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Observations

The study comprised of 110 cases that were brought to mortuary of Department of Forensic Medicine, Maulana Azad Medical College for Mediocolegal autopsy during the period May 2000 to April 2001. Cases, showing signs of decomposition were not considered. Cases studied included deaths due to Road traffic accidents, burns, poisoning, asphyxia, and cases presenting as sudden deaths. Cases presenting as sudden unexpected deaths with history suggestive of heart disease were especially included. Detailed histories as to be circumstances leading to death, any past history of myocardial infarction, or symptoms suggestive of heart disease like, breathlessness, chest pain, collapse, were obtained from the relatives, inquest papers and wherever possible from the hospital records. In none of the cases was diagnosis of myocardial infarction made. In all the cases that presented as sudden death either the patient was found dead or was declared in the hospital as "brought dead".

Of the 110 cases studied 90 were males and 20 were females. The age wise distribution of cases is given in table-1.

Age group	Males	Females	Total
0-10	2	1	3
11-20	7	4	11
21-30	26	6	32
31-40	24	2	26
41-50	10	3	13
51-60	9	4	13
61-70	8	0	8
71-80	2	0	2
81-90	2	0	0
Total	90	20	110

Considering history and hospital records where available, of the 110 cases 46 cases were of head injury, 9 cases of hemorrhagic shock, 27 cases of burns, 3 cases of asphyxia, 5 cases of suspected

poisoning, 6 cases suspected myocardial infarction, 9 cases pulmonary tuberculosis, 5 cases where history was not available. Of these 20 cases presented as sudden unexpected deaths.

The epicardial coronaries and their major branches were examined by cutting serial sections transversely at 3 mm intervals and noted for the degree of stenosis, presence of calcification, thrombosis or hemorrhage into atheromatous plaques. The stenosis of the vessels was grades as

Grade 0 when the vessels show no stenosis and is free of an atheromatous plaques

Grade 1 when the stenosis is present and occludes less than 25% of the lumen, Grade 2 when the stenosis occludes 25 to 50% of the lumen, Grade 3 when the stenosis occludes 50 to & 0% of the lumen, Grade 4 when the stenosis occludes more than 75% of the lumen.

For a sake of comparison the right coronary system was studied as comprising of three segments, (1) The proximal 2 cms of the right coronary artery from the ostium (R_1) (2) from 2 cm beyond the ostium till the right lateral margin of heart (R_2) (3) The posterior descending artery (R_3)

On the left side of the left main trunk (L1) the left anterior descending artery (L2) and the left circumflex artery (L3) were studied.

INCIDENCE OF STENOSIS IN FEMALE SUBJECTS

20 hearts of female subjects were examined of which 10 showed no stenosis of any of the coronaries the oldest subject among them was of 25 years.

Right Coronaries

The proximal 2cm of right coronary artery showed (R1)

Grade-1 stenosis in 8 cases

Grade 2 stenosis in 2 cases

Grade 3 or grade 4 stenosis was not encountered.

The 2 nd of the right coronary artery (R2) showed

Grade 1 stenosis in 5 cases,

Other higher grades of stenosis were not seen.

The posterior descending artery (R3)

Showed grade 1 stenosis in 4 of the cases

Other higher grades of stenosis were not seen.

4 hearts showed some stenosis of the segment of the right coronary system. The youngest age which showed stenosis was 30 years.

Left Coronaries

The left main coronary (L1) showed

Grade 1 stenosis in 6 cases

Grade 2 stenosis in 2 cases

Grade 3 stenosis in 1 case,

Grade 4 stenosis was not seen

The left anterior descending artery (L2) showed

Grade 1 stenosis in 6 cases

Grade 2 stenosis in 3 cases

Grade 3 stenosis in 1 case.

Grade 4 stenosis was not seen.

The left circumflex artery (L3) showed

Grade 1 stenosis in 2 cases,

Grade 2 stenosis in 2 cases,

Grade 3 stenosis in 1 case,

Grade 4 stenosis was not seen.

None of the cases showed grade 4 stenosis and one case had grade 3 stenosis in the left main coronary.

The overall incidence of stenosis is shown below:

R1-50%

R2-25%

R3-20%

L1-45%

L2-50%

L3-20%

Grade 2 stenosis or more was seen in 2 cases in R1

No case showed grade 2 or more stenosis in R2 or R3

Grade 2 stenosis or more was seen in the L1 in 3 cases, L2 in 4 cases and L3 in 3 cases.

Table 2:

Incidence of stenosis of the various arteries in the female subjects

Arteries	Grade of Stenosis					Total	%
	0	1	2	3	4		
R1	10	8	2	0	0	10	50%
R2	10	5	0	0	0	5	25%
R3	10	4	0	0	0	4	20%
L1	10	6	2	1	0	9	45%
L2	10	6	3	1	0	10	50%
L3	10	2	2	1	0	5	20%

INCIDENCE OF STENOSIS IN MALE SUBJECTS

1. Males were examined.

14 cases showed no stenosis of any of the arteries, the oldest patient among these cases of 30 years i.e. above the age of 30 years some stenosis was always found in one artery or the other.

Right coronaries

Proximal 2 cm of the right coronary (R1) showed

- Grade 1 stenosis in 45 cases
- Grade 2 stenosis in 23 cases
- Grade 3 stenosis in 7 cases
- Grade 4 stenosis in 1 case

Total of 76 cases had some degree of stenosis (84.4%)

2nd part of right coronary artery (R2).

- No stenosis in 36 cases
- Grade 1 stenosis in 39 cases
- Grade 2 stenosis in 10 cases
- Grade 3 stenosis in 1 case
- Grade 4 stenosis in 4 cases

Posterior descending artery (R3)

- No stenosis in 65 cases
- Grade 1 stenosis in 19
- Grade 2 stenosis in 4 cases

- Grade 3 stenosis in 2 cases
- Grade 4 stenosis in no case

There was no case where the posterior descending showed stenosis without concomitant stenosis of the 1st and 2nd part of right coronary arteries. Only in 4 cases was the of stenosis in the distal part of right coronary artery (R2) higher than that of the proximal part R1, out of which in 1 case there was complete occlusion with pin point lumen of the 2nd part of the right coronary artery.

Left coronaries

The left main coronary (L1) showed

Grade-1 stenosis in 47 cases

Grade-2 stenosis in 23 cases

Grade-3 stenosis in 6 cases

Grade-4 stenosis in no case.

The left anterior descending (L2) showed

Grade-1 stenosis in 39 cases

Grade-2 stenosis in 19 cases

Grade-3 stenosis in 13 cases

Grade-4 stenosis in 5 cases

2 cases showed complete occlusion with pinpoint lumen and 1 case had thrombus lodged in the LAD.

The left circumflex artery (L3) showed

No stenosis in 37cases,

Grade-1 stenosis in 36 cases

Grade-2 stenosis in 10 cases

Grade-3 stenosis in 3 cases

And grade-4 stenosis in 3 cases

The earliest age at which stenosis occurred in any of the arteries was 22 years. The overall incidence of stenosis in The proximal part of right coronary artery (R1) is 76/ 90 - 84.4%

R2 - 54/90 - 60%

R3 – 25/90 - 27.8%

In the left main (L1) –76/90-84.4%

In the left anterior descending (L2) 76/90 - 84.4%

In the left circumflex artery (L3) 53/90 - 58.9%

The incidence of stenosis of grade-2 or above vessel wise in as follows

R1 - 31/90 - 34%

R2 - 15/90 - 16.6%

R3 - 6/90 - 6.6%

L1 - 30/90 - 33.3%

L2 - 37/90 - 41.1%

L3 - 16/90 - 17.8%

L1 has the maximum incidence of stenosis of grade 2 or above followed by R1, L1, L3, R2 & R3

25(27.7%) cases had involvement of all 3 segment of the right coronary system

53 cases (58.9%) showed involvement of all the 3 segments of the left coronary system. In all the cases the stenosis was due to atheromatous plaques. Thrombus was seen in only 1 case. All the lesions above grade 2 stenosis had some amount of calcification.

Table-3

Incidence of stenosis of the various arteries in male cases

Table 1 -4

Arteries	Grade of Stenosis					Total	
	0	1	2	3	4	No	%
R1	14	45	23	7	1	76	84.4
R2	36	39	10	1	4	54	60
R3	65	19	4	2	0	25	27.7
L1	14	47	23	6	0	76	84.4
L2	14	39	19	13	5	76	84.4
L3	37	36	10	3	3	53	58.8

Incidence of stenosis of the various arteries for all the subjects

Arteries	Grade of Stenosis					Total	%
	0	1	2	3	4		
R1	24	53	25	7	1	86	78.2%
R2	46	44	10	1	4	59	53.6%
R3	75	23	4	2	0	29	26.3%
L1	24	53	25	7	0	85	77.3%
L2	24	45	22	14	5	86	78.2%
L3	47	38	12	4	3	58	52.7%

HEART MUSCULATURE

The heart was weighed and the examination of heart musculature was completed by inspecting the heart as a whole and again by cutting transverse sections, about 10 mm thick across both the ventricles. After gross examination the heart slices were incubated in the staining solution maintained at $37^{o}C$ in a water bath for 15-40 minutes depending in the speed of deposition of the dye on the surface of the heart slices. This was done using N.B.T and T.T.C. methods for adjacent slices of the s same heart.

Ischemic changes in the myocardium were detected by gross histochemical staining in a total of 17 cases out of the 110 hearts studied.

There were 2 females both aged 60 years and 15 males in the age range of 21 to 71. 6 of the cases were in the age group below 45 yrs and 11cases were in the age group above 45 yrs.

In 11 of the cases obesity was present.

HISTORY AND TIME OF SURVIVAL

6 cases had a history suggestive of heart disease like chest pain, breathlessness. One case had history of previous heart disease who died of head injures subsequent to a fall. The periods of survival taken from the onset of the episode chest pain leading up to death ranged from 1 hour to 7 1/2 hours. The period of survival was calculated from the time of onset of chest pain or collapse in cases which had such a history. In deaths due to accident the time of the survival was calculated from the time of accident. In deaths with history suggestive of heart attack or previous heart disease - which were 7 in number, the period of survival ranged from 1 hour to 7 1/2 hours. The period of survival was not known in 3 cases because reliable history was not available. The other 10 cases which were deaths due to accidental trauma the period of survival ranged from 4 hours to 12 hours. In 2 of the cases the period of survival was not known.

Table-5: Period of Survival

Period of survival (in hours)	Cases
0-4	4
5-8	5
8-12	3
Not known	6

CAUSE OF DEATH

In 4 cases the cause of death was due to hemorrhagic shock.

In 7 cases the cause of death was cerebral damage.

In the other 6 cases the cause of death was heart failure.

Gross findings

Weight of the heart

Comparing the weight of the hearts in cases where ischemic changes were found

200-300gm 7 cases,

300-400gm 8 cases,

400-500gm 2 cases.

Stenosis of arteries

Table – 6

The incidence of coronary artery stenosis in the cases revealing ischemic changes after staining.

	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Total
R1	0	6	4	6	1	17
R2	3	4	6	0	4	14
R3	4	7	3	3	0	13
L1	0	4	7	6	0	17
L2	0	3	4	5	5	17
L3	1	5	6	2	3	16

Incidence of stenosis of various arteries is as follows:

R1 - 100%, R2 -82.3%, R3 - 76.4%

L1 - 100%, L2 - 100%, L3 - 94.1%

The 1st segment of right coronary artery (R1), the left main (L1) & left anterior descending (L2) showed stenosis in all cases.

The incidence of higher grades of stenosis (3 & 4) was as follows (1) LAD - 10 cases 58.8% (2) R1 - 7 cases 41.1% (3) Left main - 6 cases 35.3% (4) LCA - 5 cases 29.4%

Complete occlusion of the lumen with pin point lumen was encountered in the 2nd segment of RCA (*R2)* in 2 cases

In the LAD in 3 cases out of which a thrombus was found in 1 case.

In one of these cases complete occlusion with pinpoint lumen was seen in R2 and LAD.

Subendocardial hemorrhages were seen in 4 cases of the hearts which revealed ischemic changes.

Subendocardial hemorrhages are sign factors of marked hypotension; they are also seen sometimes in head injury cases and arsenical poisoning.

In 2 cases the cause of death was cranio-cerebral damage, in the other 2 cases it was due to hemorrhagic shock. Subendocardial hemorrhages were also seen in two other cases in which no ischemia was detected on staining. The cause of death in these cases was hemorrhagic shock and head injury. The time of survival was $1\ ^{1/2}$ hours $2\ ^{1/2}$ hours respectively.

Valves

Overt valvular lesions were found in 3 of the 17 cases. In one heart which weighted 500 gms there was incompetence of the aortic wall and the orifice was dilated. In the other heart which also weighed 500 gms there was incompetence of the mitral valve. 1 heart had stenosis of the Aortic valve.

Signs of fresh infarct on gross examination

Only in 3 cases did gross examination reveal pale areas of infarction and in 1 case there was mottled hemorrhagic appearance of infarct (total of 4 cases). Staining demarcated the infarct areas and they were found to be more extensive than supposed by gross examination. In the other 13 cases gross examination did not reveal any evidence of fresh infarction, which were revealed only by staining. Fibrotic areas of old infarct were seen in 2 hearts.

Staining

By staining techniques 3 types of infarcts were revealed

1. Transmural infarct involving the entire depth of the wall.
2. Subendocardial infarct where only the endocardial half of the depth of the wall is involved. These may of two types - total (Circular) and localized.
3. Complicating subendocardial infarct where in addition to a subendocardial infarction there is also a transmural infarction in another area.

8 cases out of 17 showed only subendocardial infarcts. 3 cases had both transmural and subendocardial infarcts. 6 cases revealed transmural infarcts and 5 cases had infarcted papillary muscle.

Table 7: **Distribution of types of infarcts**.

Type of infarct	Cases
Transmural	6
Subendocardial	
• Total	4
• Localized	4
Complicating	3

Location of the infracted areas:

- 8 cases which showed only subendocardial infarcts, 7 were of the left ventricle and 1 was of the right ventricle.
- In 3 cases subendocardial infarcts were a part of complicating infarcts (all of them in the left ventricle). A total of 11 cases had a component of subendocardial infarct.
- In 6 cases transmural infarcts were found and in 3 cases they were apart of complicating infarcts. A total of 9 cases had a component of transmural infarct.

- In 3 cases infarct area was seen only on the anterior wall of left ventricle.
- In 4 cases infarct areas were seen both on the anterior wall and septal wall of left ventricle.
- In 1 case infarct area was seen only on the lateral wall of left ventricle.
- In 1 case infarct areas were seen on both the anterior & lateral walls of left ventricle.
- In 5 cases one of the papillary muscles of the left ventricle was infarcted, in 3 of the cases it occurred in conjunction with subendocardial infarct, & in 2 cases complicating infarcts were present

Table - 8:

Location of the infarcts in the LV after staining

Table 9:

Anterior wall of LV	8
Septal wall of LV	4
Papillary muscle of LV	5
Lateral wall	2

Correlation of Grade of stenosis of R1 and Ischemic changes detected by staining.

Table 10:

	0	**1**	**2**	**3**	**4**
Ischemic changes absent	22 100%	47 (87%)	20 (83.3%)	3 (37.5%)	0 (0%)
Ischemic changes present	0 (0%)	7 (13%)	4 (16.7%)	5 (62.5%)	1 (100%)

Correlation of Grade of stenosis of R2 and Ischemic changes detected by staining.

Table 11:

	0	**1**	**2**	**3**	**4**	**5**
Ischemic changes absent	45 (93.8%)	40 (90.9%)	5 (41.7%)	1 (100%)	4 (50%)	0 (0%)
Ischemic changes present	3 (6.3%)	4 (9.1%)	7 (58.3%)	0 (0%)	1 (50%)	2 (100%)

Correlation of Grade of stenosis of R3 and Ischemic changes detected by staining.

Table 12:

	0	1	2	3	4
Ischemic changes absent	65 (94.2%)	27 (79.4%)	0 (0%)	0 (0%)	0 (0%)
Ischemic changes present	4 (5.8%)	7 (20.6%)	4 (100%)	4 (100%)	0 (0%)

Correlation of Grade of stenosis of L1 and Ischemic changes detected by staining.

Table 13:

	0	1	2	3	4
Ischemic changes absent	27 (96.4%)	45 (91.8%)	19 (76%)	1 (14.3%)	0 (0%)
Ischemic changes present	1 (3.6%)	4 (8.2%)	6 (24%)	6 (85.7%)	0 (0%)

Correlation of Grade of stenosis of L2 and Ischemic changes detected by staining.

Table 14:

	0	1	2	3	4	5
Ischemic changes absent	24 (96%)	41 (91.1%)	17 (85%)	10 (71.4%)	0 (0%)	0 (0%)
Ischemic changes present	1 (4%)	4 (8.9%)	3 15%)	4 (28.6%)	3 (100%)	2 (100%)

Correlation of Grade of stenosis of L3 and Ischemic changes detected by staining.

Table 15:

	0	1	2	3	4
Ischemic changes absent	48 (96%)	35 (85.4%)	8 (66.7%)	1 (33.3%)	0 (0%)
Ischemic changes present	2 (4%)	6 (14.6%)	4 (33.3%)	2 (66.7%)	3 (100%)

Correlation of the Maximum Grade of stenosis anywhere in the arterial system and Ischemic changes detected by staining.

Table 16:

		0	1	2	3	4	5
Ischemic changes absent		21 (100%)	41 (95.3%)	23 (79.3%)	7 (70%)	1 (33%)	0 (0%)
Ischemic changes present	SEI	0 (0%)	1 (2.4%)	3 (10.3%)	2 (20%)	1 (33%)	0 (0%)
	Others	0 (0%)	1 (2.4%)	3 (10.3%)	1 (10%)	1 (33%)	4 (100%)
Total		0 (0%)	2 (4.8%)	6 (20.6%)	3 (30%)	2 (66%)	4 (100%)

Sex distribution of ischemic changes detected by staining:

Ischemic changes by staining	Male	Female	Total
Present	15	2	17
Absent	75	18	93
Total	90	20	110

No significant association was seen between ischemic heart disease as detected by this study and sex of the subject (p =.36).

Table 17:

Distribution of study subjects by age and detection of ischemic changes of the heart.

Age	Ischemia Present	Ischemia Absent	Total
< 50 years	7	83	90
> 50 years	10	10	20
Total	17	93	110

There is a significant association between age and Ischemic heart disease as detected by this study and age. Subject of age >50 were thirteen times more frequently affected by this disease than those below age 50. (OR = 13.17, CI: 3.51 - 51.84).

Relation between Age, Weight and Body Mass Index

	Present	Absent	t value p value
		Ischemic changes	
Age (mean + S.D.)	53.12 + 15.63	36 + 18.1	3.65 at p.05(s)
Wt (mean + S.D.)	65.82 + 13.73	55.38 + 14.24	0.71 at p .05 (n)
B.M.I (mean + S.D.)	22.89 + 4.19	21.04 + 4.07	1.68 at p .05 (n)

(s)= Significant

(n)= Not significant

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