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Case report

Fibrous dysplasia of paranasal sinuses with anterior skull-base extension presenting with pneumocephalus; a case report

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ABSTRACT

Background: Fibrous dysplasia is a benign fibro-osseous lesion where normal bone is replaced with immature dysplastic woven bone and fibrous tissue. Fibrous dysplasia has the potential to involve multiple bones of the craniofacial area in a rare condition. Management of this involvement type should be assessed carefully.
Case report: Here, we report a 52-year-old man with progressive and bilateral frontal headache. The radio/pathologic diagnosis revealed fibrous dysplasia of paranasal sinuses with anterior skull-base extension and pneumocephalus. The patient underwent a craniotomy, and 2 weeks after the procedure, the symptoms were alleviated without any complications.
Conclusion: in case of fibrous dysplasia, patients with new onset and/or mild symptoms may have extensive lesions in multiple craniofacial bones.

1. Introduction

Fibrous dysplasia (FD) is a benign fibro-osseous lesion usually affecting craniofacial bones. Craniofacial FD is a lesion of unknown etiology [1]. However, it has been reported that post-zygotic missense mutations of the GNAS1 gene (protein bound to the guanine nucleotide α-stimulating activity of polypeptide1) initiate the formation of the disease particularly in syndromic states [2–5]. Most FD patients have no apparent symptoms [3,4] and are diagnosed incidentally for other reasons by CT scan [3,6,7]. Some studies categorize FD into three main groups: monostotic, which is the most common [2,4], polyostotic which has an earlier onset and almost affects a craniofacial bone [8,9]; and syndrome-related FD, such as McCune-Albright [10,11], Mazabraud [12,13] and Jaffe-Lichtenstein Syndrome [2].

Treatment strategies should be based on the patient's condition and decided upon through multidisciplinary consultation [14]. They range from surveillance to complete resection of the lesion [15]. Surgery is the absolute treatment strategy for patients with severe symptoms [16], while debulking and decompression are used for vulnerable patients [17,18]. Additionally, some studies have shown the effectiveness of certain bisphosphonates (pain management and preventing disease progression) [17] and denosumab in FD patients [6]. Here, we reported a rare presentation of fibrous dysplasia affecting the paranasal sinuses extending to the anterior

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skull-base region, causing pneumocephalus.

2. CASE report

A 52-year-old bodybuilder man was referred to Sina Hospital in Tehran, Iran, on November 16, 2023 by his Neurologist. He had been experiencing a constant and progressively worsening bilateral frontal headache, as well as orbital pain, for the past eight months. The headache was throbbing and typically began in the morning but was alleviated with painkillers and a hair dryer. Over the past month, the intensity of the headache had increased, it was unresponsive to painkillers, and he had also developed dizziness and imbalance. His medical history included a positive hepatitis-B infection, and his psycho-social history revealed a history of consuming anabolic steroids, specifically testosterone enanthate, at a dosage of 100mg/ml once weekly for about six months. He has no positive family history of any cancer. Also, past surgical history was negative.

3. Clinical findings

Upon examination, the patient was cooperative, afebrile, and fully alert, with a Karnofsky Performance Scale score of 100. He reported having headaches, particularly when his head was down. The patient's neurological examinations were normal, except for grade-I papilledema. There was no evidence of CSF rhinorrhea or neck rigidity. Additionally, no asymmetricity or exophthalmos was observed during the physical exam. The patient had a GCS score of 15, blood pressure of 138/76 mmHg, pulse rate of 90 beats per minute, respiratory rate of 13 breaths per minute, and a body temperature of 37.1 °C on admission.

4. Timeline

The patient experienced symptoms in March 2023, which worsened by October 2023. He was referred to our hospital in November 2023 and treated in December 2023. Since then (May 2024), the patient has been undergoing follow-up with control CT scan and physical exam.

5. Diagnostic assessment

Computed tomography (CT) of the brain and paranasal sinuses demonstrated a well-defined lobulated ground glass lesion with dense sclerotic internal foci in the right frontal sinus and right anterior ethmoidal air cells with intracranial extension via destructing the anterior skull-base region leading to significant pneumocephalus. These radiographic features suggest a fibro-osseous lesion such as fibrous dysplasia or an ossifying fibroma; however, alternative diagnoses considered osteoma and sinonasal osteosarcoma (Fig. 1; A-F).

6. Therapeutic intervention

The patient underwent a right frontal craniotomy via a curvilinear incision. Firstly, the frontal sinus lesion was removed

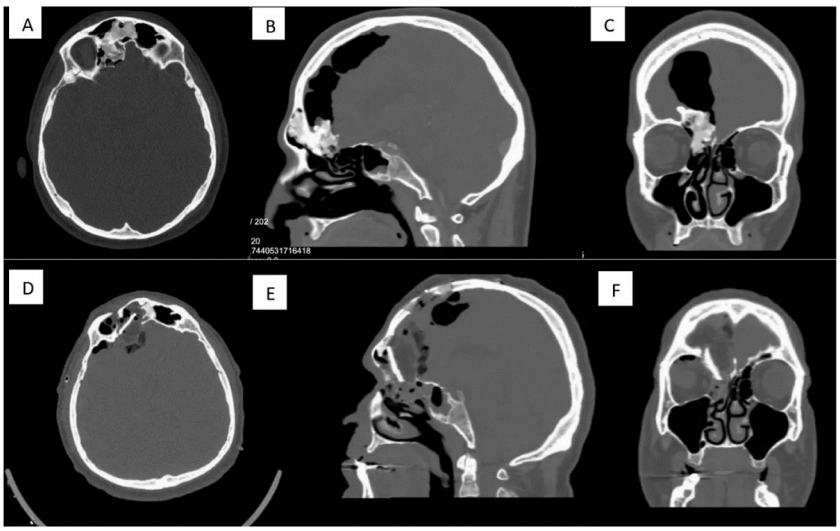

Fig. 1. **(A)** Axial; **(B)** Sagittal and **(C)** Coronal CT views of the brain and paranasal sinuses preoperatively demonstrating a fibro-osseous lesion in the right frontal and ethmoid sinuses extending towards frontobasal lobe accompanying significant pneumocephalus. **(D)** Axial; **(E)** Sagittal and **(F)** Coronal CT views of the brain and paranasal sinuses postoperatively displaying tumor removal and anterior skull-base reconstruction.

extradurally and the sinus was cranialized. Then, the frontal dura was opened to access the ethmoidal part of the tumor which had destructed anterior skull-base dura extending from the nasal cavity towards the frontobasal gyri. Microscopic tumor removal was done by downward drilling the lesion until the exposure of the normal bone followed by anterior skull-base reconstruction via sandwich technique (using autograft bone and pediculated pericranium augmented by fat which covered the whole bone defects). Cranioplasty was done and all layers were closed according to the anatomical fashion.

The specimen was sent for histopathological analysis, designated as frontal and ethmoidal mass. Microscopic examination shows branching and anastomosing irregular trabeculae of woven bone of variable thickness and intervening fibrovascular stroma with no conspicuous osteoblastic rimming. Also, portions of respiratory type epithelium were seen (Fig. 2; A,B).

7. FOLLOW-UP and outcomes

A daily assessment was conducted during the patient's admission to monitor for potential CSF leakage, rising ICP, and any other alarm signs. The patient reported experiencing a mild frontal headache, which was alleviated with Acetaminophen tablet (500mg, taken every 12 hours) for three days. Following the patient's discharge, a significant improvement in their frontal headache was observed two weeks later. Fortunately, there were no postoperative complications, and the patient could return to work shortly after. Periodic follow-ups continue to be conducted to ensure ongoing progress. By now, the patient had no complication based on examination and the last CT scan.

8. Discussion

Fibrous dysplasia is a rare and potentially benign bone tumor with a prevalence of about 7 % of all non-malignant bone tumors [2,4,19], especially in the craniofacial region. It is more frequent in women than men, and the ethmoid bone is the most commonly involved [3,9]. Reports of Fibrous Dysplasia involving both paranasal sinuses and the anterior skull-based region are rare, especially if this condition is accompanied by pneumocephalus. Symptomatic patients complain of facial asymmetry, progressive headache, dystopia, and visual impairment [2,3]. While there is no consensus on management approaches, most clinicians state that surgery (mostly endoscopic approach) is indicated in symptomatic patients [3]. If the patient is asymptomatic or due to the patient's condition, the potential benefit of surgery is limited and medical treatment or surveillance could be considered [6]. Furthermore, close follow-up by CT scan and clinical observation is mandatory due to the high recurrence risk [20] and the rare risk of sarcomatous transformation of FD following radiotherapy [7,21].

There are some issues with this case. Firstly, can we classify this type of involvement as polyostotic? The response varies and depends on various studies. The most common opinion is that when we assess multiple adjacent bones, such as in the craniofacial area, we should consider all of them in the monostotic category. This is because the pathophysiology may be the same. However, some investigators consider the extensive involvement of multiple bones in the craniofacial area as a polyostotic form [4].

Secondly, as we diagnose our case as monostotic fibrous dysplasia, it is less crucial to survey other parts of the body for evidence of a syndromic state. This is because polyostotic forms are more likely to be associated with early manifestation of McCune-Albright syndrome [22]. Studies of syndromic FD indicate that the after-zygotic mutation occurs before the separation of ectoderm, mesoderm, and endoderm from the main trunk. For non-inherited and mosaic monostotic FD, this process is delayed until mesoderm is involved [19].

Additionally, it is worth noting that the patient had been utilizing testosterone for six months prior to their diagnosis. This has led to a hypothesis that testosterone may play a role in the development of fibrous dysplasia, although there is limited research to support this claim. Further investigation is necessary to determine the relevance of any potential association. One study revealed a significant expression of estradiol and testosterone markers in fibrous dysplasia [23]. Another study tried to use aromatase inhibitors (testolactone) and tamoxifen citrate to prevent precocious puberty in McCune-Albright syndrome [24].

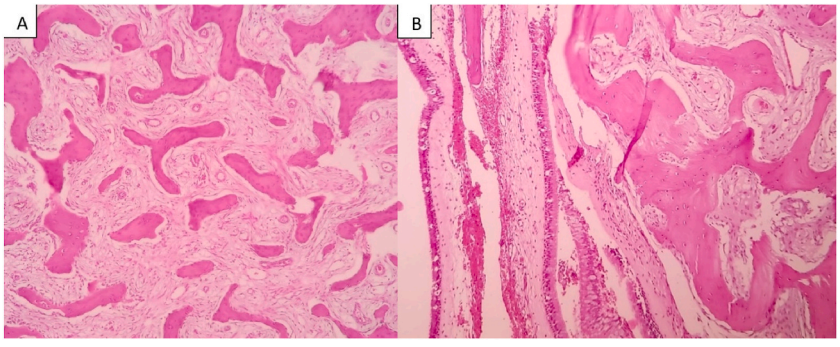

Fig. 2. **(A)** High power view of fibrous dysplasia. Notice the lack of osteoblastic rimming in the bone trabeculae. The spindle cells present in the stroma are cytologically bland. **(B)** The respiratory epithelium above the fibroosseous tissue.

9. Study limitation

Considering the type of our study, we cannot discuss about this pathology with only one case. Accordingly, more studies with high sample size are needed to investigate different aspects of this entity.

10. Conclusion

In our case, despite significant involvement, the symptoms were primarily confined to frontal headaches. After diagnosis, the patient underwent a craniotomy to address intracranial extension. The patient is scheduled for monthly follow-ups over the next three months, followed by annual CT scans to monitor progress. Given the likelihood of FD recurrence and the potential for transformation to osteosarcoma (though this is less probable), close monitoring represents the most prudent course of action. For patients with polyostotic type FD, it is advisable to investigate all other body parts for syndromic conditions.

Ethics statement

Informed consent was obtained from the patient for the publication of all images, clinical data and other data included in the manuscript.

Considerations

Four items from the checklist were not applicable in our study.

Item	The reason for not being available
8b	There have no diagnostic challenges
8d	The staging where not applicable
10a	Because of limitation in follow up time, it was merged to item 10b
12	The patient did not want to complete this part

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article.

CRediT authorship contribution statement

Seyed Mohammad Piri: Methodology, Investigation, Conceptualization. **Ahmad Pour-Rashidi:** Data curation. **Hoda Asefi:** Resources, Data curation. **Masume Allahmoradi:** Formal analysis, Conceptualization. **Hedieh Moradi Tabriz:** Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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