

Histomorphological Evaluation of Myocardial Infarction: An Autopsy Study

Shankar Marshal Toppo¹, Sunil S Chavan², Kapileshwar M Chaudhari³

Abstract

Background: Myocardial Infarction is the irreversible necrosis of the heart muscle secondary to prolonged ischemia. The incidence of coronary heart disease has markedly increased in India over the past few years. Objective was to study the histopathological spectrum of myocardial infarction in autopsy specimens that play a major role as cause of death. **Aims:** To study histomorphological changes in myocardial infarction, to determine its age-sex distribution, etiology & complications. **Materials and Methods:** This work is a retrospective study of ovarian germ cell tumors carried out in department of pathology at tertiary healthcare center. All cases of germ cell tumors during the period from August 2017 to July 2018 were retrieved from the record files and analyzed. The tissues were routinely fixed with 10% formal in, and the slides were stained with hematoxylin and eosin stain and also with special stains whenever required. **Results:** Commonest age group was 40–49 years with significant number of cases below 30 years of age. Males are more commonly affected than females. Coronary atherosclerosis was most common etiology. Left anterior descending artery causing anterior wall MI was most common morphological finding. Ventricular aneurysm is the most common complication. **Conclusion:** Myocardial infarction due to atherosclerosis is the commonest finding in death cases subjected to medico legal autopsies.

Keywords: Myocardial Infarction; Coronary Atherosclerosis; Autopsy.

How to cite this article:

Shankar Marshal Toppo, Sunil S Chavan, Kapileshwar M Chaudhari. Histomorphological Evaluation of Myocardial Infarction: An Autopsy Study. Indian J Forensic Med Pathol. 2019;12(3):179-184.

Introduction

Myocardial infarction is common diagnoses in hospitalized patients in industrialized countries. The mortality rate with acute infarction is approximately 30%. More than half of these deaths occurring before the individual reach the hospital.

Although the mortality rate after admission has declined over last two decades, approximately 1 of every 25 patients *i.e.* 4% who survives dies in the 1 year after myocardial infarction.¹ Ischemic heart disease is by far most frequent cause of sudden death, being responsible for more than 90% of cases in which death occurs within.

One hour of onset of symptoms. However, death due to ischemic heart disease reduced due to maintenance of normal blood glucose level in diabetic, lipid lowering antioxidant therapy aspirin prophylaxis. But death rates from cardiovascular disease is presently increasing world-wide.² The study of correlation of coronary artery stenosis with site of infarction and recognition of early ischemic changes in the myocardium could well lead to the development of improved methods for the prevention and control of ischemic heart diseases.³

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Received on 21.05.2019, **Accepted on** 11.07.2019

Materials and Methods

This autopsy study was conducted on 100 cases of myocardial infarction over a period of 2 years in autopsy section of pathology department at tertiary healthcare centre. In this autopsy study heart of patient with a history of chest pain/abnormal ECG known ischemic heart disease and showing early microscopic evidence of MI were evaluated. These were received in an autopsy section as medico legal post-mortem and clinical post-mortem cases.

Heart was examined grossly to identify suspected areas of early MI like subepicardial hemorrhages and fibrosis. Epicardial coronary arteries were dissected by transverse sectioning at interval of 5 mm and lumen occlusion, severity and extent of severity of atherosclerotic narrowing of lumen. Heart was cut into transverse slice. 1 cm thick starting at the apex of heart up to origin of left anterior descending artery and examined for variation in coronary thickening, block, color and consistency of myocardium. Multiple sections from apex, Anterior wall, posterior wall, lateral wall interventricular septum and coronary arteries were taken. All the sections were processed and stained with hematoxylin and eosin stain and examined under microscope. Triphenyl Tetrazolium Chloride Macro Test and Acridine Orange Fluorescence were performed whenever required.

Results

Total 100 cases of myocardial infarction were evaluated from medico-legal cases and clinical post-mortems in an autopsy section of tertiary healthcare centre over a period of 2 years. The most common age group affected by ischemic heart disease was 40–49 years, followed by 50–59 years with maximum number of cases occurring in age group 40–70 years. Male were more commonly affected than females 3.5:1 (Table 1). Chest pain was the most common presenting symptoms in this study followed by giddiness, sweating and breathlessness. More than 1 symptom was frequently present at the time of presentation. We found diabetes in 4 cases, hypertension in 5 cases, obesity in 15 cases and history of smoking in 10 cases as major risk factor. As many patients were brought dead we could not get their detailed history and investigation reports (Table 2). Atherosclerosis was the commonest etiological factor. Four cases were of Rheumatic heart diseases, three cases were aortic stenosis and one was aortic stenosis with mitral stenosis.

Left anterior descending artery 65 cases (70.65%) was most common predominantly involved artery by atherosclerotic narrowing *i.e.* more than 75% of the lumen. This follows right coronary artery. 35 cases (38.40%) and left circumflex artery 14 cases (15.21%) (Table 3).

In this series majority of the cases having one vessel disease *i.e.* only one vessel was significantly narrowed >75 of cross-sectional luminal area (Table 4). Anterior wall of left ventricle was most commonly affected by infarct. Anterior, antero-septal, antero-lateral were considered in anterior wall group while posterior, postero-septal, postero-lateral in posterior wall group. Lateral wall alone constitutes lateral wall (Table 5). Maximum numbers of cases were of less than 12 hours duration. Total exceeded 100 cases since multiple infarcts were present in many cases (Table 6).

In H and E stained sections ischemic myocardium stained as brilliant crimson red color in contrast with light brown normal fibers. Infarcted myocardium less than 12 hours duration was stained strongly. The number and intensity of staining the individual fibers was decreased slightly within 12–24 hours and further decreased and disappeared when myocardium became frankly necrotic and polymorphonuclear infiltrates reached its peak. The fibroblastic granulation tissue of healing infarct does not stain with this stain (Figs. 1-5).

Table 1: Age and sex wise distribution of cases in present study

Age (Yrs)	Male (n = 78)	Female (n = 22)	Total (%)
< 30	5	-	5 (5%)
30-39	6	2	8 (8%)
40-49	27	2	29 (29%)
50-59	19	7	26 (26%)
60-69	13	9	22 (22%)
70-79	6	2	8 (8%)
>/= 80	2	0	2 (2%)

Table 2: History of presenting symptoms of MI in all cases studied

Symptoms	No. of cases (n = 100)	%
Chest pain	60	60
Breathlessness	13	13
Sweating	13	13
Giddiness	17	17
Vomiting	4	4
Epigastric pain	3	3
Brought dead/no history	13	13

Table 3: Aetiological factors for myocardial Infarction

Aetiology	No. of cases (n = 100)	%
Atherosclerosis	92	92
Emboli	3	3
Rheumatic heart diseases	4	4
Aortic dissection	1	1

Table 4: Distribution of cases as per number of vessels involved

No. of vessels involved	No. of cases (n = 92)	%
One vessel disease	44	47.82
Two vessel disease	28	30.43
Three vessel disease	20	21.73

Table 5: Area wise distribution of recent infarct

Area involved	No. of cases (n = 48)	%
Anterior wall	23	47.91
Posterior wall	14	29.16
Lateral wall	7	14.58
Septal	1	2.08
Circumferential	3	6.25

Table 6: Distribution of cases according to age of infarct^{2,4,5,6}.

Age of infarct	No. of cases (n = 100)	%
< 12 hours	48	48
12-24 hours	18	18
1-3 days	20	20
3-7 days	6	6
1-2 weeks	4	4
2-8 weeks	22	22

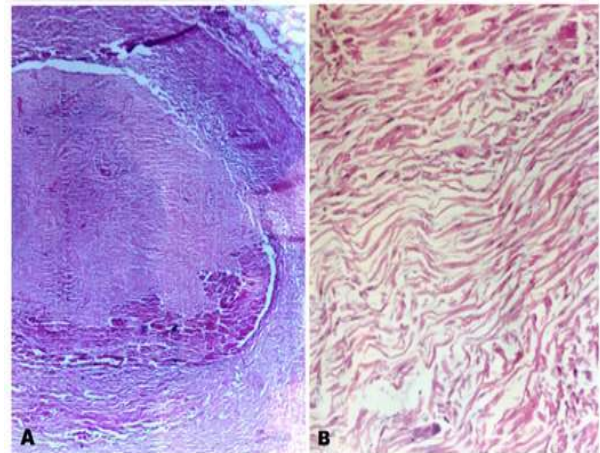


Fig. 3A: Shows thrombus occluding coronary. **B:** Shows waviness of ischaemic myocardial fibers indicating early infarct. (H and E 40x).

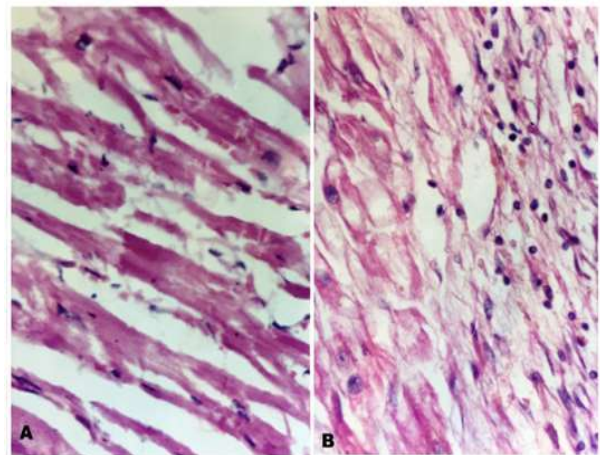
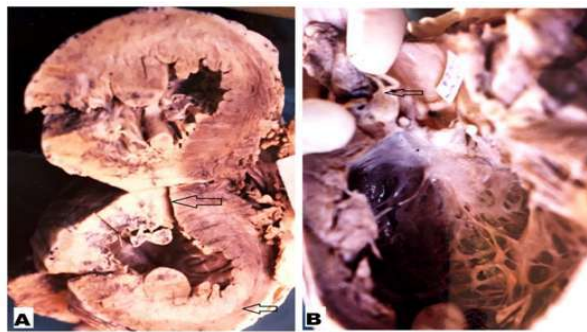


Fig. 4A: Showing contraction band necrosis of ischaemic myocardial fibers. **B:** Showing myocytolysis/vacuolar degeneration a early sign of infarct. (H and E 40x).



Figs. 1A: Showing myocardial infarction on postero-lateral wall of left ventricle. **B:** Showing aortic stenosis.

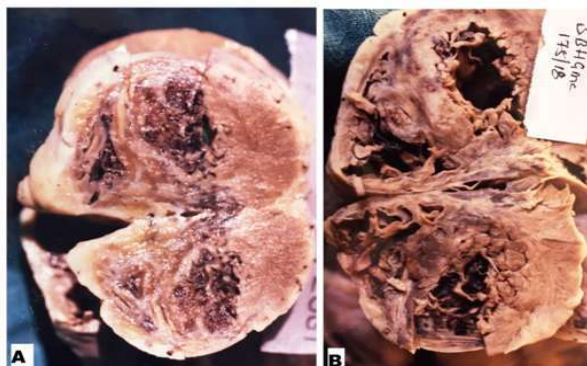


Fig. 2A: Showing apical mural thrombus. **B:** Showing recent and old infarct.

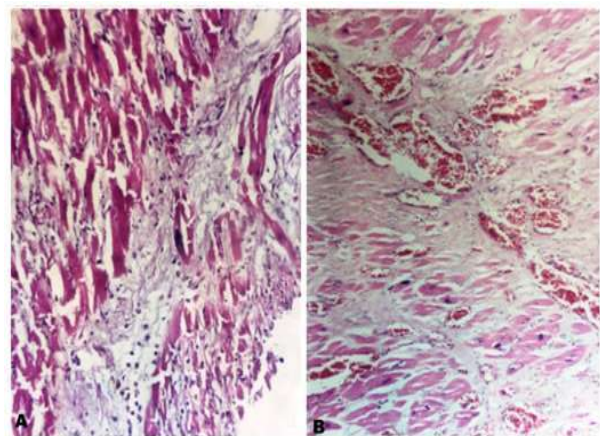


Fig. 5A: Showing well developed phagocytosis of dead cells and early formation of granulation tissue. **B:** Showing well established granulation tissue with neovascularisation and collagen deposition. (H and E 40x).

Discussion

The present study was conducted in tertiary healthcare centre of north Maharashtra region for a period of *two years*. A total 100 post-mortem hearts were grossly and microscopically studied. Out of 100 cases, incidence of myocardial infarction was seen significantly higher among male than females with ratio of 3.5:1. Maximum numbers of cases were found in age ranged from 40–59 years. In spite of this age range we found 5 cases of < than 30 years age, indicating. Also 60% of cases had history of chest pain, which were the most common presenting symptoms. Instead most of the cases had multiple symptoms like chest pain, breathlessness, Epigastric pain etc. and history of chronic diseases like diabetes & hypertension. In a study of 90 cases of sudden cardiac death by Farb *et al.* [6] revealed, 52% patients had witnessed collapse and in them 50% had chest pain or dypnoea or both, hypertension was found in 11 patients and diabetes in 9 patients.

In the present study, it was observed that 78% were male and 22% were female which are more or less similar to most of the studies done in the past. Beelwal *et al.*⁷ studied a total of 600 cases, 75 cases showed the changes of ischemia and MI and 467 (77.8%) cases were male and 133 (22.8%) were female. Ghag and Kulkarni⁸ studied 315 cases of myocardial infarction, most of the cases were found in 40–70 Years age group with male predominance. Joshi⁹ studied 115 cases of which Maximum no. of cases present between the age group of 41–60 years, 98 (85.21%) were male and 17 (14.78%) were female. Rao *et al.*¹⁰ studied 2449 cases of sudden cardiac deaths of which 104 cases 50.9% death due to MI with overall male to female ratio of 10:1, maximum number of cases found in age ranged from 40–69 years. Sweating was noted in 159 (77.9%) cases, dypnoea in 136 (66.7%), precordial pain in 161 (78.9%), vomiting in 157 (77.0%), cyanosis, and exhaust looking face in 110 (53.9%). Dhruva *et al.*¹² studied 360 cases in their study atherosclerosis of coronary arteries as predisposing factor in myocardial infarction. They revealed 73.6% were males & 26.4% were females. Most of the cases were seen in 30–60 years age group. Pandian *et al.*¹³ studied 120 cases of sudden cardiac deaths which Males ($n = 104$) were predominant over females ($n = 16$) in the ratio of 6.5:1. The age ranged from 17 to 70 years. Maximum number of death was in the age group of 31–50 years. Nisha *et al.*¹⁴ observed out of 200 heart autopsies, 184 males and 16 females and maximum number of cases belonged to 41–50 years of age group. Garg *et al.*¹⁵ examined 115 cases of post-mortem heart, 80.9% were males.

Most of the cases were found in 21–60 years age group. Porwal *et al.*¹⁶ studied 103 heart during autopsy, of these 74.75% were males quite higher than females (25.24%) forming a ratio of 3:1.

In present study, Atherosclerosis was found to the commonest etiological factor for MI. Left anterior descending artery 65 cases (70.65%) was most common predominantly involved artery by atherosclerotic narrowing *i.e.* more than 75% of the lumen. This follows right coronary artery 35 cases (38.40%) and left circumflex artery.

14 cases (15.21%). Calcification 48.91% has to be found the most common complication followed by thrombosis 14.13% and intraplaque hemorrhage 8.69%. In 5 cases (5.43%) plaque ulceration and in 4 (4.43%) cases endothelial erosion, thrombus was present overlying plaque. Out of 14.13% cases of thrombosis, in 8 cases thrombus were found within first 4 cms of left anterior descending artery and in 5 cases right coronary both proximally and distally. Infarct was noted in anterior and posterior wall respectively. Beelwal *et al.*⁷ found atherosclerosis in 52% of cases and the most common artery involved in atherosclerosis is left anterior descending, followed by left circumflex artery, and least involved is right coronary. Farb *et al.*⁶ also mentioned in their study that left anterior descending artery most common to involved by atherosclerosis accounting 68% followed by right coronary 50% and left circumflex artery 38% respectively. Ghag and Kulkarni⁸ had found atherosclerosis as most common etiological factor (288 cases), left anterior descending artery (74.65%) was the commonest involved artery by the atherosclerotic process (narrowing more than 70% of cross-sectional area of the lumen) followed by right coronary artery (33%) and left circumflex artery (25.34%). Complications of myocardial infarction were seen in 38 cases. Among them ventricular dilatation (17 cases) followed by mural thrombus (15 cases) was found as the most common complications of infarct. Joshi⁹ revealed atherosclerosis in 74/115 (64.34%) cases followed by myocardial hypertrophy in 60 (52.17%) cases, among 74 cases of atherosclerotic changes 13 cases were having calcification and 4 cases were present with thrombus in coronaries. Rao *et al.*¹⁰ stated that the left anterior descending artery (87 cases) and right coronary artery (17 cases) are the main arteries involved by the atherosclerosis causing sudden cardiac deaths. The most frequent affected site was proximal 3–5 cms of anterior descending branch of left anterior descending artery from its origin. Dhruva *et al.*¹² studied total 84 atherosclerosis cases & observed 14.28% calcification and 69.04% of the cases showed significant atheroma *i.e.* grade

4 to grade 7. Left anterior descending was most commonly involved coronary artery. Nisha *et al.*¹⁴ found out of 200 autopsied hearts, 142 (71%) revealed coronary artery atherosclerosis in one or more vessels. Left anterior descending artery was the most commonly involved vessels (137 cases), followed by right coronary artery (119 cases) and left circumflex artery (94 cases). Complicated plaques revealing atherosclerosis with calcification or acute coronary events (thrombus formation, plaque rupture and intramural hemorrhage) were observed in 53, 27, 9 cases respectively. Garg *et al.*¹⁵ revealed an average 3.09% calcification and 14.4% had capillary defect. 46.4% of the cases showed significant atheroma *i.e.* grade 4 to grade 7 amongst the atherosclerotic coronaries. Porwal *et al.*¹⁶ found left anterior descending artery as most frequently involved vessels in 46.6% cases followed by right coronary artery in 41.71% cases. Least frequently involved vessel was left circumflex artery in 38.83%.

Myocardial infarcts were seen in different areas of heart wall. Anterior wall of left ventricle was observed to be the most commonly affected by recent MI, but multiple anatomical site infarctions were seen in this study. Old infarct in the form of grayish white scar was present in 42% of cases. Out of 100 cases, 48 cases had transmural infarct and 8 cases with subendocardial infarct. Majority of the cases having one vessel disease 47.82% *i.e.* Only one vessel was significantly narrowed (> 75 of cross-sectional luminal area), followed by two vessel disease 30.43% and three vessel disease 21.73%.⁵

Farb *et al.*⁶ found one vessel disease in 44% of cases, two vessel disease in 32% and three vessel disease in 22% of the cases studied. Crawford⁴ found that anterior wall infarct 49%, posterior wall infarct 26%, lateral wall 14.58%, septal 2.08% and circumferential infarct in 6.25% of cases studied. Beelwal *et al.*⁷ revealed the maximum number of atherosclerosis cases involved triple vessels, followed by the double-vessel involved cases, and least involved cases were of single-vessel type. Ghag and Kulkarni⁸ found anterior wall is most predominantly involved area followed by posterior wall and lateral wall, Healed infarcts (52.38%) were found to be most common in our study, followed by acute infarcts (23.17%). In a study by Pandey *et al.*¹¹ the most common wall involved was anterior wall which is comparable to the present study. Joshi⁹ found 33 cases of MI out of which 15 cases were found to have old infarct. Rao *et al.*¹⁰ found their study of sudden cardiac deaths, MI cases were 49 (24.0%) recent and 55 (27.0%) old and the highest incidence in all three vessels was encountered in the age group of 50–59 years. Dhruva *et al.*¹² found

total 84 atherosclerosis cases, 31 had single vessel involvement whereas two vessels and three vessels were involved in 17 and 36 cases respectively. Nisha *et al.*¹⁴ found maximum cases (52%) had involvement of all the three vessels followed by one vessel (26.4%) and two vessel (21.6%) involvements. Garg *et al.*¹⁵ observed 115 cases of atherosclerosis; Out of these cases 13.3% had single vessel involvement whereas two vessels and three vessels were involved in 42.2% and 44.4% cases respectively. Porwal *et al.*¹⁶ studied 103 cases and observed single vessel involvement in 15% cases whereas two vessels and three vessels were involved in 37% & 40% cases respectively.

Conclusion

In this study we found a significant number of sudden deaths occurring in young adults, particularly in the age group 40–70 years. Chest pain was the most common presenting symptoms in this study followed by giddiness, sweating and breathlessness. Cardiac causes contributed the maximum number and atherosclerosis being the main culprit in causing myocardial infarction. One vessels disease most of them causing anterior wall infarction and histomorphologically maximum numbers of cases were of less than 12 hours duration.

Source(s) of support: None

Conflicting Interest: None

References

1. Elliot M. Antam and Eugene Braunwald: Acute Myocardial Infarction in Harrison's Principles of Internal Medicine, edited by Antony S Fauci, Braunwald E, 14th edition. McGraw Hill Book Company. 1998.pp.1352-74.
2. Frederic J Schoen: The Heart in Robbin's Pathologic Basis of Diseases, edited by Cotran RS, Kumar V and Collins J, *et al.* 6th edition,,WB Saunder company. 1999.pp.550-564.
3. WHO scientific group: The pathological diagnosis of acute ischemic heart disease, WHO Techn. Rep. Ser.;1970;pp.441-445.
4. U Crawford T. Sudden death as a manifestation of ischaemic heart disease in Pathology of Ischaemic heart disease, edited by Crawford T Butterworths, London-Boston; 1977.pp.77.
5. Mallory GK, White PD, Salcedo-Salgar J. *et al.* The speed of healing of myocardial infarcts: A study of the pathologic anatomy in 72 cases. American Heart Journal. 1939;18:647-71.

6. Farb A, Tang AL, Burke AP, . *et al.* Sudden coronary death: Frequency of active coronary lesions, inactive coronary lesions, and myocardial infarction. *Circulation*. 1995;92(7):1701-709.
7. Beelwal D, Pachori G, Sunaria RK, *et al.* A post-mortem study of coronary atherosclerosis and relationship to myocardial infarction in Ajmer region. *International Journal of Medical Science and Public Health*. 2017;6:563-68.
8. Ghag M, Kulkarni DG. Histomorphological evaluation of myocardial infarction: Autopsy study. *Indian Journal of Basic and Applied Medical Research*. 2018;7(2):201-7.
9. Joshi C. Postmortem study of histopathological lesions of heart in cases of sudden death-An incidental findings. *J Evid Based Med Health*. 2016;3(6):184-88.
10. Rao D, Sood D, Pathak P, *et al.* A cause of Sudden Cardiac Deaths on Autopsy Findings: A Four-Year Report. *Emergency*. 2014;2(1):12.
11. Pandey S, Jhanwar P, Jhanwar S, *et al.* A prospective study of Myocardial Infarction patients admitted in a tertiary care hospital of south-eastern Rajasthan. *Int J Biol Med Res*. 2012;3(2):1694-696.
12. Dhruva GA, Agravat AH, Sanghvi HK, *et al.* Atherosclerosis of Coronary Arteries as Predisposing Factor in Myocardial Infarction: An Autopsy Study. *Online J Health Allied Scs*. 2012;11(3):1. Available at URL: <http://www.ojhas.org/issue43/2012-3-1.htm>.
13. Pandian JR, Laishram RS, Kumar LD, *et al.* Autopsy review of sudden deaths in a tertiary hospital of north-eastern India. *J Med Soc*. 2014;28:145-48.
14. Nisha M, Bhawna S, Sumiti G, *et al.* Histomorphological spectrum of various cardiac changes in sudden death: An autopsy study. *Iranian Journal of Pathology*. 2011;1(6):179-86.
15. Garg M, Aggarwal A, Kataria S, *et al.* Coronary atherosclerosis and myocardial infarction. An autopsy study. *J Indian Acad Forensic Med*. 2011;33:971-73.
16. Porwal V, Khandelwal S, Jain D, *et al.* Histological classification of atherosclerosis and correlation with ischemic heart disease. A autopsy based study. *Annals of Pathology and Laboratory Medicine*. 2016;3(2):100-104.

