eISSN: 2810 – 0204
Available Online at : http://journal.scientic.id/index.php/sciena/issue/view/28

Fine Needle Aspiration Biopsy as A Useful Diagnostic Adjunct in The Management of Ameloblastoma: A Cytology Case Report

Rum Affida Rasfa[1], Shinta Ayu Intan[1], Noza Hilbertina[1], Meta Zulyati Oktora[2*]

[1] Department of Anatomical Pathology, Faculty of Medicine, Universitas Andalas, Padang, Indonesia
[2] Department of Anatomical Pathology, Faculty of Medicine, Universitas Baiturrahmah, Padang, Indonesia
Email : metazulyantioktora@fk.unbrah.ac.id

Abstract

Background: Ameloblastoma is one of the most common benign odontogenic tumors, known for its slow growth but locally invasive behavior, often leading to extensive bone destruction if not diagnosed and treated early. Preoperative diagnosis of ameloblastoma can be made by Fine Needle Aspiration Biopsy (FNAB) which is used as a guide for surgical planning. Diagnosis of ameloblastoma from cytology is challenging due to many pitfalls and differential diagnosis with other odontogenic lesions, but proper sampling and accurate diagnosis are very useful inpatient management Understanding its cytomorphological features can greatly assist in early differentiation from other maxillofacial neoplasms. This case report aims to describe the appearance of ameloblastoma on FNAB and reveal the contribution of the FNAB examination in the preoperative diagnosis of ameloblastoma so that adequate surgery can be carried out and the results are more optimal. **Case report:** We report a case of a tumor in the mandible of a 16-year-old man with a diagnosis of right mandibular tumor. The patient was sent for FNAB to the anatomical pathology laboratory. Preoperative cytology examination showed benign odontogenic lesions indicating ameloblastoma from FNAB. Furthermore, tumor resection was performed on the patient and histopathology tissue examination was performed with results consistent with ameloblastoma. **Discussion:** The FNAB procedure can be performed to establish for a pre-operative diagnosis of ameloblastoma. Cytological characteristics of ameloblastoma include basaloid cells or epithelial cells resembling ameloblasts with nuclei arranged palisade at the periphery and in the middle consisting of cells resembling stellate reticulum cells. False-negative results in the FNAB procedure can occur due to inadequate specimens or inaccurate sampling, mostly related to cystic tumors. To avoid this, FNAB tissue sampling can be performed at multiple sites and the deeper aspects of the tumor can assist in establishing an accurate preoperative diagnosis. **Conclusion:** The FNAB cytology is a reliable procedure for the pre-operative diagnosis of ameloblastoma. Pre-operative diagnosis of ameloblastoma can be used for planning therapy and early diagnosis of recurrence cases that can improve patient survival. The correlation between the clinicopathological and radiological findings can assist in the evaluation of the diagnosis of FNAB in ameloblastoma.

Keyword: Fine Needle Aspiration Biopsy, Ameloblastoma, Cytology, Histopathological.

Abstrak

Pendahuluan*: Ameloblastoma merupakan salah satu tumor odontogenik jinak yang paling umum, dikenal karena pertumbuhannya yang lambat tetapi perilaku invasif lokal, sering menyebabkan kerusakan tulang yang luas jika tidak didiagnosis dan diobati sejak dini. Diagnosis pra operasi ameloblastoma dapat dilakukan dengan Biopsi Aspirasi Jarum Halus (FNAB) yang digunakan sebagai panduan untuk perencanaan pembedahan. Diagnosis ameloblastoma dari sitologi merupakan tantangan karena banyak jebakan dan diagnosis banding dengan lesi odontogenik lainnya, tetapi pengambilan sampel yang tepat dan diagnosis yang akurat sangat berguna dalam manajemen rawat inap. Memahami fitur sitomorfologinya dapat sangat membantu dalam diferensiasi dini dari neoplasma maksilofasial lainnya. Laporan kasus ini bertujuan untuk menggambarkan tampilan ameloblastoma pada FNAB dan mengungkap kontribusi pemeriksaan FNAB dalam*

diagnosis pra operasi ameloblastoma sehingga pembedahan yang memadai dapat dilakukan dan hasilnya lebih optimal. ***Laporan kasus:*** *Kami melaporkan kasus tumor mandibula pada seorang pria berusia 16 tahun dengan diagnosis tumor mandibula kanan. Pasien dirujuk untuk menjalani FNAB di laboratorium patologi anatomi. Pemeriksaan sitologi pra operasi menunjukkan lesi odontogenik jinak yang mengindikasikan ameloblastoma dari FNAB. Selanjutnya, pasien direseksi tumor dan dilakukan pemeriksaan histopatologi jaringan dengan hasil yang konsisten dengan ameloblastoma.* ***Diskusi****: Prosedur FNAB dapat dilakukan untuk menegakkan diagnosis ameloblastoma pra-operasi. Karakteristik sitologi ameloblastoma meliputi sel-sel basaloid atau sel-sel epitel yang menyerupai ameloblas dengan inti yang tersusun seperti palisade di tepi dan di tengah terdiri dari sel-sel yang menyerupai sel-sel retikulum stelata. Hasil negatif palsu pada prosedur FNAB dapat terjadi karena spesimen yang tidak memadai atau pengambilan sampel yang tidak akurat, yang sebagian besar berkaitan dengan tumor kistik. Untuk menghindari hal ini, pengambilan sampel jaringan FNAB dapat dilakukan di beberapa lokasi dan aspek tumor yang lebih dalam dapat membantu menegakkan diagnosis pra-operasi yang akurat.* ***Kesimpulan****: Sitologi FNAB merupakan prosedur yang andal untuk diagnosis praoperatif ameloblastoma. Diagnosis praoperatif ameloblastoma dapat digunakan untuk perencanaan terapi dan diagnosis dini kasus rekurensi yang dapat meningkatkan kelangsungan hidup pasien. Korelasi antara temuan klinis dan radiologis dapat membantu dalam evaluasi diagnosis FNAB pada ameloblastoma.*

Kata Kunci*: Biopsi Aspirasi Jarum Halus, Ameloblastoma, Sitologi, Histopatologi*

I. INTRODUCTION

Fine Needle Aspiration Biopsy (FNAB) is a technique in which a fine needle is used to aspirate the contents of a solid or cystic lesion to produce a cellular material that is used for cytologic diagnostics. The FNAB technique is quite simple, minimally invasive with a low complication that allows rapid diagnosis, and can differentiate benign and malignant lesions with a high degree of accuracy when correlated with clinical and imaging findings. The information obtained from the FNAB procedure is useful as a guide for surgical planning, especially in large lesions and patients with systemic disorders.[1] Various lesions can be examined by FNAB, especially lesions on the surface of the body such as the jaw.

In jaw intraosseous lesions, the FNAB procedure is often used more than the incisional biopsy procedure because it minimizes trauma and allows evaluation from a different location. In intraosseous lesions, there are cellular characteristics that must be observed for accurate diagnosis.

Conventionally, FNAB is frequently being used for the diagnosis of salivary gland and neck swellings, and thyroid masses. The efficacy of FNAB for diagnosis and treatment planning of intra-osseous jaw pathology has not been well established in literature.[2] The diagnosis of intraosseous jaw lesions is often problematic because of their proximity to tooth apices, bone and solid parts that are difficult to aspirate with a needle. One of the most frequently found intraosseous lesions of the jaw is ameloblastoma.[1]

Ameloblastoma is the most common benign epithelial odontogenic tumor with malignant potential and is usually located in the jaw. It constitutes about 1-3% of all tumors and cysts of jaws. The incidence of about 0.5 cases per million population. The peak incidence is diagnosed in the fourth to fifth decade of life with an age range of 8-92 years and there is no gender predilection.[3] Ameloblastoma often presents as a slowly growing, painless, swelling causing perforation of buccal bone along with infiltration of surrounding soft tissue. This entity has a very high recurrence rate of over 50% even after wide excision.[3,4]

Preoperative diagnosis of ameloblastoma can be made by FNAB which is used as a guide for surgical planning therefore the treatment taken on the patient are more optimal and focused.[1,5] Microscopically ameloblastoma shows a cohesive group of basaloid epithelial cells with palisading margins and polygonal squamous cells.[1]

Sometimes, aspiration from cystic ameloblastoma may have a paucy of characteristic basaloid cells, the presence of polymorphs and foamy macrophages which leads to difficulty in diagnosis. In this case, ameloblastoma should be differentiated from other benign cystic lesions of the jaw including odontogenic keratocysts and dentigerous cyst. Odontogenic keratocysts show anucleate and nucleate squamous cells having central pyknotic nuclei in keratinous background. Dentigerous cysts provide straw-colored fluid containing few squamous cells and foamy macrophages. The trimodal populations of basaloid, stellate, and squamous cells are characteristic to differentiate ameloblastoma from these cysts. To obtain a cellular smear, we must aspirate from the more fragile lesion area and thinned bone under radiological guidance and it is stated in the literature that it is possible to aspirate from several lesion areas.[6]

The FNAB can offer the clinician a conservative alternative to the more invasive procedures such as open biopsy, if a proper correlation with clinico-radiological findings is done. Okoh Ds et al. conducted a study to determine the sensitivity, specificity, and accuracy of FNAB in the preoperative assessment of ameloblastoma. The author

compared the cytopathological and histopathological features so that the sensitivity, specificity, and accuracy of FNAB in the diagnosis of ameloblastoma can be determined. From this study, the sensitivity was 88.9%, specificity 100%, and accuracy 88.9%.[7]

The correlation of clinical-imaging findings helps in the evaluation of diagnosis FNAB. The FNAB procedure provides a simple, inexpensive, fast, and reliable preoperative diagnosis of ameloblastoma. It can provide an early evaluation of the lesion, avoid unnecessary surgical biopsies and ensure adequate surgical excision in a planned manner.[5]

Literature on the cytomorphology of ameloblastoma in FNAB is still limited, so that this case report is expected to provide an understanding of the cytological feature of ameloblastoma and differentiate it from other benign odontogenic lesions, thereby providing an accurate preoperative diagnosis. Diagnosis of ameloblastoma from cytology is challenging due to many pitfalls and differential diagnosis with other odontogenic lesions, but proper sampling and accurate diagnosis are very useful inpatient management.[1,5]

This case report aims to describe the appearance of ameloblastoma on FNAB and reveal the contribution of the FNAB examination in the preoperative diagnosis of ameloblastoma because although this tumor is benign, it has aggressive behavior.[4]

We report a case of a tumor in the mandible of a 16-year-old man with a preoperative diagnosis of ameloblastoma from FNAB. Cytological examination of FNAB was confirmed by histopathological preparation of tumor tissue.

II. CASE REPORT

A 16-year-old male patient presented to the oral surgery polyclinic, Universitas Andalas Hospital, Padang on April 1, 2024. The patient's chief complaint of swelling, painless over the right side of the mandible for 6 months, and progressive increasing swelling, sometimes pain the last 2 months. The patient was diagnosed with right mandible tumor and FNAB procedure was recommended for the swelling. The patient underwent FNAB procedure for the swelling at the Anatomical Pathology Laboratory of Universitas Andalas Hospital.

History of present illness, swelling in the right side of the mandible with progressive increasing, and pain the last 2 months before going to the oral surgery polyclinic. There is no history of fever, cough, headache, and difficulty swallowing.

There is no history of similar swelling in the family. The patient underwent panoramic xray with the results of a radiolucent lesion on the right mandibular bone with cortical thinning (Figure 1).

FIGURE 1. A RADIOLUCENT LESION ON THE RIGHT MANDIBULAR BONE WITH CORTICAL THINNING (↑).

Physical examination revealed a swelling in the right side of the mandible measuring 5x4x3 cm, firm, fixed, and the overlying skin was normal. The patient's consciousness is composmentis cooperative. Informed consent for the FNAB procedure was performed. The bloody aspirated material, approximately volume 0.4 ml, was smeared on four slides. The air-dried smears were

stained with may-Grunwald-Giemsa and alcohol-fixed smears with Hematoxylin-Eosin stain.

On microscopic cytologic, the smears showed the cellular smear consisting of cohesive clusters of basaloid tumor cells which are round to oval with dense chromatin, and slightly monomorphic nuclei. Compact and cohesive cell clusters with short tumor cell branching areas and palisading cells along the periphery. The lymphocytes and polymorphonuclear leucocytes are also found in the background. Based on the following cytological features consistent with the diagnosis of benign odontogenic tumour suggestive ameloblastoma (Figure 2 &3). Histopathological examination of tumor tissue is required to confirm the diagnosis.

On April 16, 2024, the patient was planned for surgical removal of the mandibular tumor and underwent a complete blood count laboratory examination and posteroanterior chest X-ray as preparation for surgery.

Complete blood laboratory examination showed Hb: 15.1 g/dl, hematocrit: 43.5%, leukocytes: 5.900/mm3, platelets: 284.000/mm3. Hemostasis: PT: 8.9; APTT: 21.8; SGOT: 18 U/L, SGPT: 14 U/L; urea: 21.7 mg/dL; creatinine: 0.6 mg/dL; blood sugar level: 97 mg/dL.

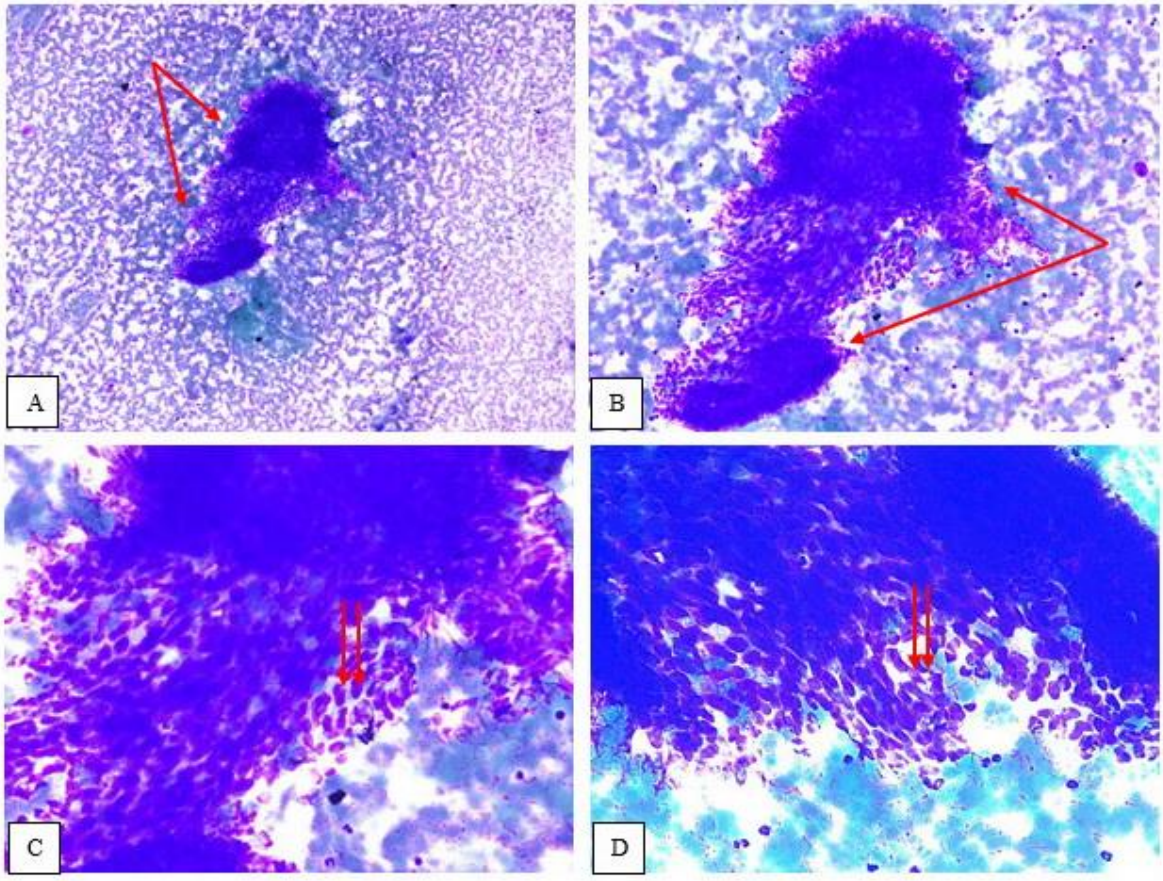

FIGURE 2. FNAB CYTOLOGY EXAMINATION IN MAY GRUNWALD GIEMSA STAINING. THE SMEARS SHOWED COMPACT AND COHESIVE CELL CLUSTERS WITH SHORT TUMOR CELL BRANCHING AREAS. (A: OBJ 100X, B: OBJ 200X) (↑). THE CELLULAR SMEAR CONSISTING OF COHESIVE CLUSTERS OF BASALOID TUMOR CELLS WHICH ARE ROUND TO OVAL WITH DENSE CHROMATIN, AND SLIGHTLY MONOMORPHIC NUCLEI. (C&D: OBJ 400X)(↑↑)

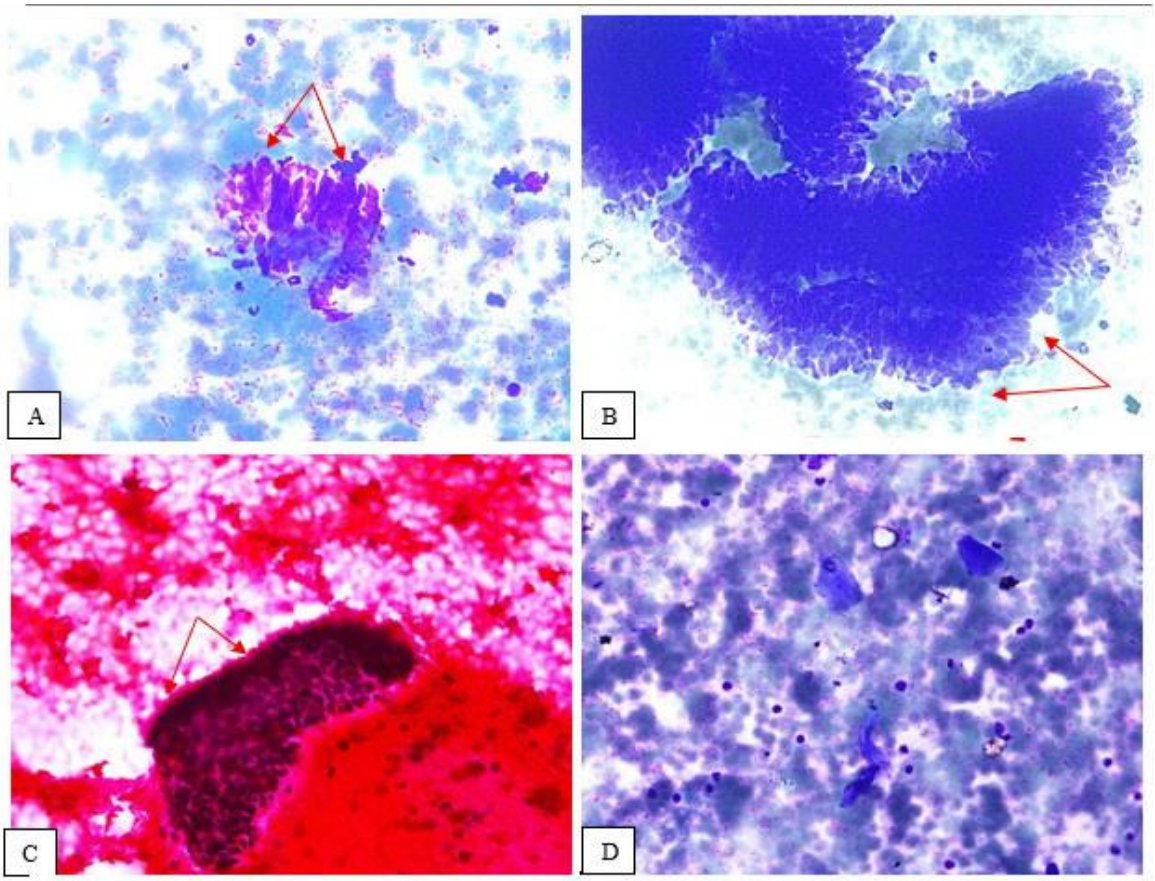

FIGURE 3. THE CLUSTERS OF BASALOID CELLS WITH PERIPHERAL PALISADING (A & B : OBJ 400X IN MAY GRUNWALD GIEMSA STAINING) (C : OBJ 400X IN HAEMATOXYLIN EOSIN STAINING) (↑). SEVERAL SQUAMOUS EPITHELIAL CELLS, LYMPHOCYTE, POLYMORPHONUCLEAR LEUCOCYTE DISTRIBUTION IN THE BACKGROUND (D: OBJ 400X)

On April 19, 2024, right mandibular marginal resection was performed. Right mandibular tumor tissue was sent to the Anatomical Pathology Laboratory, Universitas Andalas hospital for histopathological examination. The specimen was labeled.

On macroscopic examination of the mandibular tumor tissue (Figure 4) showed tissue that is partly in the form of sheets, brownish white, elastic, and bone-like structure and 2 teeth measuring 6x5x3 cm. The cross section shows a brownish white mass with a diameter of 2-5 cm.

On microscopic examination revealed connective tissue stroma containing the proliferation of odontogenic cells forming plexiform structure and islands with the edges lined with columnar epithelium arranged in palisading with reverse polarity (figure 5 A-D). The stellate reticulum cells are arranged in the middle layer. There are some cells with formation cyst, and bone trabecula also found. The histopathological diagnosis is conventional ameloblastoma (9310/0).

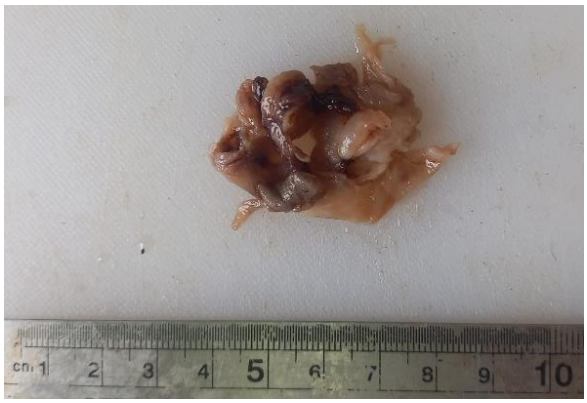

FIGURE 4. MACROSCOPIC EXAMINATION SHOWED TISSUE THAT IS PARTLY IN THE FORM OF SHEETS, BROWNISH WHITE, ELASTIC.

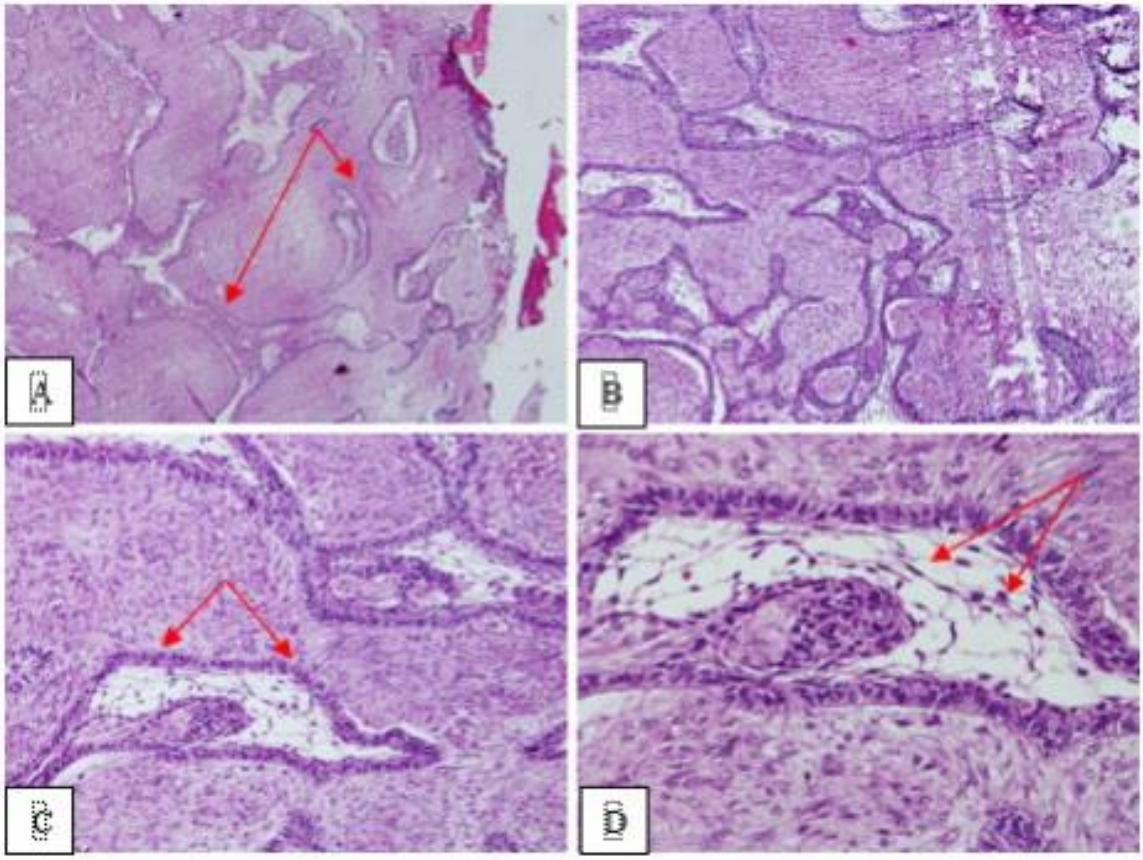

FIGURE 5. MICROSCOPIC APPEARANCE IN HAEMATOXYLIN EOSIN. THE MICROSCOPIC EXAMINATIN SHOWED THE PROLIFERATION OF ODONTOGENIC CELLS THAT FORM PLEXIFORM STRUCTURES AND ISLANDS (A:40X) (↑) AND THE CELLS ARE ARRANGED IN PALISADE AT THE PERIPHERY (B:100X, C:200X) (↑). CELLS SHOW REVERSE POLARIZATION AWAY FROM BASEMENT MEMBRANE AND SUPRABASAL CELLS WITH A LOOSE, NETWORK-LIKE ARRANGEMENT, RECAPITULATING STELLATE RETICULUM FORMATION (D: 400X)(↑).

The patient was treated for 5 days post-surgery in stable condition. The patient was discharged on April 26, 2024, and controlled to the surgical the oral surgery polyclinic. Based on follow-up on Mei 2024, the patient has no difficulty speaking, no pain, and swelling at the post-surgical site.

III. DISCUSSION

Ameloblastoma is the most common benign odontogenic tumor arising from odontogenic epithelium. They are locally aggressive epithelial odontogenic neoplasm. The patient presents with swelling in the mandibular region, slowly growing, painless, often progressive increasing swelling that can be destructive and multilocular. Ariba Zaidi et al. reported two cases of ameloblastoma in which the patient presents with swelling in the jaw from 2 years to 5 years.[5,8] In this case the patient presents with painless swelling in the mandibular region since 6 months ago. The swelling is slowly growing, and progressive increasing swelling over the last two months.

Odontogenic tumors derived from epithelial, ectomesenchyme, and mesenchymal elements of the tooth-forming apparatus, constitute a heterogenous group of lesions exclusively found within the jaw bones. It may arise from remnants of tooth-forming components, such as rests of dental lamina, developing enamel organ, and the epithelial lining of odontogenic (dentigerous) cysts, or possibly from the basal epithelial cells of the oral mucosa.[5,8,9,10]

Ameloblastoma usually occurs in the third to fifth decades of life with a peak in the fourth decade. In developing countries, the incidence is reported at a younger age.[4] The patient in this case has no history odontogenic lesion and a young man.

The genetic and molecular features of ameloblastomas are still poorly understood. As ameloblastoma is characterized by slow growth, its development may initiate in childhood. The similarities between these odontogenic tumors and the tissues found under tooth development in childhood make it difficult to distinguish them histologically. Therefore, a better understanding of the histological structures during tooth development is warranted. The fact that the posterior end of the dental lamina proliferates continuously, and that aberrant tooth germs most often are found in this region has been proposed as the statement for why ameloblastoma occurs most frequently at the angle of the mandible. This also may explain the high incidence of ameloblastoma associated with impacted lower third molar, as this region receives the significant irritation.[10,11] The stimuli and specific kind of irritation, that cause developmental epithelium to develop into ameloblastoma, demands futher investigation, as these may be the direct cause of the neoplasm. According to this case, there is a tumor in the right mandible below the 3rd molar and there is an impacted tooth in the patient. This is a risk factor for ameloblastoma in patients.

The gene expression profiling, in order to identify the candidate genes that may involved in the origination of ameloblastoma, meeds to be further studied. The expression of the genes, in relation to human tooth development, requires also further investigation.[11]

Most cases of ameloblastoma are asymptomatic and are found on radiological examination. Radiographic characteristics of ameloblastoma generally show radiolucent, unilocular, or multilocular cystic lesions with a “bubble soap” appearance, cortical thinning or destruction, local invasion, and root resorption. The CT scan showed cortical damage and soft tissue involvement due to tumor cell infiltration, especially in the cancellous portion of the bone cortex.[12] The patient in this case underwent panoramic imaging with a radiolusent lesion on the right mandibular bone with cortical thinning.

Ameloblastoma has a high recurrence rate after surgery (up to 50% of cases) and is therefore placed in the borderline tumor category rather than the benign tumor category. Long-term follow-up is required in ameloblastoma patients who have undergone surgery.[5] The research by Ling Bi et al reported patient under 50 years old has high recurrence of ameloblastoma than patient over 50 years old. Maxilla origin ameloblastoma had a higher tendency to relapse because tumor cells colud extend beyond the radiographic margin in cancellous bone at an average of 4,5 mm, even up to 8 mm. Since the cotical bone of maxilla is thinner than mandible. It is easier for tumor cells to infiltrate into cortical bone and even earlier to extend into adjacent soft tissue.[12,13]

The FNAB procedure can be performed to establish for a pre-operative diagnosis of ameloblastoma. Ameloblastoma is destructive, inherently making it easier to penetrate the needle during a FNAB procedure. In daily practice, ameloblastoma are rarely aspirated and their cytologic findings are still poorly documented in the literature.[7]

Cytological characteristics of ameloblastoma include basaloid cells or epithelial cells resembling ameloblasts with nuclei arranged palisade at the periphery and in the middle consisting of cells resembling stellate reticulum cells. The presence of squamous differentiation can be seen and this finding

was reported by Ariba Zaldi et al and Gupta et al.[8,14]

On FNAB cytology examination in this case, a cellular smear consisting of scattered and clustered epithelial cells with round-oval nuclei, slightly monomorphic, hyperchromatic. There was an infiltration of lymphocytes and PMN leukocytes. The microscopic appearance can be found in ameloblastoma and confirmed by histopathological examination of tumor tissue diagnosed as ameloblastoma.

Ameloblastoma does not grow as a uniform solid mass but contains several cystic spaces so that the FNAB procedure has the advantage of being an additional pre-operative diagnostic tool in cases of ameloblastoma, sampling can be done in many places and deeper aspects of the tumor can be sampled which can help in a more accurate diagnosis. This is difficult to do in the incision biopsy.[5,15]

False-negative results in the FNAB procedure can occur due to inadequate specimens or inaccurate sampling, mostly related to cystic tumors. To avoid this, FNAB tissue sampling can be performed at multiple sites and the deeper aspects of the tumor can assist in establishing an accurate preoperative diagnosis.[5]

Research conducted by Okoh et al. suggested that the cytological diagnosis of ameloblastoma from FNAB specimens consisted of benign basaloid cells. This is correlated with research by Shiram Kaliamooorthy et al. in 15 cases of ameloblastoma diagnosed from FNAB confirmed by histopathological examination of tumor tissue with a diagnosis of ameloblastoma. In this study, the results showed that the sensitivity of FNAB in the diagnosis of ameloblastoma was 86.6% which was in accordance with the study conducted by Gunhan O with a sensitivity of 100% and the study of Ucok et al. with a sensitivity of 93.5%. The research of Shiram Kaliamoorthy et al. also suggested that none of the false-positive intraosseous jaw lesions were diagnosed as ameloblastoma with FNAB. Therefore, the specificity of FNAB in diagnosing ameloblastoma was found to be 100%.[5,15]

Ameloblastoma can be distinguished from other basaloid cell tumors involving the jaw and other odontogenic tumors by clinical correlation. Ameloblastomas can occur in early adolescence with radiographically appearing as a well-defined radiolucent mass usually associated with malpositioned and unerupted teeth, most of which arise in the posterior mandible.[4]

Ameloblastoma recurs if inadequately removed. The standard of care is complete excision with negative margins, irrespective of the histopathological subtype. This requires removal of a bone margin of ≥ 10 mm beyond the radiographic margin to ensure removal of Ameloblastoma permeating medullary bone, usually by a segmental resection, mandibulectomy, or maxillectomy, depending on size. More conservative surgery has a high recurrence rate (60–80%), and long follow-up (1–2 decades) is mandatory.[3]

The correlation of clinicopathological, radiological findings can assist in evaluating the diagnosis of FNAB ameloblastoma and ruling out the differential diagnosis. Preoperative cytopathological diagnosis of ameloblastoma can be used for surgical planning and early diagnosis of recurrence cases. Early diagnosis of ameloblastoma cases can improve patient survival rates.[5]

IV. CONCLUSION

The fine needle aspiration biopsy cytology is a reliable procedure for the pre-operative diagnosis of ameloblastoma. Pre-operative diagnosis of ameloblastoma can be used for planning therapy and early diagnosis of

recurrence cases that can improve patient survival.

The fine needle aspiration biopsy procedure is a simple, safe, inexpensive, and minimally invasive procedure for the pre-operative diagnosis of ameloblastoma. It can reduce the limited incisional biopsy. However, the FNAB procedure is still rarely performed as an aid in establishing the diagnosis of lesions in the jaw, so there is little literature on FNAB in ameloblastoma.

The author hopes that this case report can be one of the descriptions of the cytopathological examination of ameloblastoma with the FNAB procedure. The correlation between the clinicopathological and radiological findings can assist in the evaluation of the diagnosis of FNAB in ameloblastoma.

REFERENCE

[1]. Pilati SFM, dos Santos N, Melo G, Mello FW, Rivero ERC. Diagnostic capability of fine-needle aspiration cytology in assessment of intraosseous lesions of the jaws: A systematic review. Diagn Cytopathol. 2020;48(5):430–9.

[2]. Goyal S, Sharma S, Kotru M, Gupta N. Role of FNAC in the diagnosis of intraosseous jaw lesions. Med Oral Patol Oral y Cir Bucal. 2015;20(3):e284–91.

[3]. Kleihues P, Eds CWK. World Health Organization Classification of Head and Neck Tumours [Internet]. 5th ed; vol.9. 2023

[4]. Bijwe S, Chopwad A. Case Report - Fine Needle Aspiration Cytology of Ameloblastoma. IOSR J Dent Med Sci. 2018;17(01):75–8.

[5]. Mitra P V, Raju K, Murthy PS. Cytology Diagnosis of Multilocular Ameloblastoma of the Mandible: A Case Report. Ann Pathol Lab Med. 2019;6(2):C12-15.

[6]. Raut AGSNDSPS. Fine-needle aspiration cytology as a useful diagnostic. Natl J Maxillofac Surg. 2018;

[7]. DS O, OF O, M O, Ojo M. The Role of fine Needle aspiration Cytology in the Pre-operative Assessment of Ameloblastoma: A preliminary Study. Afr J Oral Maxillofac Path Med. 2020;6(1):21–8.

[8]. Zaidi A, Srinivasan R, Rajwanshi A, Dey P, Gupta K. Ameloblastoma diagnosis by fine-needle aspiration cytology supplemented by cell block samples. Diagn Cytopathol. 2021;49(3): E93–8.

[9]. Bhuyan L, Nishat R, Behura SS, Mahapatra N, Kumar H. Insight into the molecular pathogenesis of odontogenic lesions. J Oral Biosci [Internet]. 2021;63(1):35–44. Available from: https://doi.org/10.1016/j.job.2020.12.001

[10]. Hendra FN, Van Cann EM, Helder MN, Ruslin M, de Visscher JG, Forouzanfar T, et al. Global incidence and profile of ameloblastoma: A systematic review and meta-analysis. Oral Dis. 2020;26(1):12–21.

[11]. Sehic A. Understanding ameloblastomas through tooth development. J Dent Oral Care. 2015;1(4).

[12]. Aloua R, Opoko U, Kerdoud O, Regragui M, Karkouri M, Slimani F. A Rare Presentation of an Acanthomatous Ameloblastoma of Mandibular Ramus: Case Report. Oral Maxillofac Surg Cases [Internet]. 2021;7(3):100223. Available from: https://doi.org/10.1016/j.omsc.2021.100223

[13]. Bi L, Wei D, Hong D, Wang J, Qian K, Wang H, et al. A retrospective study of 158 cases on the risk factors for recurrence in ameloblastoma. Int J Med Sci. 2021;18(14):3326–32.

[1]. Raut AGSNDSPS. Fine-needle aspiration cytology as a useful diagnostic. Natl J Maxillofac Surg. 2018;

[2]. Anggraini, D., Hasni, D., & Amelia, R. (2022). Pathogenesis of sepsis. Scientific Journal, 1(4), 334-341.

[14]. Kaliamoorthy S, Venkatapathy R, Babu P, Veeran V. Practical significance of utilizing fine needle aspiration cytology as an adjunct diagnostic aid in the preoperative presumptive diagnosis of ameloblastoma. J Cytol. 2013;30(4):247–51.