely to extend across the midline probably due to the rich lymphatic supply of the area.[6] They may present with hoarseness or altered voice, dysphagia, persistent throat pain, odynophagia, or a sensation of a lump in throat. Other patients may complain of hemoptysis, cough or inspiratory stridor. Patients are initially asymptomatic and only during the later stages of the disease that patients manifest with the abovementioned symptoms. A change in the vocal pattern are almost universally the initial symptom of a tumor especially if it is glottic in location. It is always a differential whenever one is presented with a patient complaining of hoarseness with a mass on physical examination. A wide variety of treatment options are suggested depending on the extent of the lesion - surgery, radiation, chemotherapy, or combined treatment.

C. Contact Ulcer, Granuloma

The cause of contact ulcers has been established to be due to some form of trauma to the posterior portion of the larynx. There are three major causes implicated in the production of the trauma, namely : vocal abuse, endotracheal intubation, and reflux esophagitis[1].

With vocal abuse, the vocal processes of the arytenoids are forcefully brought together traumatizing the mucosa and underlying cartilage. This is further accentuated by loudness and a harsh quality of voice. A nonlinguistic pattern of abuse such as habitual throat clearing and chronic coughing causes the most potent vocal trauma in producing contact ulcers. No evidence of vocal abuse was reported in our patient which may have aggravated her condition. The hoarseness of our patient is already present even before she worked as a sales agent, wherein mostly she performs clerical tasks.

Clinically identical lesions may be produced by endotracheal intubation. Female preponderance was noted attributing to their relatively smaller larynges and use of inappropriate large endotracheal tubes[1]. The development of a contact ulcer secondary to intubation could be explained by the abrasion of the mucous membrane of the vocal process of the arytenoids cartilage resulting in an ulcer. An inflammatory response is then elicited causing hyperplasia and eventually the formation of a granulation tissue. This then becomes sessile and in the long run becomes pedunculated approaching the appearance of a polyp. This then becomes epithelialized, giving rise to the pedunculated

granuloma[1]. As for our patient, she had no previous history of hospitalization nor operation. All her 3 pregnancies were delivered via spontaneous delivery, thus she has no history of endotracheal intubation.

Contact ulcers secondary to gastroesophageal reflux is a direct result of gastric contents irritating the laryngeal mucosa eventually causing chronic inflammation. This may be confounded by the occurrence of vocal abuse secondary to reflux. The irritation brought about by the reflux of the acid then incites a persistent foreign body sensation in the throat with a strong urge to cough or clear the throat. All of these taken together would bring about injurious approximation of the vocal processes of the arytenoids thereby causing the formation of contact ulcers. Our patient had a history of long-standing untreated hyperacidity and this could have predisposed her to developing gastro-esophageal reflux and in turn possibly developing contact ulcers.

The most common presenting symptoms of contact ulcer is hoarseness. Patients with voice abuse or reflux as the cause often have a long history of hoarseness with periods of exacerbation and remission. Post-intubation ulcers are usually composed of bilateral pedunculated, epithelialized granulation tissue often increasing in size which may give rise to respiratory compromise[1]. Treatment modalities are directed towards the causative etiologies. However, when the history is strongly suggestive of vocal abuse with no history of intubation or symptoms of gastro-esophageal reflux, voice therapy is the most effective. If ever granuloma develops, surgical removal is advised

LARYNGEAL AMYLOIDOSIS

Amyloidosis is a disorder of protein metabolism in which autologous proteins are deposited intracellularly as fibrils in different organs and results in a wide range of clinical manifestations. These amyloid materials are constantly deposited outside the cells and these compressed cells cannot work properly. Abnormalities will depend on the organ system involved. Amyloidosis most often occurs as a primary disease or in association with plasma cell dyscrasia or inflammatory diseases. Less often it may be due to inheritance or be a concomitant development of aging[3]. These may be systemic or localized to one site. Systemic amyloidosis commonly affects the heart, kidneys, nervous system, and gastrointestinal tract. A localized form also occurs but the amyloid in all types has similar morphologic, structural, and staining properties despite involvement of fundamentally different protein components. In the head and neck, almost all sites have been reported to be involved; these include the nasopharynx, salivary glands, paranasal sinuses, nose, eye, oral cavity, oropharynx, and tracheobronchial tree with the supraglottic larynx at the level of the false cord as the most frequent site[2]. While this disease is not benign in its systemic form, it usually behaves in a harmless fashion when it is localized to one site.

It can present in several forms as described in the classification of Symmers[2]: primary amyloidosis (localized or general); secondary amyloidosis (localized or general); amyloidosis associated with multiple myeloma; and hereditary or familial amyloidosis. Primary amyloidosis is a plasma cell disorder which originates in the bone marrow, a systemic disease with no identifiable cause. The deposits in this type of disease are made up of immunoglobulin light chain proteins which may be deposited in any bodily tissue or organ. The secondary amyloidosis refers to systemic amyloidosis and is caused by a chronic infection or inflammatory disease such as rheumatoid arthritis, familial Mediterranean fever, osteomyelitis or granulomatous ileitis. The deposits in this type of disease are made up of a protein called AA protein. A subclass of systemic amyloidosis occurs in patients with multiple myeloma. The familial or hereditary amyloidosis is a rare form of the disease which is found in families or nearly every ethnic background. The deposits are most commonly made up of transthyretin protein which is manufactured in the liver. In the localized form, there is no evidence of systemic amyloidosis and no underlying chronic disease. The absence of a systemic disease may very well qualify our patient with the localized form of amyloidosis.

Although the presenting symptom of laryngeal amyloidosis is usually hoarseness, other clinical manifestations may develop over time with further development of the disease[3]. It is not unusual to have patients who will complain of dysphagia, dyspnea with exertion, choking, occasional aspiration, and a fullness in the throat. A number of patients would also have significant reflux esophagitis, this raises the possibility that acid reflux can be an etiologic factor considering that amyloid deposits can result from some types of chronic inflammatory process[2]. The clinical nature of laryngeal amyloidosis has not been well established, and the natural history of the disease remains a controversy. A study made by Lewis et al[11] reviewed the clinicopathologic and immunohistochemical features of 22 cases of laryngeal amyloidosis. They concluded that hoarseness was the most common symptom and that the most frequent site affected was the false cords. However, in the retrospective study of Kerner et al[13] among 141 patients with biopsy-verified amyloidosis, they concluded that the tongue and the larynx were the most common sites of involvement. Nonetheless, both studies confirmed that localized amyloidosis is indeed common in the head and neck.

The only clinical presenting symptom of our patient is hoarseness and the gross appearance suggests a mucosally covered mass. Hence, differential diagnosis varied from infectious to malignant.

Furthermore, on direct laryngoscopy and biopsy the reading suggested a foreign-body type of reaction. It is only after the sections were re-examined and analyzed that amyloidosis was considered.

Laryngeal amyloidosis is almost always evaluated initially at the time of biopsy and their appearance may vary to a tumor-like nodule or as a diffuse infiltrates in the submucosa of the larynx mimicking a carcinoma-like lesion.[2] The 4 patterns / location of amyloid deposition in the larynx are 1. random, amorphous masses, 2. vessel walls, 3. basement membranes of the submucous glands, and 4. adipose tissue as hyaline rings. Our patient presented with random, amorphous mass over the false cord and left arytenoid.

Laryngeal Amyloidosis is best evaluated by direct laryngoscopy at the time of biopsy. It is during this time that one would assess the surface involvement, but because amyloidosis is a submucosal disease which can only be defined better by radiological scans. Aydin et al[14] stated that axial CT scan and MRI would offer the best clinical assessment of the disease and would also aid in determining the timing of the surgery based on the growth and extent of the lesion. Short of radiographic imaging to document the disease, videolaryngoscopy could be done. It is an office procedure that can be used to document changes and monitor any progress of tumor growth. As for our patient, the videolaryngoscopic finding was instrumental in determining the extent of the lesion viewed from a magnified standpoint, its surface character and the possibility of threat to the airway. It also aids us in monitoring the recurrence of her disease, which is evident 1 month post-excision. For this case however, despite the videolaryngosopy imaging, laryngeal amyloidosis was not considered as a differential diagnosis pre-operatively.

The gold standard for the diagnosis of amyloidosis is a tissue biopsy staining positive with Congo-red demonstrating apple-green birefringence under polarized light microscopy[2]. On electron microscopy a classical fibrillar appearance in the extracellular matrix is evident. The initial hematoxylin and eosin staining of the mass of the patient already raised the suspicion of amyloidosis because of the presence of hyaline and / or amyloid in the stroma. That is why Congo-red staining was suggested because hyaline would not absorb the stain compared to amyloid which would give a salmon pink appearance once viewed on light microscopy. Furthermore, on polarized light, amyloid would show the classical apple-green birefringence which was very evident with our patient. Electron microscopy was not done.

Once the diagnosis of laryngeal amyloidosis is made, further work-up should be done to rule out the possibility of a systemic disease. Some systemic causes that should be considered are multiple myeloma, tuberculosis, and rheumatic diseases. The work-up should include a pulmonary evaluation, tuberculin skin testing, complete blood count, blood urea nitrogen and creatinine levels, liver enzyme studies, sedimentation rate, determination of Rh factor; urinalysis, antinuclear antibody values, and serum and urine electrophoresis.[2] Only a complete blood count and chest x-ray were done for our patient which revealed normal results. All these have yet to be done at the time of this report. The rest of laboratories were not requested primarily because the diagnosis of amyloidosis was not considered pre-operatively. Clinically, our patient did not show any signs and symptoms that would raise the suspicion of a systemic disease.

The treatment for isolated laryngeal amyloidosis can be one of observation or surgery. Depending on the size of the lesion, one may opt to wait provided that it does not obstruct the airway. Other forms of treatment, such as radiation therapy have little or no effect on the disease. The best treatment options for isolated laryngeal amyloidosis is still surgery. Surgical options ranges from microscopic laryngoscopy with carbon dioxide laser or cold knife excision to external partial laryngeal resection. Endoscopic carbon dioxide laser is successful in treating localized amyloidosis with no evidence of recurrence for at least 2 years.[15] This was refuted by Kennedy[2] et al who claimed claimed that laser excision is often not complete and it almost always resulted in recurrence. Some authors advocated external approaches to handle large supraglottic amyloid deposits, namely thyrotomy and supraglottic laryngectomy. Kennedy et al then proposed a conservative surgical management, a lateral supraglottic procedure through the upper thyroid lamina. This approach prevents the loss of internal supraglottic structure and interruption at the anterior commissure that may have an effect on swallowing and voice respectively.

Localized amyloidosis can be successfully treated by surgery alone with little or no major sequelae. In spite of this, Chow et al[8] reported 1 mortality secondary to massive hemorrhage of upper respiratory tract as a complication of undiagnosed localized laryngeal amyloidosis. This suggests that early recognition of the disease would prevent complications.

Tracheostomy was done prior to the excision biopsy because of the threat of airway compromise.

In a study by Noguchi et al stated that laryngeal amyloidosis is fragile and hemorrhagic, and that massive bleeding may occur during intubation.

The procedure intended for our patient pre-operatively was only excision biopsy, which may be the reason why recurrence was noted 1 month post-operatively. If laryngeal amyloidosis was considered then, a more definitive management which is wide excision of the amyloid mass could have been done. Since amyloidosis is a very slow growing, recurrence is expected and may only manifest after several years so long term follow-up is necessary. The most ideal management for complete resolution of localized amyloidosis with recurrence would be multiple excision. Godbersen et al[9] suggested that removal of the amyloid tumors at intervals is more feasible than radical resection, because of the slow growth of these tumors. Prognosis of the disease depends on both the size of the amyloid deposit and whether there is systemic involvement.

CONCLUSION

Hoarseness as an initial presenting symptom should alarm an otorhinolaryngologist regarding the underlying disease which may be as benign as an infectious process or as life threatening as a carcinoma. One should always consider that inflammatory condition such as amyloidosis exist.

Laryngeal Amyloidosis usually indicates localized disease with no systemic involvement. Early diagnosis and recognition of the disease, would lead to less morbidity and appropriate plan of treatment. However because of the potential for an underlying disease state such as multiple myeloma, a full medical evaluation for systemic disease should be performed. Complete work-up should include pulmonary evaluation, tuberculin skin testing, complete blood count, blood urea nitrogen and creatinine levels, liver enzyme studies, sedimentation rate, determination of Rh factor; urinalysis, antinuclear antibody values, and serum and urine electrophoresis. We therefore recommend that these laboratories be done when one makes a diagnosis of amyloidosis, whether it is systemic or in localized form.

This case was presented in an effort to shed light on the possibility of occurrence of amyloidosis of the larynx in our local setting. Although no local data was available to document its incidence, the numerous international studies on laryngeal amyloidosis suggest that it is relatively common accounting for about less than 1% of all laryngeal tumors. And once undiagnosed, this could be fatal because of the tendency to obstruct the airway and possibly cause massive hemorrhage.

Amyloidosis in any form is a slowly progressive lesion that does not respond to nonsurgical treatment. Thus management of localized laryngeal Amyloidosis is by far no exception. Local surgical excision is the treatment of choice for laryngeal Amyloidosis and laser excision is probably the best. However, one should always consider the possibility of recurrence, as exhibited by our patient. Thus proper evaluation and documentation should be made before planning to resect the mass. Based on literature review, this paper also suggested treatment options in excising the mass. And because of its tendency to recur even after complete excision is done, close monitoring is advised.

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PARAGANGLIOMA PRESENTING AS A PAROTID MASS*

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ABSTRACT

OBJECTIVE: To present our experience on the clinical behavior of paraganglioma occurring in the head and neck area as this tumor has rarely been encountered in the local setting. Early recognition of this tumor will facilitate immediate and complete resection and minimize further complications.

DESIGN: A case report

SETTING: A tertiary-hospital in Quezon City, Philippines

PATIENT: A 17-year old male presenting with a 1-year history of a slowly enlarging left infra-auricular mass.

RESULTS: The patient underwent left total parotidectomy using a lazy-s incision to excise the superficial lobe with preservation of the left facial nerve, and a transmandibular approach (lip splitting+mandibular swing) to excise the deep lobe. Extensive dissection of the tumor tissue was done in the area of the left base of the skull, left lateral pharyngeal wall and around the left carotid sheath.

CONCLUSION: A high index of suspicion is needed to diagnose a paraganglioma in the head and neck area as majority of these cases are asymptomatic, has an insidious growth and are multicentric in origin. Paraganglioma of the head and neck should also be considered in patients presenting with an infra-auricular mass. Delayed identification leads to tumor enlargement with increased surgical risk to neurovascular structures and possible incomplete resection. Surgical excision is the mainstay of therapy for paraganglioma of the hea and neck.

INTRODUCTION

Paragangliomas are neuroendocrine neoplasms which originate from neural-crest cells called paraganglia that are located throughout the body.[1,5] The incidence of paraganglioma in the head and neck region is low, accounting for only 0.012% of all tumors in man.[1] Paraganglioma of the head and neck can occur in such locations as the larynx, orbit, paranasal sinuses and the jugulotympanicarea along cranial nerves IX and X,[7] however the majority of these tumors arise in the carotid bifurcation and are known as "carotid body tumors".[4] The most common presentation of a carotid body tumor is of an asymptomatic, slowly enlarging mass in the upper portion of the neck, anterior to the sternocleidomastoid muscle, just below the angle of the mandible.[1] This tumor is usually benign but is well known for local soft tissue and bone invasion.[6] Malignancy is difficult to determine histologically and is usually based on the presence of metastatic disease.[19] Documented cases of paraganglioma of the head and neck with a clinical presentation similar to that seen in our patient is uncommon, making diagnosis difficult. It is important that an early recognition of this tumor be made so as to facilitate the immediate and complete resection of the tumor and minimize further complications.

CASE REPORT

Our patient is B.P., a 17-year-old male, with a 1-year history of a slowly enlarging, non-tender, firm, slightly movable mass at the left infra-auricular area, with no associated signs and symptoms. The patient's previous medical history and family history were unremarkable. Since our patient had no other subjective complaints at that time, there was no

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attempt made to consult with a physician and the patient continued with his regular activities. After a few months, the patient complained of further enlargement of the mass which had extended to the pre-auricular area, as well as a sensation of dysphagia upon intake of solid food. Persistence of the dysphagia alarmed our patient's parents prompting consult at our medical institution. Upon clinical examination, the mass was noted to be around 5 x 6 x 3 cm. in size, and was firm, non-tender and slightly movable. Further examination of the oral cavity revealed a bulging left lateral pharyngeal wall with the uvula displaced to the right. There were no other abnormal findings in the rest of the physical examination.

Based on the clinical findings, our primary consideration was a Parotid New Growth, probably benign. Our differential diagnoses included a Branchial cleft cyst, TB adenitis, and Lymphoma. Diagnostics done to confirm our initial impression included a Fine Needle Aspiration Biopsy (FNAB) which revealed cytomorphologic features consistent with a pleomorphic adenoma and Contrast-enhanced Computed Tomography (CTScan) which revealed the presence of a large, irregular soft tissue mass in the left parotid space. The mass was noted to extend anterolaterally to the ipsilateral masticator space, medially to the parapharyngeal space and posteromedially to the carotid space. The left carotid sheath was displaced posteriorly with note of small, rim-enhancing hypodense nodular structures in the left carotid space. The CTScan Findings was signed out as a soft-tissue mass in the left parotid space with extensions and lytic erosions consistent with a parotid gland tumor as well as the consideration of an enlarged lymph node in the left carotid space. The chest x-ray (CXR), complete blood count (CBC) and urinalysis of our patient yielded normal results.

Surgical management involved a left total parotidectomy using a lazy-s incision to excise the superficial lobe with careful preservation of the facial nerve, and a transmandibular approach (lip splitting + mandibular swing) to excise the deep lobe. The left submandibular and sublingual glands were removed. Intra-operative findings showed the mass to extend until the base of the skull, left lateral pharyngeal wall, and the area of the patient's left external carotid artery (ECA), left internal jugular vein (IJV) and left internal carotid artery (ICA). Excision of the mass was done together with transection and ligation of the patient's left ECA. Frozen section was not done and the specimens were sent for routine histopathologic examination (permanent section).

Our patient tolerated the procedure well, with no post-operative complications, and was discharged on his eighth post-op day. The official histopathologic examination was signed out as a Carotid Body Tumor (Paraganglioma). Our patient appeared well during subsequent follow-up, however on the 5th month post-op, a 2 x 3 x 3 cm. slowly enlarging, non-tender mass was again observed in the left lateral neck area. A repeat chest x-ray (CXR) showed the presence of multiple nodules in the right mid- and bilateral lower lung region, the largest of which measured 2 cm. in its widest dimension. Tumor residual and growth with possible metastasis was suspected. The patient was then advised radiotherapy but was lost to follow-up.

DISCUSSION

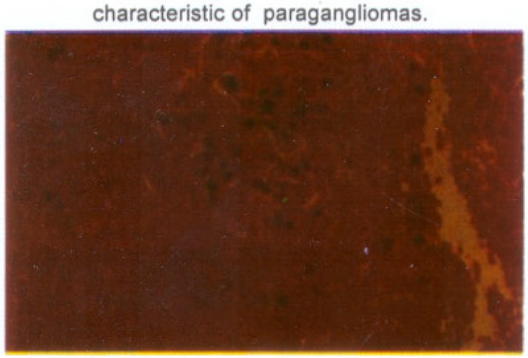
Paragangliomas arising from the carotid bodies account for 60% of all head and neck paragangliomas.[1] They usually occur in patients 40 to 60 years old,[1,3] making the appearance of this tumor in our 17-year old patient relatively unusual. Approximately 10% of all paragangliomas have an autosomal dominant pattern of inheritance,[4] however our patient's past medical history and family medical history were unremarkable. The most common presentation of a paraganglioma in the head and neck area is that of an asymptomatic, slowly enlarging mass at the anterior border of the sternocleidomastoid muscle that is mobile in the lateral plane but limited in cephalocaudal direction.[21] They may grow large enough, as in our case, to encroach into nearby structures causing a variety of symptoms such as the dysphagia of our patient. As this tumor enlarges, progressive symptoms not only of dysphagia but also of odynophagia, hoarseness and other cranial nerve (IX-XII) deficits may appear.[21]

Aside from a Parotid new growth, our differential diagnoses included Branchial cleft cysts, TB adenitis and Lymphoma,[2] mainly because of the location and characteristics exhibited by the mass, as well as the absence of other signs and symptoms. All our other considerations were ruled out by appropriate clinical examination and diagnostic work-up.

Fine-needle Aspiration Biopsy (FNAB) is not useful in the diagnostic evaluation of paraganglioma of the head and neck,[2] although for tumors of the thyroid and parotid, it has a specificity of 88% – 89% and a sensitivity of 87% - 100%.[12] Fine needle aspiration cytology of a carotid body paraganglioma would usually reveal blood rich aspirate with poor to moderate cellularity, indistinct cell outline, and acinar formation.[22] Interestingly enough, the FNAB of our patient showed cells with features consistent with a benign tumor of the salivary gland and was signed out as Pleomorphic Adenoma. Final histopathologic examination of the tumor in our case (Figure 3) revealed features

characteristic of paraganglioma, that of typical Zellballen or alveolar arrangement of chief cells with inconspicuous sustentacular cells separated by prominent capillary network.[3] The clinical behavior of the tumor in this particular case cannot be predicted solely on the basis of the histologic sections that were obtained. Certain features such as nuclear pleomorphism, mitotic activity, necrosis of Zellballen and vascular invasion have been advocated by some as potential indicators of malignancy, however these are not absolute since these features have also been seen in benign tumors as well. [3,5,16]

Figure 3. Permanent section showing Zellballen pattern characteristic of paragangliomas.



Diagnostic modalities such as a Magnetic Resonance Imaging (MRI) and CTScan are useful in cases of paragangliomas of the head and neck as they can identify the presence and extent of the tumor,[4] as well as demarcate soft-tissue planes that would provide the anatomic detail crucial for the planning of the surgical approach.[5] If the mass had been initially suspected to be paraganglioma of the head and neck, the best diagnostic work-up would be a selective angiography which would show widening of the carotid bifurcation with a well-defined tumor-blush,[2,3,5] findings that are characteristicof this type of tumor. In our patient, only a CTScan was done and this showed the posterior displacement of the left carotid sheath (Figure 1), as well as the extent of the mass in the area of the carotid space (Figure 2). Angiography was not done in our patient.

Figure 1. contrast-enhanced CT Scan showing posterior displacement of left carotid vessels

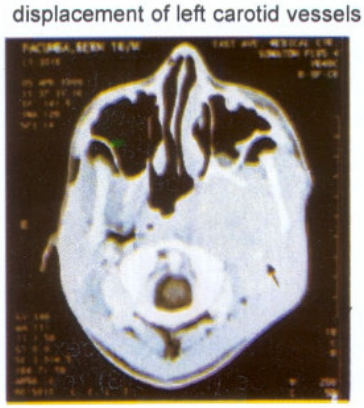
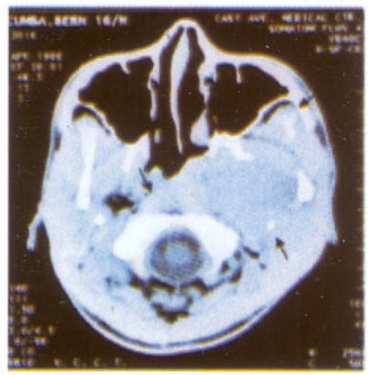
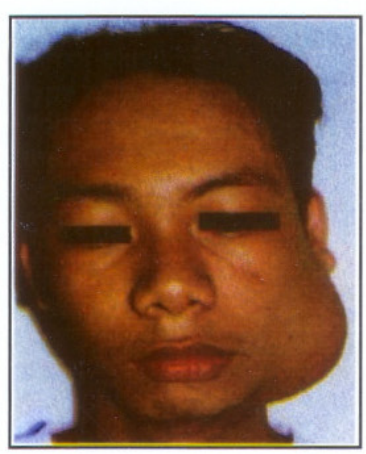


Figure 2. contrast-enhanced CT Scan showing extent of the mass.



Surgical excision remains the mainstay of therapy since most carotid body paragangliomasare benign and can be cured if total excision is done at the time of the initial surgery.[1] The immediate and complete removal of the mass would prevent neurovascular complications[2] associated with continual enlargement since treatment morbidity increases with the size of the mass.[4] In our patient, intra-operative findings showed the mass to be extensive and was actually adherent to the carotid sheath. A great deal of care was taken during the surgery to remove as much tumor tissue as possible while carefully preserving the important neural and vascular structures, thus ensuring an uneventful post-operative course in our patient.[4] The appearance of a 2 x 3 cm. mass in the left lateral neck area (Figure 4), 5th month post-op, may indicate possible tumor residual due to incomplete excision of the mass rather than a tumor recurrence.

Figure 4. The patient on follow-up (5 month post-op). Please note of re-emergence of mass.



Tumor recurrence is a rare event, and if it does occur it usually happens 10-15 years after surgery.[5] Some reports associate tumor regrowth to the development of metastasis which occur in 6% to 9% of patients,[1] half of which appear in regional lymph

nodes, while the remainder occur in distant sites, particularly to the lungs and bone.[1,6] In fact, a repeat CXR of our patient, done 5th month post-op, showed the presence of a mass occupying the right mid- and bilateral lower lung regions. A question of malignancy now arises as malignant head and neck paragangliomas are said to be characterized by metastatic spread, [3,24] but because of its rarity no single report has been able to accurately demonstrate the biologic or clinical behavior of this tumor making prognosis of our patient's case difficult and unpredictable.[3,6,8]

The role of radiotherapy in the treatment of paraganglioma of the head and neck is arguable since paragangliomas are biologically radioresistant.[7] Radiotherapy is advocated in our patient because reports have shown that it can help control the symptomatic progression of the disease.[2] High response rates have been noted in paraganglioma of the head and neck exposed to irradiation doseages of 3400 to 6000 rads,[2,7] yielding excellent control for the large paragangliomas that are unresectable as well as for the malignant variety that have metastasized.[3]

CONCLUSION

A high index of suspicion is needed to diagnose paraganglioma of the head and neck as majority of these cases are asymptomatic, has an insidious growth and are multicentric in origin. Early identification of a paraganglioma in the head and neck area is essential as delayed identification allows tumor enlargement with increased risk to neurovascular structures. Symptoms such as dysphagia, hoarseness, and syncope are actually late manifestations secondary to tumor enlargement and its pressure effect. A CTScan and an MRI are both useful in detecting the presence of the tumor as well as its extent, however an Angiography will prove not only very diagnostic but can be of help in pre-operative evaluation of the resectability of the tumor. Surgical excision remains the mainstay in the treatment of paraganglioma of the head and neck since most are curable at the time of resection. Radiotherapy is arguable but is advocated to help ease the symptomatic progression of the disease, control further growth of unresectable tumors, and may benefit those cases with evidence of metastatic spread.

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