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Orthopaedic Implications of COVID-19: Investigating Avascular Necrosis of the Femoral Head

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ABSTRACT

Background: The SARS-CoV-2 pandemic has significantly impacted global health, with emerging evidence indicating potential long-term complications affecting various organ systems, including the musculoskeletal system. Avascular necrosis (AVN) of the femoral head, characterized by the death of bone tissue due to disrupted blood supply, has been increasingly reported among COVID-19 patients.

Methods: We conducted a cross-sectional retrospective study in the Department of Orthopaedics at Gandhi Medical College, Bhopal. Patients presenting with new onset hip pain, and low back pain, which was not present before COVID-19 with radiological diagnosis of AVN hip were included in the study. Data on demographics, comorbidities, steroid use, and COVID-19 management were collected and analyzed using statistical tests to identify associations between these factors and AVN incidence.

Results: A total of 86 patients met the inclusion criteria. Most participants were males (83.7%), predominantly within the 30-45 years (44.2%) and 15-30 years (30.2%) age groups. Bilateral AVN was observed in 62.8% of cases. A significant portion (25.6%) had a history of COVID-19, with 68.2% managed in the hospital. Steroid use was prevalent among 30.2% of participants. Statistically significant associations were found between COVID-19 status and age distribution (p=0.049), comorbidities (p=0.014), symptom onset (p=0.001), and steroid therapy history (p=0.002).

Conclusion: This study highlights a notable incidence of AVN among COVID-19 patients, with significant correlations to steroid use and specific comorbidities. The findings underscore the importance of vigilant monitoring for AVN in post-COVID-19 patients, particularly those with a history of steroid therapy. Early detection and intervention are crucial in managing AVN and improving patient outcomes.

Key-words: Avascular Necrosis, COVID-19, Steroid Use, Risk Factors, Retrospective Study

INTRODUCTION

The SARS-CoV-2 pandemic has had far-reaching implications beyond its primary respiratory effects, impacting various organ systems and leading to significant long-term complications. Among these complications, AVN of the femoral head has emerged as a condition of interest due to its severe impact on patients' mobility and quality of life.

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AVN is characterized by the death of bone tissue resulting from interrupted blood supply, leading to the eventual collapse of the bone structure. The prevalence of AVN varies globally, with estimates ranging from 15,000 to 20,000 new cases annually in the United States alone [1]. The incidence is higher in populations with known risk factors such as corticosteroid use, excessive alcohol consumption, and certain chronic conditions. The COVID-19 pandemic has introduced new variables, with emerging evidence suggesting that COVID-19 may exacerbate or even directly cause AVN due to factors like hypercoagulability and prolonged steroid therapy [2,3].

Drawing from the lessons learned from the 2003 SARS Epidemic, which saw a reported surge in cases of femoral

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head avascular necrosis (FHAVN) among afflicted patients, ranging from 23% to 28.8%, and primarily ascribed to the widespread use of corticosteroids for treating respiratory symptoms while also reducing the inflammatory response [4–7], some writers expressed apprehensions about the possibility of a similar outcome with the current COVID-19 pandemic [4, 7–9].

Steroid therapy has become a vital component in the management of severe COVID-19 patients due to its strong anti-inflammatory effects, especially when administered in large quantities. However, prolonged and heavy steroid usage has been linked to a known risk of avascular necrosis, mainly because of its deleterious effects on bone metabolism and vascular integrity. Therefore, the combination of COVID-19 infection and steroid therapy prompts research into how each of them contributes, either independently or in combination, to the development of avascular necrosis [10-13].

This study aims to investigate the incidence and risk factors associated with AVN in patients treated for COVID-19, focusing on potential links with steroid use and specific comorbidities.

MATERIALS AND METHODS

Study Design- Cross-sectional retrospective study.

Study Subjects- Patients who visited the Orthopaedics Outpatient Department (OPD) during the study period from July 2022 to December 2023 and met the specified inclusion and exclusion criteria were considered for the study.

Sample Size- A total of 86 cases were enrolled in the study.

Inclusion Criteria

- Patients presented with new onset hip Pain, and low back pain, which was not present before COVID-19.
- Patients with X-ray and MRI suggestive of AVN hip.
- Patients of age group 16 - 75 years.
- Individuals who gave their informed consent to take part in the research.

Exclusion Criteria

- Patients with congenital hip pathology, with metallic implants & cardiac pacemakers.
- Posttraumatic and postoperative patients.
- Age group <16 years.
- Patients not given consent for the study.
- Patient lost to follow-up

Study Procedure

- Cases were identified from the Orthopedics OPD based on symptoms and initial examination suggesting hip pathology.
- Detailed patient histories and clinical exams were conducted, including COVID-19 exposure and management history.
- X-rays (AP view) and MRIs of the hip were performed to assess bony structures, joint spaces, and soft tissues. AVN was classified using the modified Ficat and Arlet classification system.
- Patients meeting the inclusion criteria were invited to participate. Informed consent was obtained, ensuring an understanding of the study's purpose, risks, benefits, and confidentiality.
- Enrolled patients were studied for factors related to AVN of the hip, collecting data on demographics, clinical findings, and radiological results.
- The study compared AVN cases with and without a history of COVID-19 to assess any potential association between COVID-19 and AVN risk.

Data Analysis- Data analysis was done with IBM SPSS version 20. Parametric and non-parametric tests, including Chi-square, assessed associations, with a significance level set at $p<0.05$.

Ethical Clearance- Ethical clearance was obtained from the institutional ethics committee before commencing the study.

RESULTS

Most participants were within the 30-45 years age group (44.2%), followed by the 15-30 years age group (30.2%). Only a small percentage (2.3%) of participants were in the 60-75 years age group (Table 1).

Table 1: Age Group Distribution

Age Group	Frequency	Percentage (%)
15-30	26	30.2
30-45	38	44.2
45-60	20	23.3
60-75	2	2.3

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The study participants are predominantly male (83.7%), with females constituting only 16.3% of the participants (Fig. 1).

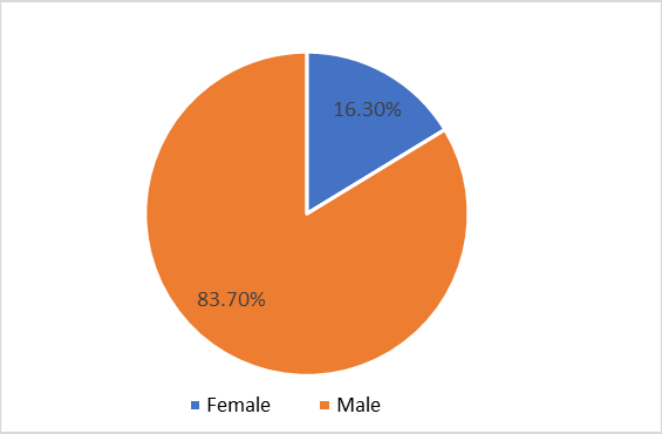

Fig. 1: Gender Distribution

Most participants (74.4%) were non-COVID patients, while 25.6% were post-COVID patients (Fig. 2).

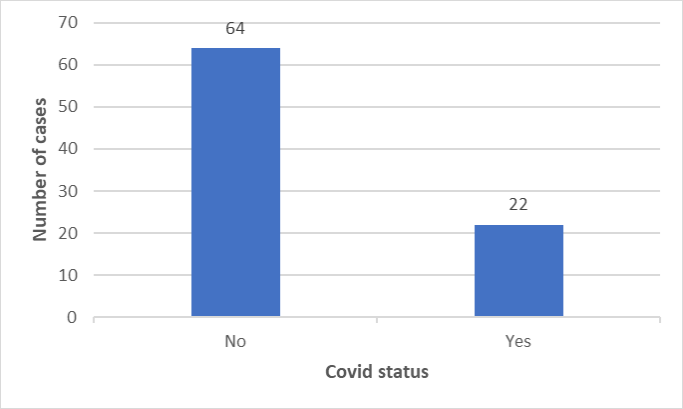

Fig. 2: COVID-19 Status Distribution

Bilateral AVN was observed in 62.8% of the cases, with similar distributions in both non-COVID (62.5%) and post-COVID (63.6%) groups. Left-sided AVN was more frequent in post-COVID patients (22.7%) compared to non-COVID patients (18.8%), while right-sided AVN was more frequent in non-COVID patients (18.8%) compared to post-COVID patients (13.6%) (Table 2).

Bilateral hip pain was the most common presenting complaint, more frequent in post-COVID patients (54.5%) compared to non-COVID patients (43.8%). Lower back pain was slightly more frequent in post-COVID patients (18.2%) than in non-COVID patients (15.6%) (Table 2).

Table 2: Side of AVN and Presenting Complaint among study participants

	Covid Status	
	No (%) (64)	**Yes (%) (22)**
Side of AVN		
Bilateral	40 (62.5)	14 (63.6)
Left	12 (18.8)	5 (22.7)
Right	12 (18.8)	3 (13.6)
Presenting Complaint		
Bilateral Hip Pain	28 (43.8)	12 (54.5)
Left Hip Pain	12 (18.8)	4 (18.2)
Lower Back Pain	10 (15.6)	4 (18.2)
Right Hip Pain	14 (21.9)	2 (9.1)

Table 3 presents the association between COVID-19 status and various comorbidities and habits among 86 patients. The data indicates a significant association (p-value=0.014), suggesting that the presence of comorbidities and certain habits significantly correlates with COVID-19 status.

Table 3: Association of COVID status versus comorbidities and habits

Comorbidities and habits	**COVID status**		**Total**
	No	**Yes**	**N**
Alcoholic	1	0	1
HTN	1	3	4
HTN, T2DM	1	0	1
NIL	54	12	66
SMOKER	6	3	9
SMOKER, T2DM	0	1	1
T2DM	1	3	4
Total	64	22	86

p-value=0.014, i.e. significant

Table 4 shows the association between COVID-19 status and steroid therapy history among 86 patients diagnosed with AVN. Among patients without a history of COVID-19 infection, 46 didn't take steroid therapy while 18 took steroid therapy. In contrast, among patients with a history of COVID-19 infection, 14 took steroid therapy while 8 didn't take steroid therapy. The P-value of 0.002

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indicates a significant association, suggesting that a history of steroid therapy is significantly correlated with COVID-19 status in patients with AVN.

Table 4: Association of COVID-19 Status with Steroid Therapy History

Steroid Therapy History	Covid Status		p-value
	No	Yes	
No	46	8	0.002
Yes	18	14	
Total	64	22	

DISCUSSION

This retrospective study investigated the incidence and risk factors of AVN in patients treated for COVID-19. The findings highlight a notable incidence of AVN among COVID-19 patients, with significant correlations to steroid use and specific comorbidities. The majority of AVN cases were observed in middle-aged males, consistent with existing literature that indicates a higher prevalence of AVN in males due to higher rates of risk factors like alcohol consumption and steroid use [14]. Previous studies have similarly reported a male predominance in AVN cases, particularly in the age groups most affected by high-risk behaviors and comorbidities [15].

Bilateral AVN was the most common presentation, observed in 62.8% of cases. This finding aligns with prior research indicating that AVN often presents bilaterally, especially in conditions associated with systemic risk factors such as steroid use and chronic illnesses [16]. The high prevalence of bilateral AVN in this study underscores the systemic nature of the risk factors involved. A significant portion of the study participants had a history of COVID-19, with a notable number requiring hospitalization. This association suggests that severe COVID-19 cases, particularly those requiring hospitalization and steroid therapy, may be at higher risk for developing AVN [17].

Previous research has highlighted the hypercoagulable state induced by COVID-19 as a potential contributor to AVN [18]. The study found significant associations between AVN and the presence of comorbidities such as hypertension and diabetes, as well as a history of steroid use. These findings underscore the importance of careful monitoring of patients with these risk factors, particularly in the context of COVID-19 treatment [19]. The link between steroid use and AVN is well-documented, with corticosteroids being a known risk factor for the condition [20].

CONCLUSIONS

This study highlights a notable incidence of AVN among COVID-19 patients, with significant correlations to steroid use and specific comorbidities. The findings underscore the importance of vigilant monitoring for AVN in post-COVID-19 patients, particularly those with a history of steroid therapy. Early detection and intervention are crucial in managing AVN and improving patient outcomes. Further research is needed to elucidate the mechanisms linking COVID-19 and AVN and to develop targeted prevention strategies

RECOMMENDATIONS

Routine screening for AVN should be implemented in patients recovering from COVID-19, especially those with a history of steroid therapy or relevant comorbidities. Utilization of advanced imaging techniques such as MRI can aid in early detection and accurate diagnosis. Additionally, stringent guidelines for steroid use in COVID-19 patients should be adopted to minimize the risk of AVN, and alternative anti-inflammatory treatments should be explored. Structured follow-up programs for COVID-19 survivors, patient education on risk factors, and the development of rehabilitation programs focusing on joint health and mobility are also recommended. Further research and participation in clinical trials are essential to improve the understanding and management of AVN in the context of COVID-19.

CONTRIBUTION OF AUTHORS

Research concept- Rehan Khan, Saurabh Sharma
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Materials- Saurabh Sharma, Vaibhav Vishwakarma
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REFERENCES

[1] NIH. National Institute of Arthritis and Musculoskeletal and Skin Diseases. Avascular Necrosis, 2020. Available at: https://www.niams.nih.gov/.

[2] Sulewski A, Sieroń D, Szyluk K, Dąbrowski M, Kubaszewski L, Lukoszek D, et al. Avascular Necrosis Bone Complication after Active COVID-19 Infection: Preliminary Results. Med., 2021; 57(12): 1311.

[3] Disser NP, De Micheli AJ, Schonk MM, Konnaris MA, et al. Musculoskeletal Consequences of COVID-19. J Bone Jt Surg Am., 2020 102: 1197–204.

[4] Zhang S, Wang C, Shi L, Xue Q. Beware of Steroid-induced avascular necrosis of the femoral head in the treatment of COVID-19-experience and lessons from the SARS epidemic. Drug Des Devel Ther., 2021; 15: 983–95. doi: 10.2147/DDDT.S298691.

[5] Auyeung TW, Lee JS, Lai WK, Choi CH, Lee HK, et al. The use of corticosteroid as treatment in SARS was associated with adverse outcomes: a retrospective cohort study. J Infect., 2005; 51(2): 98–102. doi: 10.1016/j.jinf.2004.09.008.

[6] Patel MS, Gutman MJ, Abboud JA. Orthopaedic considerations following COVID-19: lessons from the 2003 SARS Outbreak. JBJS Rev., 2020; 8(7): e2000052. doi: 10.2106/JBJS.RVW.20.00052.

[7] Li W, Huang Z, Tan B, Chen G, Li X, et al. General recommendation for assessment and management on the risk of glucocorticoid-induced osteonecrosis in patients with COVID-19. J Orthop Translat. 2021; 31: 1–9. doi: 10.1016/j.jot.2021.09.005.

[8] Snowden GT, Clement ND, Zhang S, Xue Q, Simpson A. Orthopaedic long COVID - the unknown unknowns: are we facing a pandemic of avascular necrosis following COVID-19? Bone Joint Res. 2022; 11(1): 10–11.

[9] Shetty GM. Double trouble-COVID-19 and the widespread use of corticosteroids: Are We staring at an osteonecrosis epidemic? Indian J Orthop., 2022; 56(2): 226–36. doi: 10.1007/s43465-021-00546-8.

[10] Polak SB, Van Gool IC, Cohen D, von der Thüsen JH, van Paassen J. A systematic review of pathological findings in COVID-19: A pathophysiological timeline and possible mechanisms of disease progression. Mod Pathol., 2020: 33, 2128–38.

[11] Roy A, Uddin SG, Binta AM. Avascular necrosis of the femoral head in COVID-19: A case series. J. Orthop Surg Res., 2021: 16, e35368.

[12] Puhaindran ME, Phan K. Avascular necrosis of the hip in COVID-19: A case series. J Clin Orthop Trauma, 2020: 11 (Suppl. S4): S486–S89.

[13] Monteagudo LA, Boothby A, Gertner E, Foroohar A. Avascular necrosis of bone after COVID-19 infection: A case series. J Med Cases, 2021: 12: 208–12.

[14] Assouline-Dayan Y, Chang C, Greenspan A, Shoenfeld Y, Gershwin ME. Pathogenesis and natural history of osteonecrosis. Semin Arthritis Rheum., 2002; 32(2): 94-24.

[15] Zalavras CG, Lieberman JR. Osteonecrosis of the femoral head: evaluation and treatment. J Am Acad Orthop Surg., 2014; 22(7): 455-64.

[16] Moya-Angeler J, Gianakos AL, Villa JC, Ni A, Lane JM. Current concepts on osteonecrosis of the femoral head. World J Orthop., 2015; 6(8): 590-601. doi: 10.5312/wjo.v6.i8.590.

[17] Huang C, Wang Y, Li X, Zhao J, Hu Y, Zhang Fan, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet, 2020, 395: 497–506.

[18] Griffith JF. Musculoskeletal complications of severe acute respiratory syndrome. Semin Musculoskelet Radiol., 2011; 15: 554–60.

[19] Inoue S, Horii M, Asano T, Fujioka M, Ogura T, et al. Risk factors for nontraumatic osteonecrosis of the femoral head after renal transplantation. J Orthop Sci., 2003; 8(6): 751-56.

[20] Mont MA, Cherian JJ, Sierra RJ, Jones LC, Lieberman JR. Nontraumatic osteonecrosis of the femoral head: where do we stand today? A ten-year update. J Bone Joint Surg Am., 2015; 97(19): 1604-27.