Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

# JUDGING THE BOOK BY ITS COVER, NOT ALWAYS WRONG: SERIES OF INTERESTING CARDIAC AND AORTIC LESIONS IN AUTOPSY CASES

**Dr. UDAY RAMDAS NIMKARDE[1], Dr. VIJAYA WANE[2], Dr. QAZI AMISA TALHA[3], Dr. BHARAT R. SONWANE[4]**

1. Junior Resident, Dept. of Pathology, Govt. Medical College, Chhatrapati Sambhajinagar.
2. Assistant Professor, Dept. of Pathology, Govt. Medical College, Chhatrapati Sambhajinagar.
3. Assistant Professor, Dept. of Pathology, Govt. Medical College, Chhatrapati Sambhajinagar.
4. Professor and Head, Dept. of Pathology, Govt. Medical College, Chhatrapati Sambhajinagar.

**Corresponding Author: Dr. Uday Ramdas Nimkarde.**
Email: rs.udax18@gmail.com
Contact No: 9699957121

## ABSTRACT:

**BACKGROUND:** Ischemic heart disease and stroke are the predominant causes and are responsible for majority of cardiovascular disease related deaths. Some of the non-ischaemic causes includes inflammatory diseases, cardiomyopathies, valvular heart diseases, aortic aneurysm & dissection and congenital heart diseases.

**AIM:** The aim is to study various non-ischaemic cardiac and aortic lesions in autopsy cases.

**METHODS:** A three-year retrospective study was carried out at Department of Pathology within the time span of January 2022 to December 2024. It included a total of 23 cases. After gross examination and routine processing, Hematoxylin and Eosin-stained slides were examined and results were noted.

**RESULT:** With a male-to-female ratio of 1.3:1, males (56.52%) were more than females (43.48%) among the 23 autopsy cases studied. With a decrease in older age groups, the age group of 21–30 years old accounted for the bulk of cases (26.08%), followed by those aged 31–40 years (21.73%). Aortic aneurysm, Aortic dissection, Hypertrophic cardiomyopathy, and Tetralogy of Fallot were less common than inflammatory lesions, which accounted for 69.56% of all lesions.

**CONCLUSION:** According to this study, inflammatory lesions are the most prevalent type of cardiovascular lesions in young individuals. Tetralogy of Fallot and hypertrophic cardiomyopathy were also observed. The findings highlight the significance of region-specific data, early detection, and awareness in developing successful prevention programs.

**KEYWORDS:**

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

Autopsy, Aortic aneurysm, Aortic dissection, Hypertrophic cardiomyopathy, Tetralogy of Fallot.

## INTRODUCTION

Cardiovascular diseases (CVD) are the leading cause of death worldwide with an incidence of 60-70%.[1] Ischemic heart disease and stroke are the predominant causes and are responsible for >80% of CVD deaths.[1] Cardiomyopathies, Inflammatory diseases, Genetic channelopathies, Valvular, Congenital heart disease, Aortic Aneurysm and Dissection are some Non-Ischemic causes of sudden cardiac deaths. Over one fifth of clinically unexpected autopsy findings are correctly diagnosed only by histological examination[1]. These are a vast variety of cardiovascular pathologies and many are found incidentally on post mortem examination.[2] Identifying these wide spectrum of lesions on histopathological examination of heart autopsies can help in studying epidemiology, pathogenesis and management modalities of these diseases.[2] The study aims to identify the various non-ischaemic histopathological lesions of heart found incidentally and which may play a significant role as a cause of disease.[3]

## AIM AND OBJECTIVE

To study various non-ischaemic cardiac and aortic lesions in autopsy cases.

## MATERIALS AND METHOD

The present study is a retrospective observational study conducted at Department of Pathology, Government Medical College, Chhatrapati Sambhajinagar.

This study included a total of 23 cases over a period of three years, from January 2022 to December 2024.

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

**Inclusion Criteria: -** All autopsy cases having non-ischemic cardiac and aortic lesions on gross and microscopic examination of Heart and Aorta.

**Exclusion Criteria: -**

1)Poorly fixed/unfixed specimens.

2)Autolysed specimens.

3)Specimen containing only tissue piece of heart.

4)Cases of coronary artery disease, myocardial infarction and atherosclerosis.

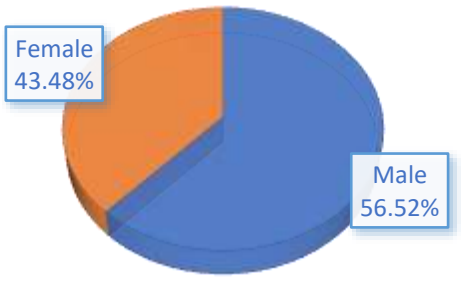
All the autopsy specimens received in Medico Legal Cases section of Department of Pathology fulfilling the inclusion criteria were included in the study.

Autopsy specimens with unique identification number were received, gross findings were noted and slides were reviewed.

## OBSERAVATION AND RESULTS

In our study out of the 23 autopsy cases analysed, males constituted 56.52%, while females accounted for 43.48%. This finding highlights a higher prevalence of cardiac and aortic lesions in males, with a male-to-female ratio of approximately 1.3:1 (figure 1).

FIGURE 1: DISTRIBUTION OF CASES ACCORDING TO GENDER




The age distribution of cases revealed that the age group of 21–30 years old accounted for the largest percentage of cases 26.08%, followed by the age groups of 31–40 which accounted for 21.73%. Only 4.34% of cases occurred in the 61–70 age group, as cases gradually decreased in older age groups. According to this distribution, young to middle-aged persons were more likely to have cardiac and aortic abnormalities in the postmortem cases under study (table 1).

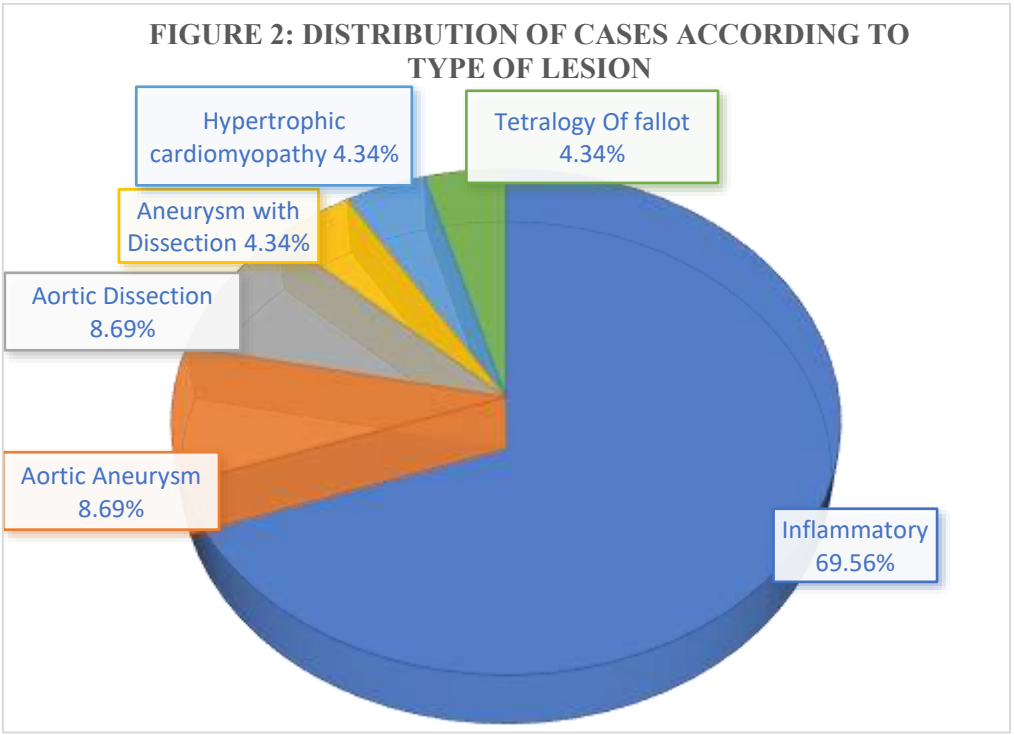
**Table 1: Distribution Of Cases According To Age Group.**

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

| Age Group | n | % |
|---|---|---|
| 0 to 10 | 2 | 8.69 |
| 11 to 20 | 2 | 8.69 |
| 21 to 30 | 6 | 26.08 |
| 31 to 40 | 5 | 21.73 |
| 41 to 50 | 4 | 17.39 |
| 51 to 60 | 3 | 13.04 |
| 61 to 70 | 1 | 4.34 |
| **Total** | **23** | **100.00** |

Among the 23 autopsy cases studied, inflammatory lesions were the most prevalent, observed in 69.56% of cases. Aortic aneurysm and aortic dissection were each seen in 8.69% of cases, while one case exhibited both aortic aneurysm and dissection. One case was of hypertrophic cardiomyopathy and one was of tetralogy of fallot. This distribution underscores the dominance of inflammatory pathology among cardiac and aortic lesions, with structural abnormalities like aneurysm, dissection, hypertrophic cardiomyopathy and tetralogy of fallot occurring less frequently in the present study (figure 2).

FIGURE 2: DISTRIBUTION OF CASES ACCORDING TO TYPE OF LESION



ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

*Figure 3: Pericardium showing fibrinous exudates.*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025


*Figure 4: Pericardium showing fibrinous exudates.*

*Figure 5: Longitudinally opened aorta shows dissection throughout the length.*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

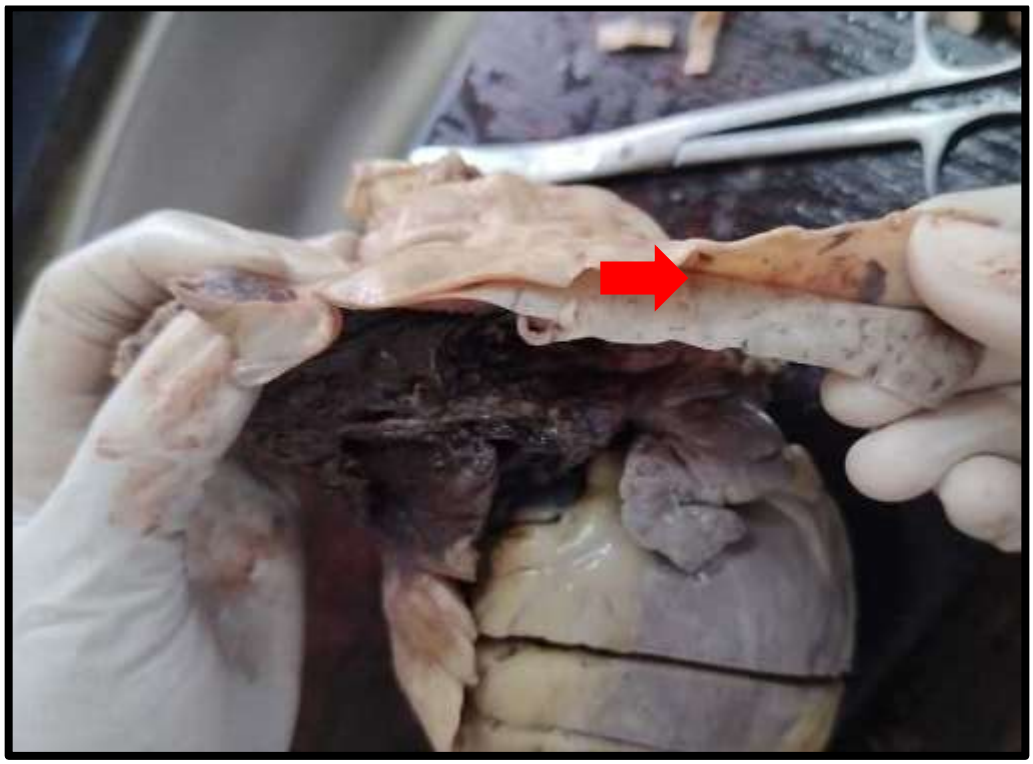


*Figure 6: Separation of walls of aorta seen arising from the root.*


*Figure 7: Aortic arch shows aneurysmal dilatation.*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025


*Figure 8: Part of aorta showing dilatation at proximal end and bifurcation at distal end.*

*Figure 9: Cut section shows increased interventricular thickness.*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

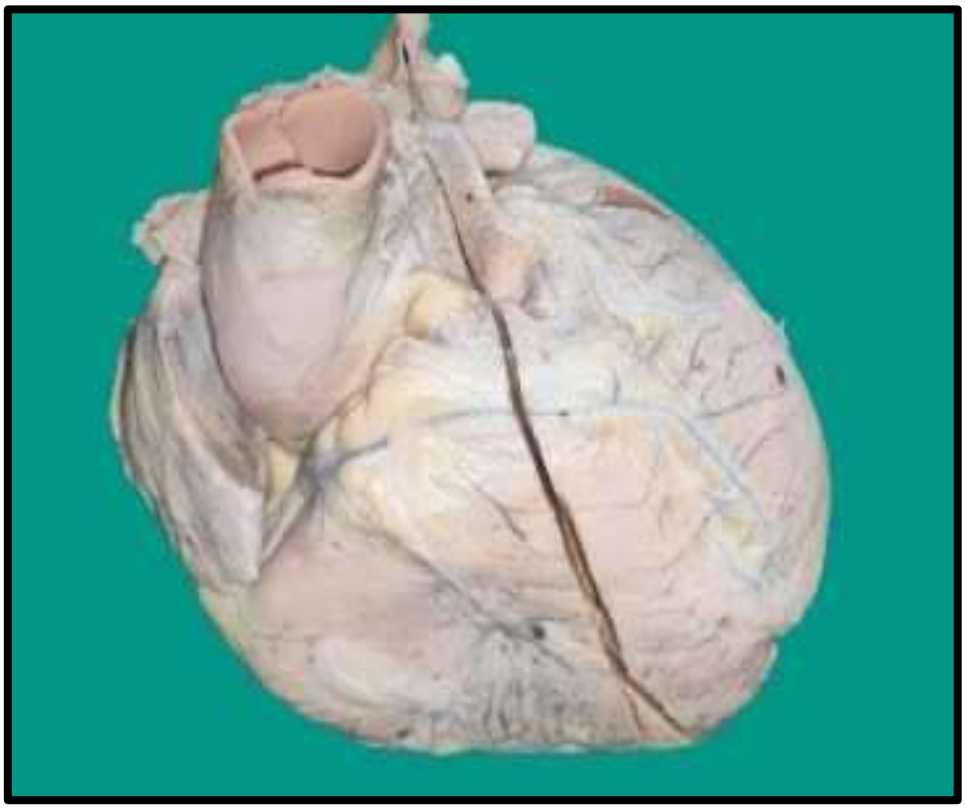


*Figure 10: Boot shaped heart.*

*Figure 11: Boot shaped heart.*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

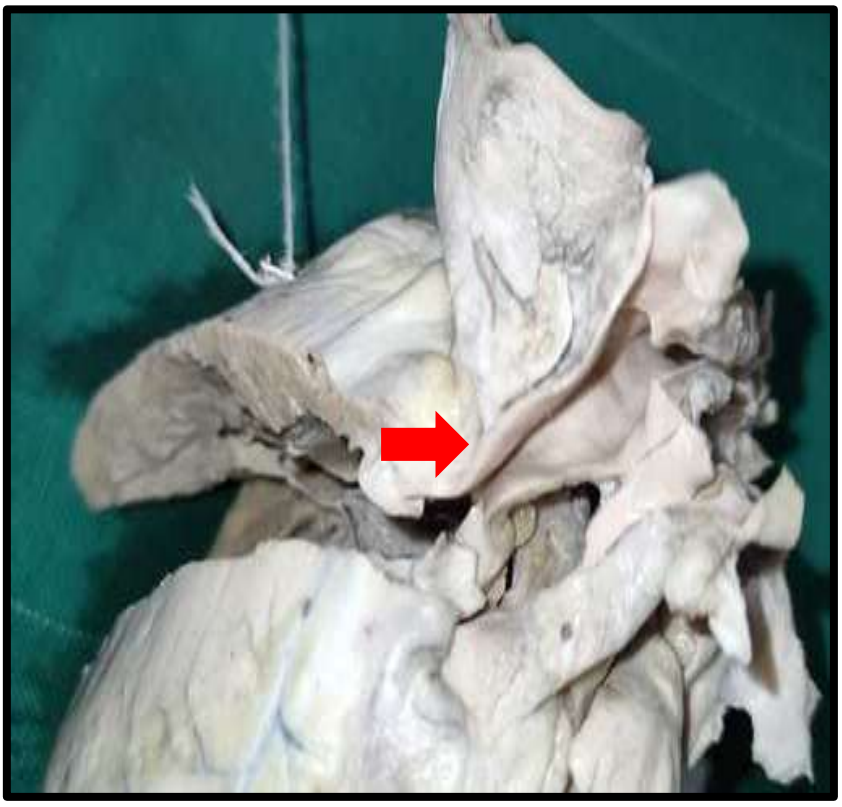


*Figure 12: Stenosed pulmonary trunk and overriding aorta.*

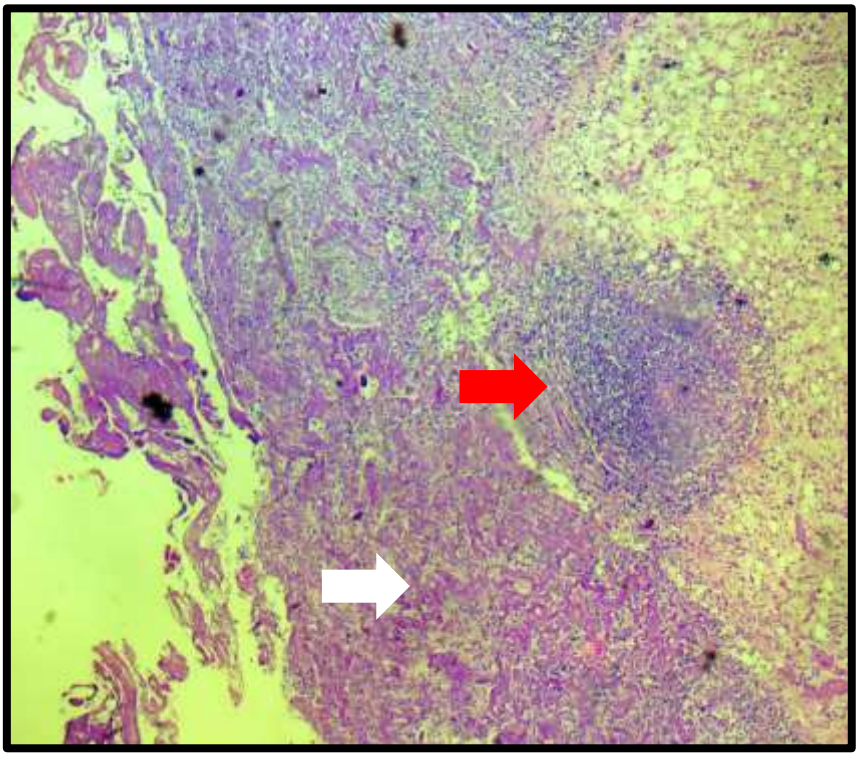


*Figure 13: Red arrow showing caseating granuloma and white arrow showing acellular eosinophilic material(fibrin). (H&E 40X)*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

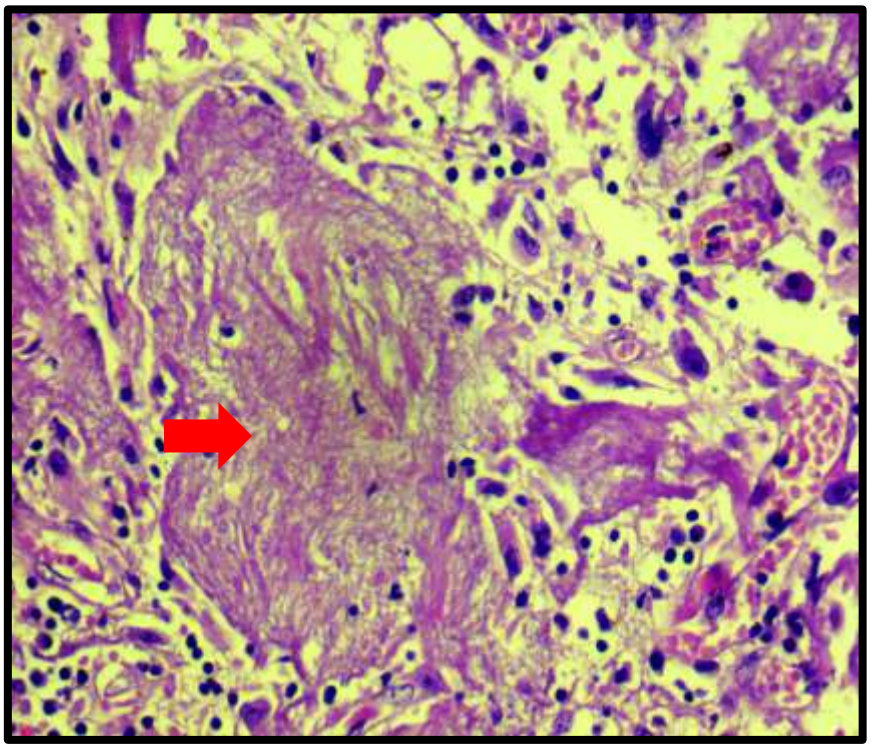


*Figure 14: Section showing acellular eosinophilic material(fibrin) and inflammatory cells. (H&E 400X)*

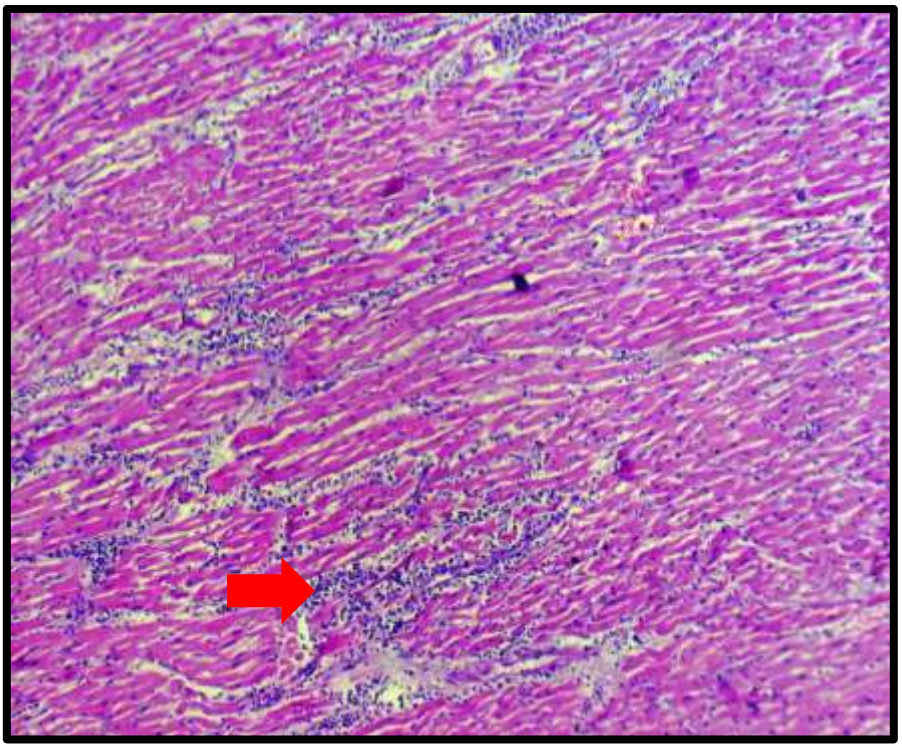


*Figure 15: Myocardium shows infiltrates of lymphocytes and plasma cells. (H&E 40X)*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

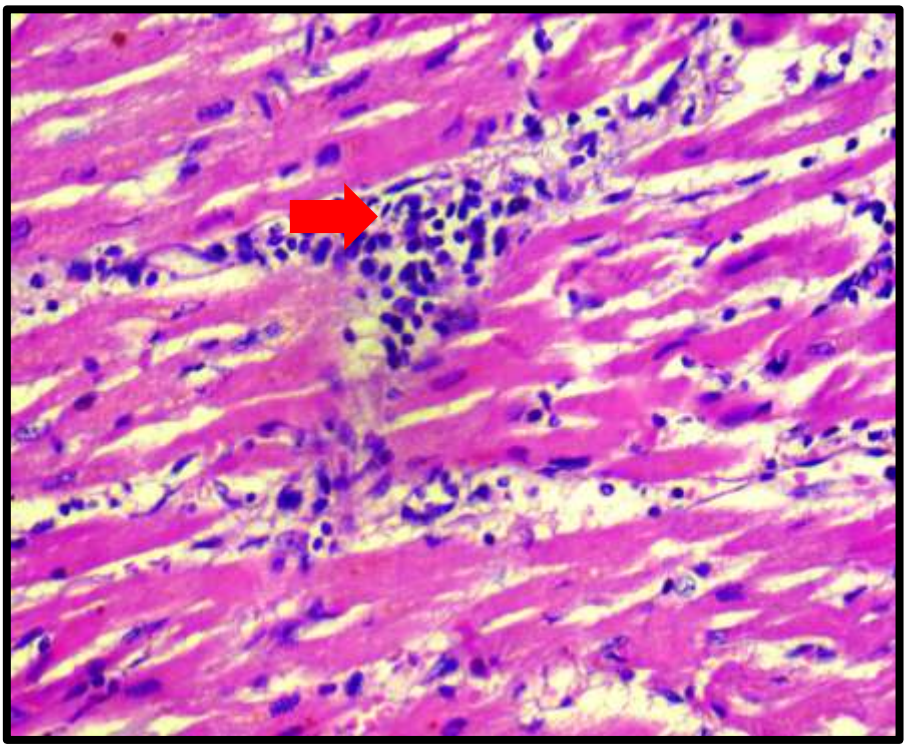


*Figure 16: Myocardium shows infiltrates of lymphocytes and plasma cells. (H&E 400X)*

*Figure 17: Section showing separation of vascular layers along with areas of hemorrhage. (H&E 40X)*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

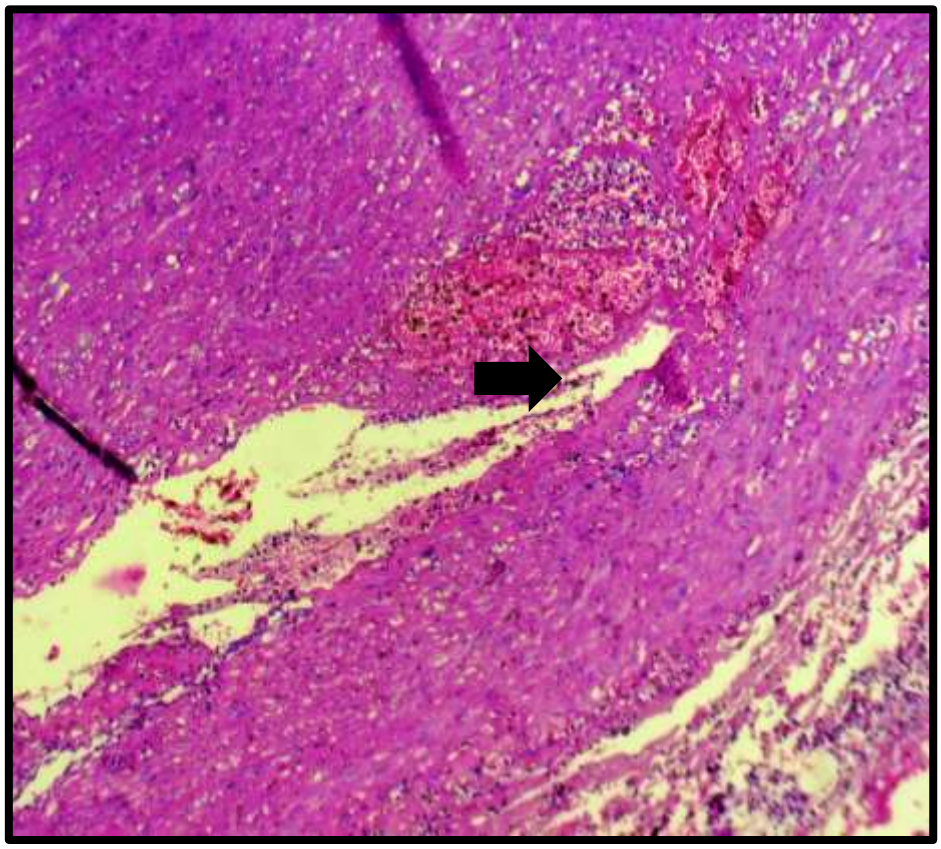


*Figure 18: Section showing separation of vascular layer. (H&E 100X)*

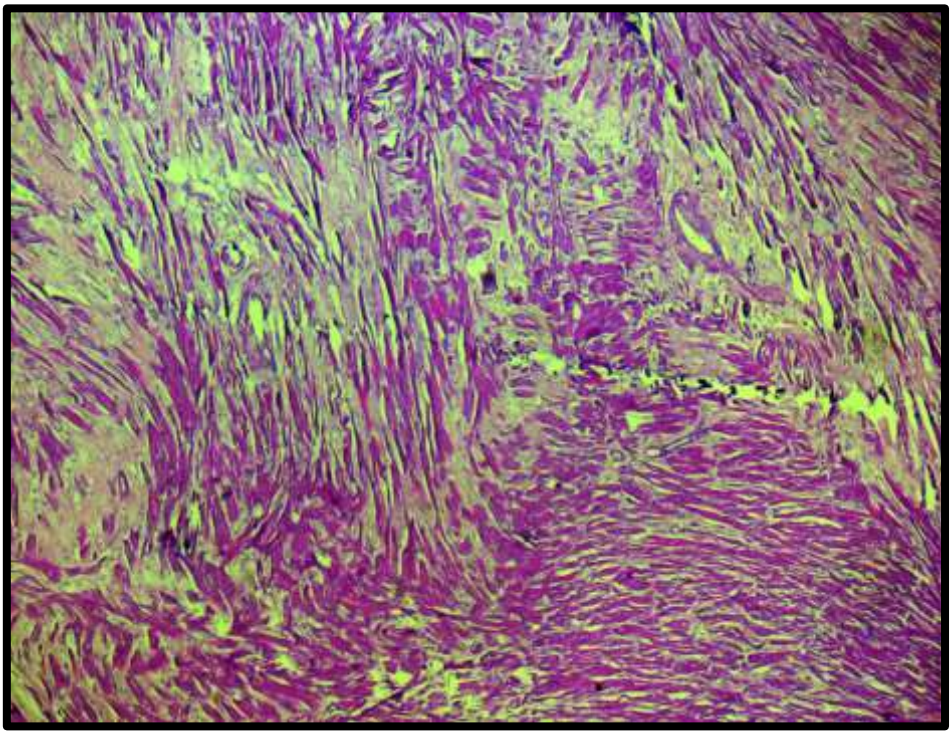


*Figure 19: Myocardium shows disarray and hypertrophy of myocytes. (H&E 40X)*

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

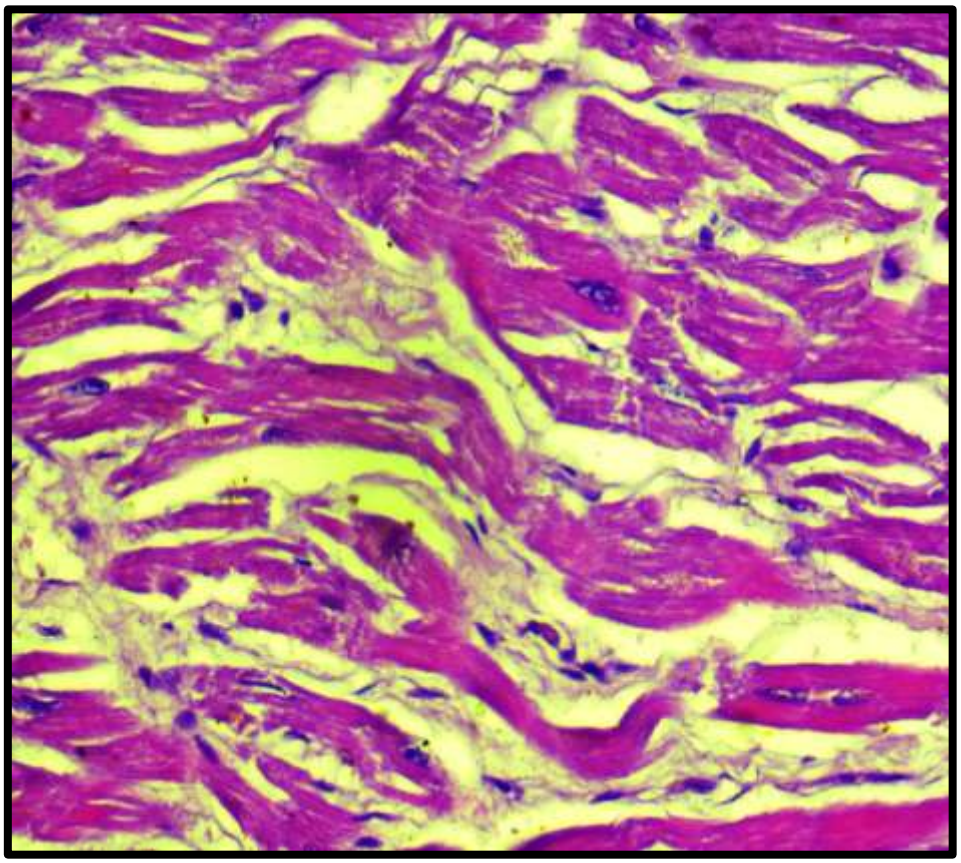


*Figure 20: Myocardium shows disarray and hypertrophy of myocytes. (H&E 400X)*

## DISCUSSION

**Table 2: Comparison Of Gender Wise Distribution of Cases.**

| Sr. No. | Author | Year | No. Of cases | Male:Female Ratio |
|---|---|---|---|---|
| **1** | Muniraj, et al.[13] | 2024 | 100 | 3.34:1 |
| **2** | Pandey, et al.[3] | 2023 | 208 | 3.72:1 |
| **3** | Chaudhary A, et al.[2] | 2023 | 133 | 3.15:1 |
| **4** | Verma et al.[1] | 2021 | 1000 | 4.95:1 |
| **5** | Gian Nugraha et al.[14] | 2021 | 7 | 6.00:1 |
| **6** | Garg S et al.[15] | 2018 | 141 | 3.14:1 |
| **7** | Sonawane SY et al.[16] | 2017 | 124 | 4.39:1 |
| **8** | Marwah Nisha, et al.[17] | 2011 | 200 | 11.5:1 |
| **9** | **Present Study** | **2025** | **23** | **1.30:1** |

The present study, comprising of 23 autopsy cases, revealed a male predominance with a male-to-female ratio of 1.3:1. This is in concordance with previous studies, which have also demonstrated a higher prevalence of cardiovascular lesions among males. However, the male predominance observed in our study is relatively lower compared to other studies, such as

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

Marwah et al. (2011), who reported a ratio of 11.5:1, and Nugraha et al. (2021), who observed a ratio of 6.00:1. This variation could be attributed to differences in study populations, geographic factors, and underlying risk profiles.

Comparing case distribution, larger studies, such as Verma et al. (2021), who analysed 1000 cases, and Pandey et al. (2023), with 208 cases, provide more extensive epidemiological insights. The present study's smaller sample size (n=23) may account for differences in male-to-female ratios. However, studies with similar sample sizes, such as Nugraha et al. (2021) (n=7) and Muniraj et al. (2024) (n=100), also highlight a consistent male predominance (table 2).

The findings suggest that males are more frequently affected by cardiac and aortic pathologies in autopsy cases, possibly due to increased cardiovascular risk factors such as hypertension, smoking, and genetic predisposition.

**Table 3: Comparison Of Age Group Wise Distribution Of Cases.**

| Sr. No. | Author | Year | No. Of Cases | Most Common Age Group(Year) |
|---|---|---|---|---|
| **1** | Bolde S et al.[18] | 2024 | 19 | 15 to 40 yrs |
| **2** | Muniraj, et al. [13] | 2024 | 100 | 31 to 40 yrs |
| **3** | Pandey, et al. [3] | 2023 | 208 | 31 to 45 yrs |
| **4** | Chaudhary A, et al. [2] | 2023 | 133 | 41 to 50 yrs |
| **5** | Verma et al. [1] | 2021 | 1000 | 41 to 50 yrs |
| **6** | Gian Nugraha et al. [14] | 2021 | 7 | 60 yrs and above |
| **7** | Garg S et al. [15] | 2018 | 141 | 51 to 60 yrs |
| **8** | Sonawane SY et al. [16] | 2017 | 124 | 41 to 50 yrs |
| **9** | Marwah Nisha, et al. [17] | 2011 | 200 | 41 to 50 yrs |
| **10** | **Present Study** | **2025** | **23** | **21 to 30 yrs** |

In the present study, of 23 autopsy cases, we found that the most commonly affected age group was 21 to 30 years, which is supported by Bolde S et al. (2024), indicating that younger populations are increasingly affected by heart disease. This could be attributed to rising risk factors such as poor lifestyle choices, stress, sedentary behavior, and genetic predispositions.

Middle-aged individuals (31 to 50 years) remain the most common group affected, as seen in Muniraj et al. (2024) and Pandey et al. (2023), with conditions like hypertension, diabetes, and obesity contributing to the rise in cardiovascular deaths. Older age groups (51 years and above) also show a significant prevalence of cardiac deaths, as seen in studies like Garg S et al. (2018), consistent with known aging-related risk factors (table 3).

The variation in age distribution across studies may be influenced by regional demographics, genetic predisposition, lifestyle habits, and sample size variations. The findings of the present study further support that cardiac and aortic pathology is not confined to older individuals but is increasingly seen in younger and middle-aged populations. This underscores

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

the need for early screening, preventive interventions, and awareness programs to reduce cardiovascular mortality in younger individuals.

**Table 4: Comparison Of Cases According to Type of Lesion.**

| Sr. No | Author | Year | No. Of Cases | Inflammatory | Aneurysm | Dissection | Aneurysm with Dissection | Hypertrophic cardiomyopathy | Tetralogy Of Fallot |
|---|---|---|---|---|---|---|---|---|---|
| **1** | Bolde S et al.[18] | 2024 | 19 | 47.40% | 5.30% | 5.30% | | - | - |
| **2** | Pandey, et al.[3] | 2023 | 208 | 0.08% | - | - | - | - | - |
| **3** | Chaudhary A, et al.[2] | 2023 | 133 | 1.50% | - | - | - | - | - |
| **4** | Gian Nugraha et al.[14] | 2021 | 7 | - | 14.28 % | - | - | - | - |
| **5** | Tiwana et al.[7] | 2020 | 470 | - | - | - | - | 11.5% | - |
| **6** | Garg S et al.[15] | 2018 | 141 | 6.37 % | - | - | - | - | - |
| **7** | Sonawane SY et al.[16] | 2017 | 124 | 5.64 % | - | 0.80 % | - | 3.22% | - |
| **8** | Marwah Nisha, et al.[17] | 2011 | 200 | 3.50 % | - | 0.50 % | - | - | - |
| **9** | **Present Study** | **2025** | **23** | **69.56%** | **8.69%** | **8.69%** | **4.34%** | **4.34%** | **4.34%** |

The present study of 23 autopsy cases, revealed a high prevalence of inflammatory lesions (69.56%), followed by aortic aneurysm & aortic dissection (8.69%) each, and aneurysm with dissection, hypertrophic cardiomyopathy and tetralogy of fallot (4.34%) each. This finding contrasts significantly with previous studies, where inflammatory lesions were reported at much lower frequencies. The reason may be because we have only selected the cases with non-ischaemic cardiac and aortic diseases.

Among the inflammatory lesions 9 cases were of Pericarditis and 7 cases were of myocarditis. Out of 9 pericarditis cases 2 cases were consistent with Fibrinous pericarditis. Pericarditis is the inflammatory process involving the pericardium as a result of systemic disease or a primary pericardial disorder. Typically fibrinous pericarditis also known as bread and butter pericarditis is an entity, wherein, the pericardium, which is regularly smooth and bright, becomes opaque and granular and macroscopically resembles two pieces of buttered

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

bread pressed together and then pulled apart(refer figure 3 & 4). The histology shows the deposition of fibrin and leukocytic exudates involving the pericardial leaflets.[6](refer figure 13 & 14).

Among prior studies, Bolde et al. (2024) reported inflammatory lesions in 47.4% of cases, which is the closest to our findings, but still considerably lower. In contrast, Pandey et al. (2023) and Chaudhary et al. (2023) documented minimal inflammatory cases (0.08% and 1.5%, respectively), suggesting significant variations in study populations and case selection. Similarly, Garg et al. (2018) (6.37%), Sonawane et al. (2017) (5.64%), and Marwah et al. (2011) (3.5%) also reported markedly lower proportions of inflammatory lesions compared to the present study.

Regarding aortic aneurysms and dissections, our study found aneurysm (8.69%) and dissection (8.69%) to be equally prevalent, with an additional 4.34% of cases showing combined aneurysm with dissection. This is in contrast to Bolde et al. (2024), who reported a lower prevalence of aneurysm (5.3%) and dissection (5.3%). Similarly, Sonawane et al. (2017) (0.8%) and Marwah et al. (2011) (0.5%) reported much lower frequencies of dissection. Notably, Nugraha et al. (2021) documented a relatively higher prevalence of aneurysm (14.28%), indicating that aneurysmal changes might be more prominent in certain populations or age groups.

Aortic dissection is a catastrophic illness characterized by dissection of blood between and along the laminar planes of the media with the formation of blood-filled channels within the aortic wall which often ruptures outwards causing massive haemorrhage(refer figure 5 & 6). Aortic dissection is most common in men. In women half of aortic dissection occur during pregnancy before 40.[4] In most cases, this is associated with a sudden onset of severe chest or back pain, often described as "tearing" in character.[5] Aortic aneurysms form in both the abdominal and thoracal segments, it is the dilatation of aortic segment(refer figure 7 & 8).

Hypertrophic cardiomyopathy (HCM) was identified in 4.34% of cases in our study, a finding that aligns with the 11.5% reported by Tiwana et al. (2020). Sonawane et al. (2017) reported it to be 3.22%. However, most other studies did not document HCM, suggesting possible underreporting or differences in case selection criteria. Hypertrophic cardiomyopathy is an autosomal dominant disorder and an important cause of sudden cardiac death.[7] In HCM there is disproportionate hypertrophy of ventricular septum with myofiber disarray in ventricular septum[7](refer figure 9,19 & 20). This disease affects a wide spectrum of age group and particularly younger patients.

Tetralogy of Fallot (TOF) was identified in 4.34% of cases in our study, a finding not commonly reported in previous autopsy studies. The absence of TOF in most comparative research suggests that congenital heart diseases may be underrepresented in autopsy series or may not be consistently documented. Classic tetralogy of Fallot (TOF) is a congenital heart defect (CHD) that is comprised of 4 anatomical alterations: an anteriorly misaligned ventricular septal defect (VSD), an overriding aorta which results in infundibular right ventricular outflow tract obstruction (RVOTO), and consequent right ventricular hypertrophy secondary to chronic systemic pressures(refer figure 11 & 12). The pulmonary valve annulus is often hypoplastic, with a pulmonary valve that is dysplastic and stenotic.[19](table 4).

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

The significantly higher proportion of inflammatory lesions in our study compared to previous reports could be attributed to differences in case selection, geographic variations, or an increasing recognition of inflammatory cardiovascular pathology in autopsy cases. Additionally, the higher occurrence of aortic aneurysms and dissections in our study suggests the need for better screening and early detection strategies, especially in individuals at risk of vascular diseases.

## CONCLUSION

This study provides valuable insights into the demographic distribution and types of cardiovascular and aortic lesions observed in autopsy cases. The preponderance and lower male-to-female ratio in the 21–30 age range point to the growing prevalence of cardiovascular illnesses in younger people and point to changing patterns. The identification of diseases like hypertrophic cardiomyopathy and Tetralogy of Fallot, as well as the noticeably high frequency of inflammatory lesions, highlight the necessity of increased awareness, prompt diagnosis, and effective treatment. These results also highlight how crucial regional studies are to comprehending the changing trends in cardiovascular disease and directing successful preventative measures.

## ACKNOWLEDGEMENT

We acknowledge the support of our technical staff and the entire Department of Pathology who helped us in this study.

Conflict of interest: None

Funding: None

## REFERENCES

1. Verma R, Singh S, Marwah N, Pawar R, Rana D. Histopathological array of cardiac lesions: An autopsy based study in a tertiary care centre. IP Arch Cytol Histopathology Res. 2021;6(3):173-80.
2. Chaudhary A, Rai NN. Histopathological spectrum of cardiovascular findings in forensic autopsies in Hadoti region: A prospective study of one year. IP Arch Cytol Histopathology Res. 2023;8(2):99-107.
3. Pandey V, Kulkarni V, Bhaskar V, Mire V. Spectrum of histopathological lesions of heart: An autopsy study at tertiary care center. MGM J Med Sci. 2023;10:389-96.
4. Köken Tok Ö, Kaya K, Çelik E, Gülmen MK. Aortic dissection as the cause of death in a patient treated according to the pre-diagnosis of poisoning: A case report. Ahi Evran Med J. 2021;5(2):165-8.
5. Özesen TA, Kaya K, Çelik EB, Gülmen MK. Aortic aneurysm deaths (Aort Anevrizmasına Bağlı Ölüm Vakalarına Bakış). Bozok Tıp Derg. 2020;10(4):123-6.

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

6. de Souza PM, Dos Santos AM, Paulino EM, Hirth CG, Dornelas CA. "Bread and butter" fibrinous pericarditis. Autops Case Rep. 2016;6(4):5-7. doi: 10.4322/acr.2016.050. PMID: 28210567; PMCID: PMC5304555.

7. Hypertrophic Cardiomyopathy as a cause of Sudden Cardiac Death—An Autopsy Study. Indian J Forensic Med Toxicol. 2020;14(4):398-401.

8. de Freitas CP, Petrini CA, Araújo RS, Lima LG, Picciarelli de Lima P, Duarte-Neto AN. Rupture of an ascending aortic aneurysm as a cause of sudden death. Autops Case Rep. 2016;6(3):23-8. doi: 10.4322/acr.2016.044. PMID: 27818955; PMCID: PMC5087980.

9. Kulshrestha V, Sharma M, Jain GV. Sudden death due to aortic dissection – A case report. Int J Recent Sci Res. 2020;11(7):39121-4. doi: 10.24327/ijrsr.2020.1107.5445.

10. Yow AG, Rajasurya V, Sharma S. Sudden Cardiac Death. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 [updated 2024 Jan; cited 2025 May 15].

11. Phadke RS, Vaideeswar P, Mittal B, Deshpande J. Hypertrophic cardiomyopathy: an autopsy analysis of 14 cases. J Postgrad Med. 2001;47(3):165-70. PMID: 11832616.

12. Pál D, Szilágyi B, Berczeli M, Szalay CI, Sárdy B, Oláh Z, et al. Ruptured aortic aneurysm and dissection related death: an autopsy database analysis. Pathol Oncol Res. 2020;26(4):2391-9. doi: 10.1007/s12253-020-00835-x. PMID: 32548697; PMCID: PMC7471188.

13. Muniraj K, Vincy TM, Boopathy T, Prakasam G, Kannan G. Histopathological study of heart and cardiac vessels in autopsy cases from tertiary health-care center. Asian J Med Sci. 2024;15(1):189-93. doi: 10.3126/ajms.v15i1.56926.

14. Nugraha G, Novita N, Aminah H. Histopathological findings in sudden cardiac death: 5-years autopsy experience in a tertiary hospital in Bandung, Indonesia. Althea Med J. 2021;8(2). doi: 10.15850/amj.v8n2.2324.

15. Garg S, Hasija S, Sharma P, Kalhan S, Saini N, Khan A. A histopathological analysis of prevalence of various heart diseases: an autopsy study. Int J Res Med Sci. 2018;6:1414-8.

16. Sonawane SY, Matkari PP, Pandit GA. Pathology of heart, coronaries and aorta in autopsy cases with history of sudden death: an original article. Int J Res Med Sci. 2017;5:3287-91.

17. Nisha M, Bhawna S, Sumiti G, Amrita D, Sunita S, Rajeev S. Histomorphological spectrum of various cardiac changes in sudden death: an autopsy study. Iran J Pathol. 2011;6(4):179-86.

18. Bolde S, Kharolkar VD, Watane S, Hiwale BN, Nemane N, Ghogare M, Rathod G. Histopathological spectrum of uncommon lesions in heart and aorta: A review of 19 autopsy cases. *J Clin Diagn Res*. 2024;18(2):1022-30. doi:10.4807/jcdr.2024.15.02.116.

ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 5, 2025

19. Horenstein MS, Diaz-Frias J, Guillaume M. Tetralogy of Fallot. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan– [updated 2024 Dec 2; cited 2025 May 15].