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Synovial Mysteries: A Histopathological Insight Into Joint Lesions

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ABSTRACT

Introduction: Synovial lesions include inflammatory, infectious, degenerative, crystal-induced, and neoplastic types. Tissue samples are obtained via blind needle or ultrasound-guided biopsy. Advances in imaging, arthroscopy, and histopathology have improved diagnosis and classification, enabling tailored treatments. We hereby evaluated the histopathological spectrum of synovial lesions through retrospective analysis of synovial biopsy samples, and to correlate the findings with clinical parameters such as age, gender, and joint involvement for improved diagnostic categorization and clinical management.

Materials and Methods: This retrospective study analyzed 100 synovial biopsies received between January 2016 and December 2020 at Vinayaka Mission Kirupananda Variyar Medical College, Salem. Clinical and radiological data were reviewed, and inclusion/exclusion criteria applied. Biopsies were fixed in 10% buffered formalin, processed, sectioned at 2 microns, and stained with Hematoxylin and Eosin; two cases were also stained with Ziehl-Neelsen for AFB. Lesions were histologically classified into inflammatory, degenerative (including crystal-induced), tumor-like lesions, and tumors.

Results: Among 90 synovial biopsy cases, inflammatory conditions were most common—non-specific synovitis (18.8%) and bursitis (16.6%)—followed by rheumatoid arthritis (11.1%), septic arthritis (5.5%), tuberculosis (2.2%), and gout (4.4%). Tumor-like lesions included ganglion cysts (26.6%) and synovial lipomatosis (3.3%), while neoplasms comprised synovial chondromatosis (4.4%) and giant cell tumors (2.2%). Loose bodies were seen in 4.4%. Females showed higher rates of non-specific synovitis, bursitis, and rheumatoid arthritis, while males had more septic arthritis, tuberculosis, gout, and synovial chondromatosis. Ganglion cysts were more common in females. Inflammatory conditions spanned a wide age range. Degenerative diseases and synovial lipomatosis affected older adults, while ganglion cysts and giant cell tumors were seen in younger individuals. The hip joint was mainly affected by chronic synovitis; the knee was commonly involved in most other conditions. Rheumatoid arthritis affected small hand joints, gout the big toe, and ganglion cysts the wrists.

Conclusion: Early detection of inflammatory conditions enables effective anti-inflammatory treatment, preventing irreversible joint damage and surgery. Accurate diagnosis of rare crystal-induced lesions avoids unnecessary treatments. Early identification of neoplastic lesions can limit surgery to simple excision. Understanding common synovial lesions and their correlation with age, gender, and site is essential for proper diagnosis.

KEYWORDS: Synovial tissue; Histopathological examination; Chronic non-specific inflammation; Tuberculous synovitis; Degenerative osteoarthritis.

INTRODUCTION

Synovium is a specialized connective tissue that lines the joint spaces, tendon sheath and bursa. It produces synovial fluid for lubrication of joints. It plays an important role in transporting nutrients into the joint and removing metabolic waste products. The synovium has 2 layers: Intima- inner lining layer which produce synovial fluid, subintima that contains blood vessels and connective tissue.[1,2]

Synovial lesions encompass a diverse group of pathological conditions affecting the synovium, tendon sheath and bursa. [3] The lesions can be classified into inflammatory, infectious, degenerative, crystal induced and neoplastic. The tissue may be obtained using blind needle technique or under ultrasound guidance. [4,5]

Advances in imaging, arthroscopy and histopathology with special stains have significantly improve the diagnosis and classification of synovial lesions aiding in tailored therapeutic approaches. [6,7] This paper provides comprehensive overview of pathological spectrum of synovial lesions.

Materials and Methods

This is a retrospective analysis of a total of 100 synovial biopsies received between January 2016 to Dec 2020 at a Vinayaka Mission Kirupananda Variyar Medical College Salem. Relevant clinical and radiological details were obtained. Inclusion and exclusion criteria were applied. All the biopsies were received in 10% buffered neutral formalin. They were processed and sections were cut at 2 microns thickness and stained using Hematoxylin and Eosin. 2 cases were stained with Ziehl Nielson stain for AFB. The lesions were classified based on histomorphological features into inflammatory joint diseases, degenerative joint diseases including crystal induced diseases, tumour like lesions and tumours.

RESULTS:

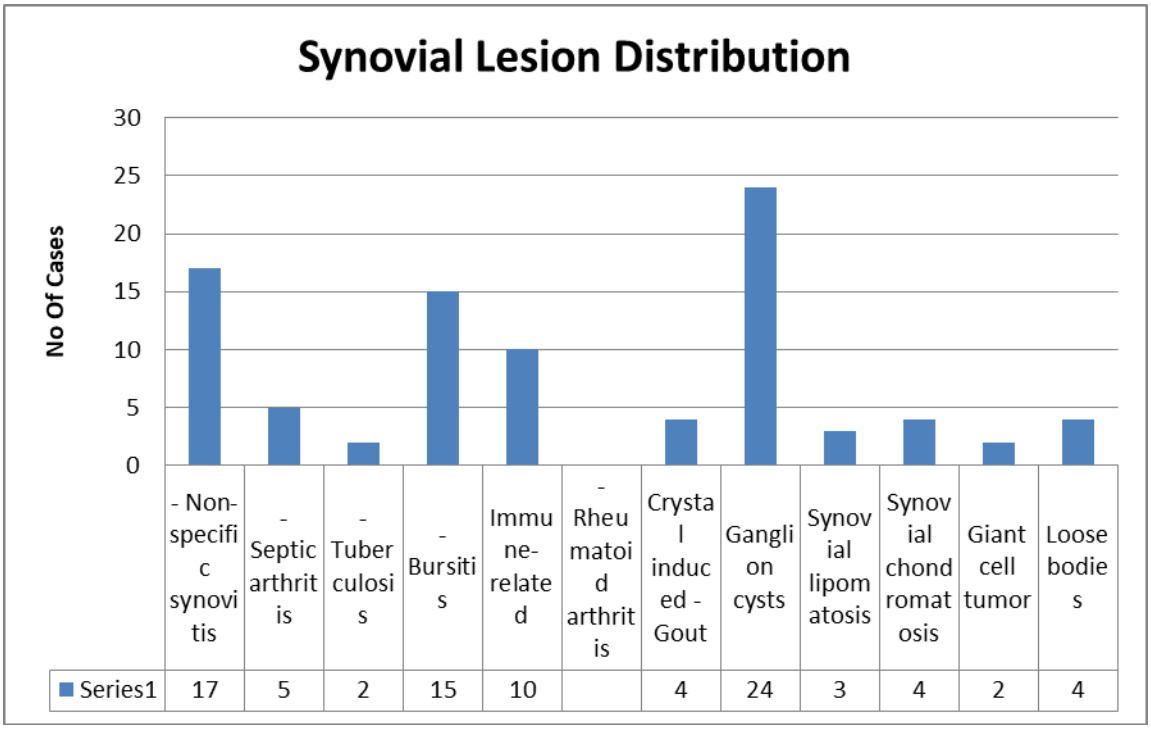
SYNOVIAL LESION DISTRIBUTION

A total of 90 cases were categorized into various joint lesion types. Inflammatory diseases accounted for a significant portion, with non-specific synovitis being the most common (17 cases, 18.8%), followed by bursitis (15 cases, 16.6%), septic arthritis (5 cases, 5.5%), and tuberculosis (2 cases, 2.2%). Immune-related conditions included rheumatoid arthritis (10 cases, 11.1%), while crystal-induced gout was seen in 4 cases (4.4%). Tumor-like lesions were led by ganglion cysts (24 cases, 26.6%) and synovial lipomatosis (3 cases, 3.3%). Among neoplasms, synovial chondromatosis was observed in 4 cases (4.4%) and giant cell tumors in 2 cases (2.2%). Additionally, 4 cases (4.4%) involved loose bodies categorized under miscellaneous conditions.

Table.1: Synovial Lesion Distribution

Lesion Category	Disease Subcategory	Cases	%
Inflammatory diseases	- Non-specific synovitis	17	18.8%
	- Septic arthritis	5	5.5%
	- Tuberculosis	2	2.2%
	- Bursitis	15	16.6%
	Immune-related - Rheumatoid arthritis	10	11.1%
	Crystal induced - Gout	4	4.4%
Tumor-like	Ganglion cysts	24	26.6%
	Synovial lipomatosis	3	3.3%
Neoplasms	Synovial chondromatosis	4	4.4%
	Giant cell tumor	2	2.2%
Others	Loose bodies	4	4.4%

Figure 1: Synovial Lesion Distribution



Gender-Based Disease Distribution

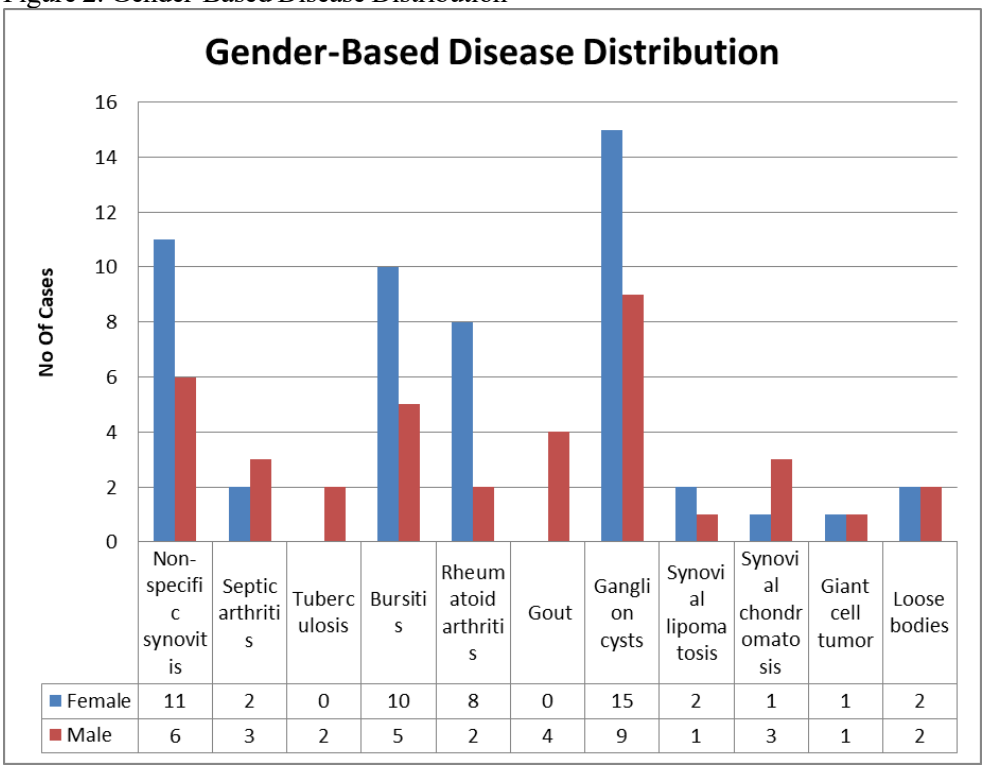
Among the 90 cases (52 females, 38 males), inflammatory conditions were more common in females, with higher rates of non-specific synovitis (21.1% vs. 15.7%), bursitis (19.2% vs. 13.1%), and rheumatoid arthritis (15.3% vs. 5.2%). Males had slightly more septic arthritis (7.8% vs. 3.8%) and all tuberculosis (5.2%) and gout (10.5%) cases. Tumor-like lesions, especially ganglion cysts, were more frequent in females (28.8% vs. 23.6%). Synovial lipomatosis was slightly more common in females (3.8% vs. 2.6%). Among neoplasms, synovial chondromatosis was more prevalent in males (7.8% vs. 1.9%), while giant cell tumors showed similar rates (1.9% in females vs. 2.6% in males). Loose bodies were slightly more common in males (5.2% vs. 3.8%).

Table.2: Gender-Based Disease Distribution

Disease Category	Female (n=52)	Male (n=38)
Inflammatory		
Non-specific synovitis	11(21.1%)	6(15.7%)
Septic arthritis	2(3.8%)	3(7.8%)
Tuberculosis	0 (0%)	2 (5.2%)
Bursitis	10 (19.2%)	5 (13.1%)
Rheumatoid arthritis	8 (15.3%)	2 (5.2%)
Degenerative		
Gout	0 (0%)	4 (10.5%)
Tumor-like		
Ganglion cysts	15(28.8%)	9 (23.6%)
Synovial lipomatosis	2 (3.8%)	1 (2.6%)
Neoplasms		

Disease Category	Female (n=52)	Male (n=38)
Synovial chondromatosis	1 (1.9%)	3 (7.8%)
Giant cell tumor	1 (1.9%)	1 (2.6%)
Others		
Loose bodies	2(3.8%)	2(5.2%)

Figure 2: Gender-Based Disease Distribution



Age Distribution Of Synovial Lesions

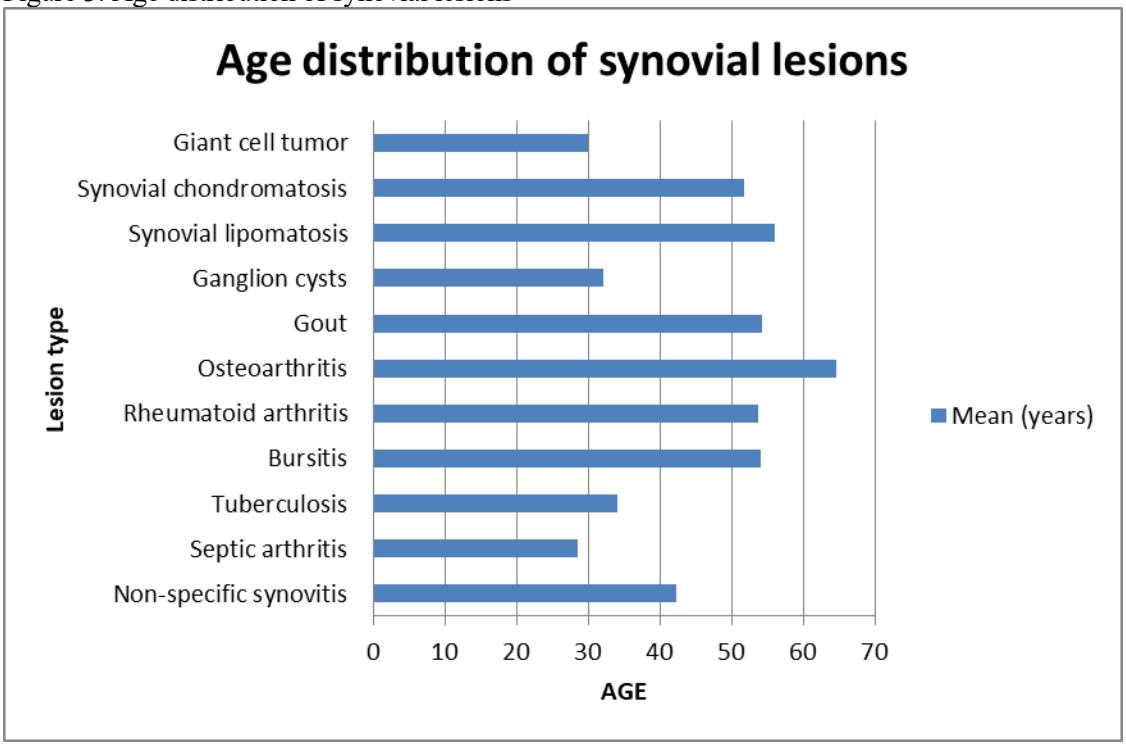
The age distribution of joint diseases showed clear patterns. Inflammatory conditions spanned a wide age range: non-specific synovitis (mean 42.3 years), septic arthritis (28.5), tuberculosis (34.0), bursitis (54.1), and rheumatoid arthritis (53.6). Degenerative diseases affected older adults—osteoarthritis (64.5) and gout (54.3). Tumor-like lesions varied: ganglion cysts appeared in younger individuals (32.1), while synovial lipomatosis occurred in older patients (56.0). Neoplasms also differed by age—synovial chondromatosis was seen around 51.8 years, while giant cell tumors occurred in younger patients (30.0).

Table.3: Age distribution of synovial lesions

Disease Category	Mean ± SD (years)	Range
Inflammatory		
Non-specific synovitis	42.3 ± 12.4	25-66
Septic arthritis	28.5 ± 16.2	6-47
Tuberculosis	34.0+/-6.0	28-40
Bursitis	54.1 ± 14.3	33-85

Disease Category	Mean ± SD (years)	Range
Rheumatoid arthritis	53.6 ± 12.8	24-76
Degenerative		
Osteoarthritis	64.5 ± 8.5	53-77
Gout	54.3 ± 8.9	45-68
Tumor-like		
Ganglion cysts	32.1 ± 14.6	6-62
Synovial lipomatosis	56.0 ± 14.7	43-77
Neoplasms		
Synovial chondromatosis	51.8 ± 9.8	39-64
Giant cell tumor	30.0+/-5.0	25-35

Figure 3: Age distribution of synovial lesions



COMMON SITES AFFECTED

Chronic non-specific synovitis commonly involves the hip joint, while septic arthritis, tuberculous synovitis, bursitis, synovial lipomatosis, synovial chondromatosis, tenosynovial giant cell tumour, and loose bodies predominantly affect the knee joint. Rheumatoid arthritis typically targets the small joints of the fingers and wrists. Gout most often affects the big toe, whereas ganglion cysts are frequently found around the wrists.

Table 4: Common sites affected by various diseases.

DISEASES	SITES AFFECTED

Chronic non-specific synovitis	Hip joint
Septic arthritis	Knee joint
Tuberculous synovitis	Knee joint
Bursitis	Knee joint
Rheumatoid arthritis	Small joints of fingers and wrists
Gout	Big toe
Ganglion cysts	Wrists
Synovial lipomatosis	Knee joint
Synovial chondromatosis	Knee joint
Tenosynovial giant cell tumour	Knee joint
Loose bodies	Knee joint

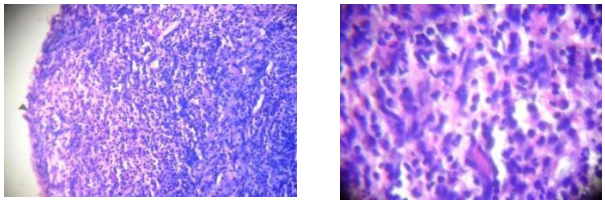


Fig.1.1: 10x and 40x Showing microscopic finding of bursitis.

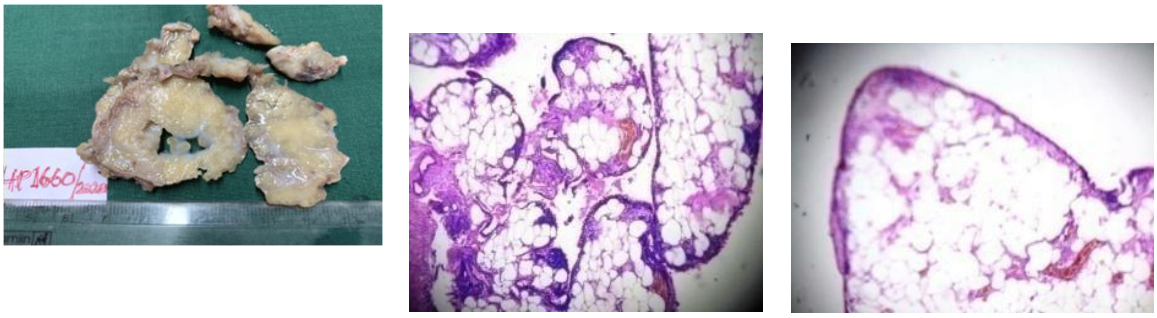


Fig.1.2: Gross and microscopic finding of synovial lipomatosis.

DISCUSSION

In our study the most common lesion of synovium was identified as ganglion cysts constituting 26.6%. Microscopy showed excised cyst like specimen without true lining epithelium having myxoid content within the lumen identified. The fibrocollagenous cyst wall showed focal area of myxoid change Incidence was found to be higher in female (28.8%). The mean age of incidence was found to be 32.1years. Among neoplasms, synovial chondromatosis was observed in 4 cases (4.4%) and giant cell tumors in 2 cases (2.2%). Similar to our study, Sharma P et al [8] states that ganglion cyst was the commonest non-neoplastic lesion while tenosynovial giant cell tumor was the commonest neoplasm (12.1%, 8/66) observed from their study on synovial lesions.In the inflammatory lesions, chronic non-specific synovitis followed by bursitis was identified to be the more common lesion accounting for 18.8% and 16.6% respectively. The inflammatory lesions were also found to be higher in females (21.1% and 19.2%). Non-specific synovitis showing features like synovial lining hyperplasia with subsynovium showing mixed inflammatory cell infiltration composed of lymphocytes, macrophages and plasma cells noted. Synovial stroma also showed increased proliferation with neovascularisation. This was found to occur between age group of 25-66years in hip joint and bursitis between 33-85years in knee joint. Mamatha.S.V.et al [9] also found the common age presentation of chronic non-specific synovitis as 32-65 years but with male preponderance (50%) in contrast to our study. In other studies

conducted by Jayanthi KJ et al [10] and Vijay PM et al [11] also showed higher incidence among adults with age ranging from 61-70years and 41-50 years. Jayanthi KJ et al [10]also found chronic non-specific synovitis as the commonest lesion accounting for 73%. This is in similar to studies conducted by Vijay PM et al [11] and Kulkarni et al [12]Cases of rheumatoid arthritis showed synovial hypertrophy in the form of villi with stroma having dense lymphoid aggregate admixed with plasma cells. Occasional areas of fibrinoid necrosis with palisading histiocytes also noted. This was found next common to chronic non-specific synovitis with incidence of 11.1%. Females found to have 15.3% of occurrence, which was higher than males. This is similar to study by Manavir Singh Tevatia et al [13]. The mean age of occurrence was 53.6years and the most common site affected was small joints of fingers.

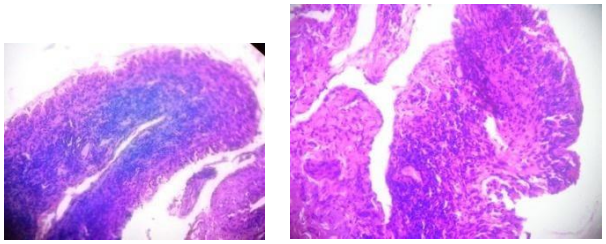


Fig.1.3: 10X and 40X showing features of rheumatoid arthritis.

Septic arthritis was found in 5.5% cases in knee joint commonly. Men had higher incidence of septic arthritis, constituting 7.8%. Septic arthritis was reported in wide age group as from 6 years to 47 years with mean age of 28.5. Similar to our study, Alexandersson H et al [14] state that from their study men were most commonly affected with 58% involvement however the median age is 71 years.

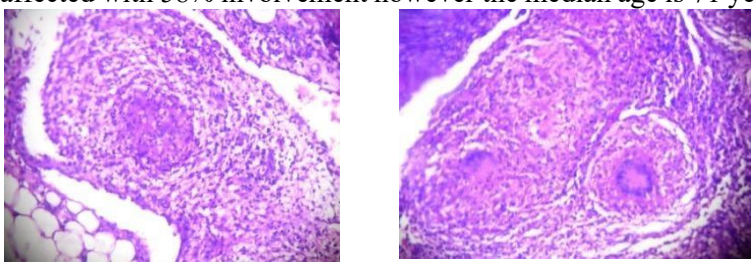


Fig.1.4: High power image showing granuloamtous reaction with langhan giant cells in tuberculous synovitis.

Tuberculous synovitis with the characteristic necrotising granulomatous reaction was found in only 2.2% of cases. 5.2% cases of males found to have tuberculous synovitis which was higher than females. Tuberculous synovitis was common in adults with mean age of 34years. This was in similar to the age group affected in a study conducted by Sant.M.S.et al [15] (11-30 years). Synovial lipomatosis was found in 3.3% having synovial hyperplasia in the form of villi with stroma of villi having mature adipocyte clusters and variable lymphocytic infiltration and synovial chondromatosis seen in 4.4% having multiple hyaline cartilaginous nodules within the synovium. Clustering of chondrocytes with increased cellularity without atypia identified. Focal areas of calcification noted. Synovial lipomatosis found higher in females for 3.8% and synovial chondromatosis was 7.8% in males. Manavir Singh Tevatia et al [13] also found mean age as 40 years and female preponderance which was in concordance with Hallel et al [16] study. But studies by Rao et al [17] and Jayanthi KJ et al [10] showed male preponderance. Synovial lipomatosis was common among 43-77years and synovial chondromatosis was among 39-64years. Both were found commonly in knee joint.4 cases of gouty arthritis with incidence of 4.4% showed multiple nodular acellular amorphous pale eosinophilic homogenous deposits surrounded by histiocytes, multinucleated giant cells and lymphocytes. The synovial lining shows villous hyperplasia. All cases seen in males around age group of 45-68 years. Similar high incidence in males and in great toe was found in Manavir Singh Tevatia et al [13] study.Neoplastic lesion was found to be rare with tenosynovial giant cell tumor to occur in 2.2% in knee joint. The lesions were circumscribed composed of mononuclear cells admixed with multinucleated giant cells, hemosiderin laden macrophages and foamy histiocytes. The mononuclear cells showed epithelioid appearance with eosinophilic cytoplasm and

eccentrically placed nucleus. No atypia or increased mitosis seen. The two cases were reported equally in males and females. This finding is similar to the findings observed in studied conducted by Jayanthi KJ et al [10], Flevas DA et al [18] and Celayir A et al [19]. Neoplastic lesion was reported between age group of 25-35years.

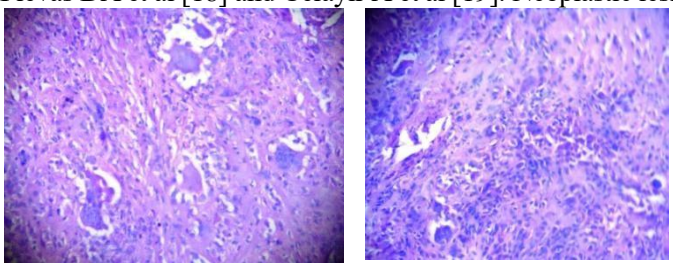


Fig.1.5: Microscopy of tenosynovial giant cell tumor showing monomorphous spindle shaped tumor cells with osteoclast giant cells.

Loose bodies which used to be found in osteoarthritis like degenerative conditions was found in 4.4% in knee joint. Both males and females reported equal incidence. Loose bodies were having areas of hyaline cartilage with enchondral ossification and central necrosis [20]

Out of 49 inflammatory synovitis case, 22 were found to have grade 1, 20 had grade 2 and 7 cases had grade 3 synovitis according to the Krenn Synovitis Score [21-27] This helps to categories the cases and treat accordingly.

CONCLUSION

Synovial lesions contribute to a significant number of debilitating diseases which could be diagnosed by histopathological examination of synovial tissue. Early diagnosis of inflammatory diseases lead to proper treatment with anti-inflammatory drugs which could avoid late stage irreversible joint damages and surgeries. Crystal induced joint damages even though rare has to be correctly diagnosed to avoid unnecessary irrelevant treatments. Neoplastic lesions when identified and diagnosed earlier can avoid major surgeries inspite of simple excision biopsies. Malignancies though rare in synovium and not reported during our study, can occur in adults requiring major surgeries and followup treatments. Idea about the commonest synovial lesions, correlation with age, gender and sites are necessary for proper diagnosis.

RECOMMENDATION

- **Routine Histopathological Evaluation:**

Synovial biopsy with histopathological examination should be routinely performed in cases of unexplained joint swelling or pain to facilitate early and accurate diagnosis of synovial lesions.

- **Use of Special Stains and Scoring Systems:**

Incorporation of special stains such as Ziehl-Neelsen for infectious cases and the Krenn Synovitis Score for grading inflammatory synovitis can enhance diagnostic precision and guide therapeutic decisions.

- **Clinical and Radiological Correlation:**

A multidisciplinary approach involving clinicians, radiologists, and pathologists is crucial to interpret synovial biopsy findings in conjunction with clinical and imaging data for appropriate management.

- **Awareness of Gender and Age Predilections:**

Considering the differences in lesion prevalence by gender and age, tailored clinical suspicion should be maintained for specific synovial conditions in respective patient groups.

- **Focus on Early Detection of Neoplastic and Infectious Lesions:**

Although rare, neoplastic and infectious synovial lesions such as giant cell tumors and tuberculosis must be promptly identified to avoid morbidity and plan effective treatment.

REFERENCES

1. Tamer TM. Hyaluronan and synovial joint: function, distribution and healing. Interdiscip Toxicol. 2013;6(3):111-125. doi:10.2478/intox-2013-0019
2. Smith MD. The normal synovium. Open Rheumatol J. 2011;5:100-106. doi:10.2174/1874312901105010100
3. Turan A, Çeltikçi P, Tufan A, Öztürk MA. Basic radiological assessment of synovial diseases: a pictorial essay. Eur J Rheumatol. 2017;4(2):166-174. doi:10.5152/eurjrheum.2015.0032
4. Sharma P, Gupta R, Bhardwaj S, Mahajan M. Cytomorphological Evaluation of Synovial Lesions in a Tertiary Care Centre in North India: A Retrospective Study. J Cytol. 2020;37(4):166-169. doi:10.4103/JOC.JOC_66_20
5. Pagani C, Coscia DR, Dellabianca C, Bonardi M, Alessi S, Calliada F. Ultrasound guided fine-needle aspiration cytology of breast lesions. J Ultrasound. 2011;14(4):182-187. doi:10.1016/j.jus.2011.10.001
6. Singhal O, Kaur V, Kalhan S, Singhal MK, Gupta A, Machave Y. Arthroscopic synovial biopsy in definitive diagnosis of joint diseases: An evaluation of efficacy and precision. Int J Appl Basic Med Res. 2012;2(2):102-106. doi:10.4103/2229-516X.106351
7. Paus AC, Refsum S, Førre O. Histopathologic changes in arthroscopic synovial biopsies before and after open synovectomy in patients with chronic inflammatory joint diseases. Scand J Rheumatol. 1990;19(3):202-208. doi:10.3109/03009749009095044
8. Essra Ali Safdar and Nida Ali Safdar (2024). Pantoprazole induced angioedema - A Case Report. *Journal of American Medical Science and Research*. DOI: https://doi.org/10.51470/AMSR.2024.03.02.15
9. Sharma P, Gupta R, Bhardwaj S, Mahajan M. Cytomorphological Evaluation of Synovial Lesions in a Tertiary Care Centre in North India: A Retrospective Study. J Cytol. 2020;37(4):166-169. doi:10.4103/JOC.JOC_66_20
10. Essra Ali Safdar and Nida Ali Safdar (2024). Mermaid Syndrome- A Systematic Review. *Journal of American Medical Science and Research*. DOI: https://doi.org/10.51470/AMSR.2024.03.02.25
11. Mamatha SV, Muralidhara. V. Clinicopathological study of inflammatory synovial lesions of the knee joint , J EVID Based Med Healthc.2015;2(59),8952-56.
12. Jayanthi KJ, Niranjan MR. Retrospective study of synovial biopsies- Tertiary centre experience IP Arch Cytol Histopathol Res. 2019;4:128-32
13. Lenmem Yosung, G Narayana Swamy, G Ramesh, Swapnil Gupta, Majid Mohiuddin (2020). Integrating Water Management, Nutrient Inputs, and Plant Density: A Holistic Review on Optimizing Cotton Yield under Variable Agroecosystems. *Plant Science Review*. DOI: https://doi.org/10.51470/PSR.2020.01.01.01
14. Vijay PM, Doddikoppad MM. Clinicopathological study of inflammatory synovial lesions Int J Bio Med Res. 2011;2:882-8
15. Vidhya, C. S., Swamy, G. N., Das, A., Noopur, K., & Vedulla, M. (2023). Cyclic Lipopeptides from Bacillus amyloliquefaciens PPL: Antifungal Mechanisms and Their Role in Controlling Pepper and Tomato Diseases. *Microbiology Archives, an International Journal*. DOI: https://doi.org/10.51470/MA.2023.5.2.1
16. Kulkarni MM, KhandeparkerSGS, Joshi AR, Patil SR, Lengare PV. Clinicopathological study of synovial biopsies at tertiary care hospital and its diagnostic utility Indian J Pathol Oncol.2017;4:595-9
17. Tevatia, Manvir Singh; Goyal, Neeti; Baranwal, Ajay Kumar; Mishra, P.S.; Gupta, Arun; Sharma, Vyom; Agarwal, Mohit; Gupta, Prashant Sen; Dangwal, Vidhu. A study to analyze the pattern of synovial lesions from synovial biopsies in a tertiary care centre. Indian Journal of Pathology and Microbiology 64(4):p 702-706, Oct–Dec 2021.
18. Alexandersson H, Dehlin M, Jin T. Increased Incidence and Clinical Features of Septic Arthritis in Patients Aged 80 Years and above: A Comparative Analysis with Younger Cohorts. Pathogens. 2024;13(10):891. Published 2024 Oct 11. doi:10.3390/pathogens13100891
19. Sant M, Bajaj H. Role of histopathology in the diagnosis of tuberculous synovitis. J Indian Med Assoc. 1992;90(10):263-264.
20. Hallel T, Lew S, Bansal M. Villous lipomatous proliferation of the synovial membrane (lipoma arborescens) J Bone Joint Surg Am.1988;70:264-70
21. Rao S, Rajkumar A, Elizabeth MJ, , Ganesan V, Kuruvilla S. Pathology of synovial lipomatosis and its clinical significance J Lab Physicians. 2011;3:84-8
22. Flevas DA, Karagiannis AA, Patsea ED, Kontogeorgakos VA, Chouliaras VT. Arthroscopic Removal of Tenosynovial Giant-Cell Tumors of the Cruciate Ligaments. Presentation of Two Cases. Journal of Orthopaedic Case Reports 2021 April, 15(04): 23-27.
23. Celayir A, Marangoz H, Göktürk Özcan G, Abdullaev N, Camurdan VB, Karaismailoglu B. A Case Report on an Uncommon Presentation of Giant Cell Tumor of the Tendon Sheath in the Infrapatellar Region. Cureus. 2025;17(3):e80918. Published 2025 Mar 20. doi:10.7759/cureus.80918
24. Surekha S, Afsanabanu Manik, Dhanoji (2023). Honeybee-Derived Honey as a Natural Arsenal Against Antibacterial and Antimicrobial Challenges. *Microbiology Archives, an International Journal*. DOI : https://doi.org/10.51470/MA.2023.5.1.1
25. Schwab A, Pap T, Krenn V, Rüther W, Lohmann C, Bertrand J. Loose Bodies Found in the Human Intra-Articular Space Showed Characteristics Similar to Endochondral Bone Formation. Cartilage. 2024;15(4):353-362. doi:10.1177/19476035231212608

26. Krenn V, Morawietz L, Häupl T, Neidel J, Petersen I, König A. Grading of chronic synovitis--a histopathological grading system for molecular and diagnostic pathology. *Pathol Res Pract*. 2002;198(5):317-325. doi:10.1078/0344-0338-5710261
27. Vidhya C. S., G Narayana Swamy, Apurba Das, Kohima Noopur, Madhavi Vedulla (2023). Cyclic Lipopeptides from *Bacillus amyloliquefaciens* PPL: Antifungal Mechanisms and Their Role in Controlling Pepper and Tomato Diseases. *Microbiology Archives, an International Journal*. 01 to 06. DOI: https://doi.org/10.51470/MA.2023.5.2.1

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