P58

LIST OF PROCEDURES DONE
PROJECT REPORT

TITLE OF THE PROJECT:

1. LIST OF PROCEDURES DONE
2. PROJECT I : FREE RADICAL ACTIVITY AFTER AORTO CORONARY BY PASS GRAFTING - PATTERNS AND CLINICAL SURGICAL CORRELATES.
3. PROJECT II : LEFT MAIN CORONARY ARTERY DISEASE - CLINICAL MARKERS, ARTERIOGRAPHIC APPRAISAL AND SHORT TERM - SURGICAL RESULTS

NAME..... DR K. SUNITHA KUMARI

PROGRAMME :..... DM CARDIOLOGY

MONTH & YEAR
OF SUBMISSION :..... NOVEMBER 1991

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY, TRIVANDRUM 695 011

Name	Dr K. Sunitha
Page	of
Date	6/11/91

Note:— (i) In the case compilation of procedures done, the contents and the subsequent pages should be made into different sections (a) Procedures done (b) Procedures assisted (c) Procedures participated (d) Procedures attended / participated etc. in Other Centres. Each section should be preceded by a leaf carrying the name of the section that is succeeding.

(ii) The Contents page will carry information as per model given under

PROCEDURES DONE

Closed Mitral valvotomy ..... 124 (say)

Patent ductus arteriosus-ligation 10

Atrial septal defects 20

PROCEDURES ASSISTED

Closed Mitral valvotomy ..... 100 (say)

(iii) In the subsequent pages details of each procedure done/assisted should be given in the format given below :—

Heading : Closed mitral valvotomy

Date	Name of the patient	Age	Sex	Patient No.

(iv) In the case of Project Report in the page immediately following the Certificate page the under-mentioned details should be given :—

(a) Title

(b) Duration

(c) Aim and scope

(d) 50 word summary of work done

CERTIFICATE

I, Dr. K. Sunitha Kumari .....hereby declare that I have actually performed all the procedures listed / carried out the project under report.

Signature Sunitha

Place : Trivandrum

Name in Dr K. Sunitha Kumari
capital letters

Date : 6/11/91

Forwarded. He has carried out the minimum requirement of procedures / etc.

Signature

Head of the department

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CONTENTS

LIST OF CARDIAC CATHETERISATIONS DONE

Sl. No.	DIAGNOSIS	HOSPITAL NO.	RHC	LHC	ANGIO
1.	V.S.D	8701438	+	+	+
2.	V.S.D	8803210	+	+	+
3.	V.S.D, A.R	8700411	+	+	+
4.	B.V.E.M.F	11951	+	+	+
5.	D.C.R.V, V.S.D	8802965	+	+	+
6.	A.S.D, P.A.H	8903046	+	–	+
7.	CONSTRICTIVE PERICARDITIS	8904547	+	+	+
8.	A.S.D (PRIMUM)	8707723	+		+
9.	R.V.E.M.F	8809003	+	+	+
10.	A.S.D	8904920	+	–	–
11.	RHD MS MR	2745	+	+	+
12.	TOF	15560	+	+	+
13.	A.S.D, MR.	8905094	+	+	+
14.	A.S.D	8906955	+	–	–
15.	CONSTRICTIVE PERICARDITIS	8909155	+	+	+
16.	V.S.D	8901101	+	+	+
17.	POST OF TOF	8708149	+	+	+
18.	P.D.A.	9000520	+	+	+
19.	A.S.D	8907509	+	–	+
20.	A.S.D M.R	2478	+	+	+
21.	TOF	8703542	+	+	+
22.	VSD PS	8901149	+	+	+
23.	PVLA-V FISTULA	905829	+	–	+
24.	ASD	9000338	+	–	–
25.	PDA	9008246	+	+	+
26.	TOF	8800984	+	–	+
27.	ASD MR	9100655	+	+	+
28.	VSD PAH	8907139	+	+	+
29.	VSD	9000707	+	+	+
30.	VSD PAH	9009692	+	+	+
31.	BV EMF	900443	+	+	+
32.	ASD	9001072	+	–	–
33.	ASD	9007423	+	–	–
34.	VSD	9001164	+	+	+
35.	TOF	8708562	+	+	+
36.	ASD	9001785	+	–	–
37.	TRICUSPID ATRESIA, V.S.D P.S	187955	+	+	+
38.	SEUEREVALPS	9103471	+	+	+
39.	PDA PAH	9100234	+	+	+
40.	2° ASD HOCM	9001742	+	+	+
41.	RSOV - RV	9005692	+	+	+
42.	CAD	9003350	–	+	+
43.	CAD	9103590	–	+	+

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Sl. No.	DIAGNOSIS	HOSPITAL NO	RHC	LHC	ANGIO
44.	VSD	9008547	+	+	+
45.	RSOV	8909552	+	+	+
46.	CAD	9010036	+	+	+
47.	CAD	9100508	–	+	+
48.	VSD	8704434	+	+	+
49.	TRICUSPID ATRESIA	8662387	+	+	+
50.	TOF	8900372	+	–	+
51.	TOF	9008448	+	+	+
52.	RHD MR AR	13122	+	+	+
53.	HOCM	9005996	+	+	+
54.	DCRV	8601998	+	+	+
55.	TOF	8605618	+	–	+
56.	VSD MR	9004669	+	+	+
57.	VSD	9103856	+	+	+
58.	CAD	9104390	+	+	+
59.	CAD	9101554	+	+	+
60.	TOF	890948	+	+	+
61.	PDA PAH	9004864	+	+	+
62.	SEVERE A.R	9100078	+	+	+
63.	COARCTATION	8907454	+	+	+
64.	RHD MR AR	8900147	+	+	+
65.	CAD	9006666	+	+	+
66.	CAD	9002761	+	+	+
67.	VSD PAH	11149	+	+	+
68.	PDA PAH	9009915	+	+	+
69.	VSD PS	8706487	+	+	+
70.	TOF	9100358	+	+	+
71.	ASP	11729	+	–	–
72.	TOF	9100182	+	+	+
73.	CAD	9100472	–	+	+
74.	TOF	870791	+	+	+
75.	TOF	8809387	+	–	+
76.	RVCMF	9103892	+	+	+
77.	VSD PAH	9102626	+	+	+
78.	TOF	19971	+	+	+
79.	VSD	8900422	+	+	+
80.	VSD	9006716	+	+	+
81.	TOF	37810	+	–	+
82.	PDA	27352	+	–	–
83.	ASD MR	8800038	+	+	+
84.	TOF	8806790	+	–	+
85.	PAH PR	8901229	+	+	+
86.	VSD ASD	8802315	+	–	+
87.	LVEMF	13333	+	+	+
88.	TOF	8901124	+	+	+
89.	ASD	8800673	+	–	+
90.	VSD PS	15978	+	+	+

Sl. No.	DIAGNOSIS	HOSPITAL NO	RHC	LHC	ANGIO
91.	V.S.D	8709722	+	+	+
92.	VSD	28979	+	+	+
93.	PDA	8804749	+	+	+
94.	MSMR	8803842	+	+	+
95.	TOF	8604756	+	+	+
96.	ASD MR	8607848	+	+	+
97.	VSD MR	8901760	+	+	+
98.	VSD PS	8803165	+	+	+
99.	TOF	38351	+	-	+
100.	VSD	8807267	+	-	+
101.	TOF	8804404	+	-	+
102.	TOF	28603	+	+	+
		Total	98	80	94

LIST OF ECHOCARDIOGRAPHIC PROCEDURES INCLUDING DOPPLER

Sl. No.	HOSPITAL NO	DIAGNOSIS
1.	8603788	TOF
2.	9009239	RHD MS
3.	8803427	Val PS
4.	9009295	Val AS
5.	9101593	PPH
6.	9007269	CAD LV FUNCTION
7.	8707358	ASD MR
8.	9101919	DORV
9.	8904648	d TGA
10.	9100783	DCM
11.	8909193	DCRV
12.	8806362	HOCM
13.	9004140	VSD
14.	8801678	VSD Dextro CARDIA
15.	8804317	SINGLE VENTRICLE
16.	9007185	DORV VSD AS
17.	9102419	TOF
18.	9102468	TGA
19.	11951	BV EMF
20.	8708557	SINGLE VENTRICLE PS
21.	9102747	VSD PS
22.	9101781	TOF
23.	38461	VSD PULMONARY ATRESIA
24.	9002245	TOF
25.	9102987	COARCTATION OF AORTA, EFE
26.	91002489	VSD PAH
27.	9009606	VSD PAH
28.	9003972	ASD PS
29.	8904384	RVEMF
30.	9008247	COARCTATION OF AORTA

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LIST OF TEMPORARY TRANSVENOUS PACING DONE

Sl. No.	HOSPITAL NO	DIAGNOSIS
1.	8901423	CHB
2.	21623	CHB
3.	9010221	HIGH GRADE AV BLOCK
4.	9010285	2:1 AV BLOCK
5.	9103621	SSS
6.	9104663	HIGH GRADE AV BLOCK
7.	9007733	CHB
8.	9104952	CHB WIDE QRS
9.	9103389	CHB
10.	9100634	AMI CHB

LIST OF ELECTROPHYSIOLOGIC STUDIES DONE

Sl. No.	HOSPITAL NO	PROCEDURE	DIAGNOSIS
1.	8900882	SINUS NODE FUNCTION	SSS
2.	8902427	HIS BUNDLE ELECTROGRAM	BIFASCULAR BLOCK
3.	8904025	SINUS NODE FUNCTION	SSS
4.	9006955	PES	VT
5.	9008764	HBE	2:1 AV BLOCK
6.	9009699	SINUS NODE FUNCTION	SSS
7.	9008990	PES	EBSTEINANOMALY WPW
8.	9007423	SINUS NODE FUNCTION	2° ASDI° AV BLOCK
9.	9103618	PES	VT
10.	9010295	PES	WPS SYNDROME

LIST OF PROCEDURES DONE
PROJECT REPORT

TITLE OF THE PROJECT:

FREE RADICAL ACTIVITY AFTER AORTOCORONARY BYPASS GRAFTING - PATTERNS AND CLINICAL - SURGICAL CORRELATES

NAME: Dr. K. SUNITHA KUMARI

PROGRAMME: D.M. CARDIOLOGY.

MONTH & YEAR OF SUBMISSION: NOVEMBER 1991

CERTIFICATE

I, Dr. K. SUNITHA KUMARI .....hereby declare that I have actually performed all the procedures listed / carried out the project under report.

Signature.....

Place: Trivandrum,

Date:

Name in capital letters: Dr. K. SUNITHA KUMARI

Forwarded. He has carried out the minimum requirement of procedures / etc.

Signature

Head of the department

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY, TRIVANDRUM 695 011

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CONTENTS

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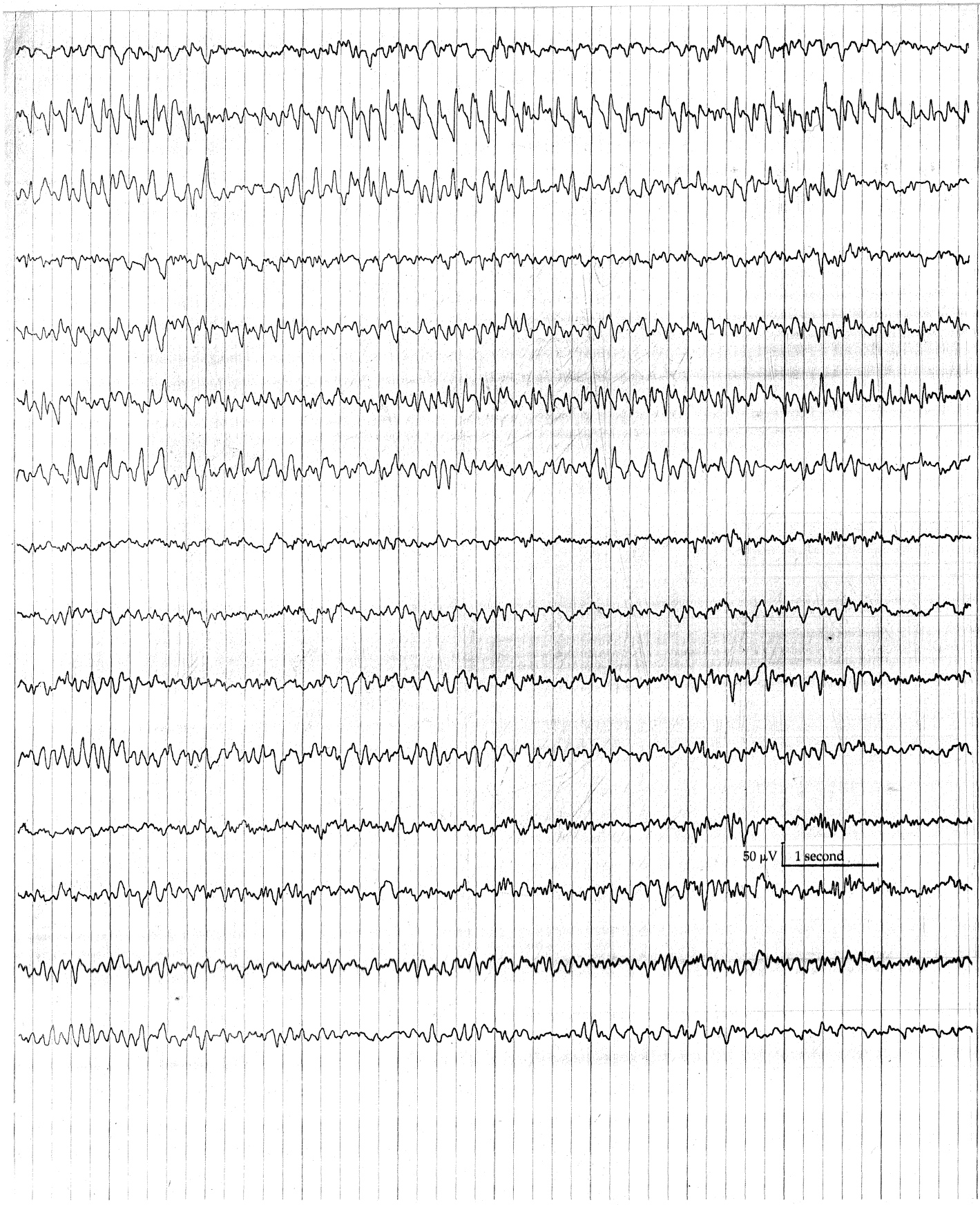
ABSTRACT

Free radical production may cause myocardial damage during reperfusion of ischaemic myocardial tissue. When free radicals interact with polyunsaturated fatty acids or their esters, lipid peroxides are produced. A product of lipid peroxidation, malondialdehyde, as an index of oxidant free radical activity, was measured in the plasma of 15 consecutive patients who underwent CABG at baseline, five minutes after releasing of aortic side clamp, 2 hours after CABG, day 1, day 4, day 6 and day 10. There was a highly significant rise (p less than .001) in the concentration of peroxidation products, (by analysis of variance) immediately after release of aortic side clamp, from 32 $\pm$ 14.3nm/gmalbumin before bypass to 37 $\pm$ 8.2 nm/gmalbumin after release of cross clamp. The levels rose to a peak of 67.6 $\pm$ 21.8 nm/gm albumin on the 6th day (p less than .0001). By logistic regression analysis there was no statistically significant correlation between the aortic occlusion time or total CPB time to the peak levels or absolute rise of peroxidation products. There was however a trend (trend p less than .015) towards increase in the peak levels of lipid peroxidation with increasing body surface area and a weak positive correlation was demonstrated between increasing number of grafts and increased concentration of malondialdehyde (r = .3).

However, a larger sample volume is needed before hard core conclusions can be drawn.

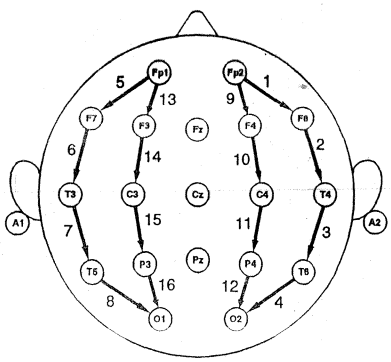


Rhythmic Temporal Theta Bursts (Psychomotor Variant)

Age 9

This drowsy record shows continuous rhythmical right posterior temporal and mid-temporal 5 Hz notched waves (channels 2–4). Rhythmical 5 Hz notched waves appear independently over the left posterior temporal and mid-temporal regions (1st, 3rd, and 7th seconds, channels 6–8). The activity sometimes appears as spikes in this longitudinal bipolar run (2nd second, channel 3, and 10th second, channels 3 and 7). The awake record was completely unremarkable with a 10–11 Hz alpha rhythm, which is visible in the first second of this tracing (channels 12 and 16).

The patient had frequent episodes of "dizziness" but no frank seizures.



INTRODUCTION

The stunned myocardium has recently become the focus of considerable interest because of its potential role in negating the benefits of reperfusion. A critical but still unresolved issue relates to the mechanism responsible for this contractile abnormality. In recent years an increasing number of studies have provided indirect evidence that post ischaemic myocardial dysfunction may be mediated in part by the generation of reactive oxygen species, such as superoxide radical, hydrogen peroxide and hydroxyl radical. The oxygen free radicals could arise from various sources such as hypoxanthine conversion by xanthine oxidase, catecholamine degradation and mitochondrial electron transport. Direct evidence of injury by free radicals has yet to be shown in the human heart, but studies of other mammals have linked reactive oxygen metabolites with myocardial injury.[1,2] . During myocardial ischaemia, xanthine dehydrogenase which appears to be located in the endothelial cell[3] is converted to xanthine oxidase, an enzyme that produces superoxide radical, hydrogen peroxide and uric acid from hypoxanthine or xanthine and molecular oxygen[4]. At the same time ischaemia is associated with rapid catabolism of adenosine triphosphate[4]. This breakdown of adenosine triphosphate causes an efflux of breakdown products that are able to pass through the cell membrane resulting in an accumulation of hypoxanthine, 1 of 2 substrates for xanthine oxidase. The other substrate

(molecular oxygen) is provided by reperfusion which results in a burst of free radical generation[5]. These oxygen free radicals have been directly detected by electron spin resonance[2], and free radical damage products have also been measured[6]. Myocardial reperfusion is associated with several potentially harmful effects, including transient impairment of myocardial function - stunning, an increased incidence of dysarrhythmias[7], and possibly increased myocardial necrosis[8]. These adverse effects can be reduced by treatment with various antioxidants at the time of myocardial reperfusion[9-10] which indicates that free radical formation is an important factor in their pathophysiology. But, how far can the results of these animal experiments be extrapolated to man? In particular, most animal studies have used a period of complete coronary artery occlusion of sudden onset followed by equally sudden myocardial reperfusion. This sequence would clearly be unusual in man, in whom coronary artery occlusion may be incomplete and myocardial reperfusion gradual. Thus it is important to look for evidence of free radical formation in man under conditions of controlled coronary artery occlusion and reperfusion. Recently few studies have addressed the issue of myocardial reperfusion and free radical mediated injury in the background of PTCA[11,12] and post thrombolytic therapy[13]. There has been only one previous clinical study[14] in humans as regards free radical activity after myocardial reperfusion by CABG. However they had not gone

into details of the patterns of release associated with free radicals nor the clinical surgical correlates affecting the levels of free radicals. Hence this study has undertaken to demonstrate these parameters. Free radical species are very short lived and can only be directly measured by electron spin resonance - a technique difficult to apply in man. However, when free radicals are produced, they react with various molecules to form products which can be measured as an indirect indicator of free radical activity. Lipid peroxides are produced when free radicals interact with polyunsaturated fatty acids or their esters. As an indicator of lipid peroxidation, we have measured malondialdehyde, a product of free radical attack on polyunsaturated fatty acids, in a group of patients who underwent CABG for coronary artery disease.

MATERIAL AND METHODS

Fifteen consecutive patients (aged 31-65 years) with severe coronary artery disease undergoing aortocoronary bypass grafting, were recruited (Table I). All had angina on effort and were receiving B adrenergic receptor blockers, nitrates, and calcium channel blocking agents. None had evidence of CHF.

PROTOCOL:

Peripheral venous blood samples were collected for assay of thiobarbituric acid reactive material (TBA-RM) in the plasma at baseline (morning of CABG - 0 hour sample), 5 mins. after release of aortic side clamp on completion of proximal anastamoses, 2 hours after cross clamp removal, day 1, day 2, day 4, day 6 and day 10. Care was taken to avoid use of venous tourniquet. The samples were collected in glass tubes and immediately capped and stored in the ice until separation and analysis, within 3 hours of sampling.

ANAESTHESIA, OPERATION AND CONDUCT OF BYPASS

After premedication with diazepam, morphine and glycopyrrholate, anaesthesia was induced with thiopental sodium (2 to 4 mg/kg) and muscle relaxation was achieved with pancuronium (140 to 200 mg/Kg. Ventilation was controlled with nitrous oxide (50% to 60%) in oxygen. Analgesia was administered, and cannulas were introduced into the aorta and right atrium. Bypass equipment constituted Sarns roller pumps and

membrane or bubble oxygenator. The pump oxygenator was primed with 2 L of Hartmann's solution with 50 mmol of sodium bicarbonate.

After institution of bypass at a flow rate of 2-4 $l/m^{-2}/min$. the aorta was crossclamped and 1 L of St. Thoma's Hospital Cardiologic solution at 4 deg.C was infused into the aortic root to provide myocardial preservation. At the same time moderate hypothermia was induced to give an oesophageal temperature of 27 ^{o}C to 30^{o}C and lung ventilation was discontinued. Mean arterial pressure was maintained at 50 to 60 mm Hg, with an infusion of sodium nitropruside if required. In all cases perfusion flow was non-pulsatile. After completion of all venoarterial distal anastamoses, the aortic cross clamp was removed and the proximal anastamoses were performed while the patient was being rewarmed to 37^{o}C with an aortic side clamp.

During this time myocardial activity returned spontaneously. After commencement of controlled ventilation, the bypass flow was reduced to zero over a 2 minute period before decannulation of the heart and aorta. At that time residual heparinisation was reversed with protamine sulphate (1 mg. for each 300 units heparin). No patient received blood or blood products during CPB.

LABORATORY METHODS

Products of peroxidation were assyed in separated plasmas by a modification of the TBA reactions.[15]

Reagent:

Stock: TCA-TBA-Hcl reagent containing 15% w/v TCA. 0.37% w/v thiobarbituric acid and 0.25 N Hcl. This solution was then heated for 15 minutes in a boiling water bath. After cooling flocculation precipitate was removed by centrifugation at 1000 g for 10 minutes. The absorbance of the sample was then determined at 535 nm against a blank. The MDA concentration of the sample was calculated using an extraction coefficient of $1.56 \times 10^5 m^{-1} cm^{-1}$. The value of TBA reactive products were expressed as nmoles/gm albumin.

Quality control of the assay was counterchecked by reestimation of the previous samples of the patient, when every new batch of reagent was used.

STATISTICAL ANALYSIS

The mean of plasma TBA-RM levels at different test points of time i.e. at 0 hr. 5 mins and 2 hours after release of side clamp, day 1, day 4, day 6, day 10 were calculated and were analysed for significant differences by analysis of variance (ANOVA).[16]

The association between the various clinical variables like age, height, BSA, previous myocardial infarction and number of vessels diseased and surgical variables like

number of grafts given, aortic occlusion time, total bypass time with the outcome i.e. peak levels of lipid peroxidation products and absolute increase of lipid peroxidation products over the baseline was studied by calculating the correlation coefficients as well as by logstic regression analysis.

In binarary logistic regression, the outcome was coded as more than 2 fold increase in peak level of TBA-RM as compared to baseline and in other situations an increase or decrease compared to baseline levels.

Any 'P' value less than 0.05 conferred statistical significance and a 'p' value between 0.05 and 0.10 was taken as that of borderline significance. All tests were two tailed.

RESULTS

PATIENT CHARACTERISTICS: (See Table I)

TBA-reactive products:

Mean malondialdehyde concentrations at baseline (see Table II) was 32.14 ± 14.13 nm/gmalbumin. There was highly significant rise in the levels (p less than .0001) from baseline at 5 mts, (36.75 nm/gmalbumin), 2 hrs (39.53 ± 9.7 nm/gmalbumin) day 1 (40.9 ± 13.27 nm/gmalbumin) day 2 (51.18 ± 11.9 nm/gm albumin) day 4 (54.6 ± 10.9) nm/gmalbumin) day 6 (67.6 ± 21.8 nm/gmalbumin) and day 10 (57.37 ± 14.9 nm/gmalbumin). The levels continued to rise beyond day 1, reached a peak around day 6, and then exhibited a gradual decline. But at 10 days the levels had not reached basal values, beyond which assay was not done (Fig. 1).

Of the clinical varialbles tested by logistic regression analysis that influence the peak levels of lipid peroxidation products (See Table III) there was a statistically significant correlation between the body surface area and peak levels (p less than 0.015). As the number of vessels diseased increased from 3 vessel disease to left main disease with three vessel disease the odds ratio for a rise in lipid peroxidation increased (0.7 Vs 2.8) this however did not attain statistical significance (p less than 0.07). Other variables like hypertension, smoking, diabetes mellitus,

duration of symptoms, history of previous myocardial infarction did not seem to affect the peak rise or peak levels of TBA-RM.

As regards surgical variables, the aortic occlusion time and the bypass time did not affect the peak levels of TBA-RM (Table IVa and b) (p less than 0.782 and p less than 0.66 respectively. Odds ratio was 0.5 and 0.75 respectively with aortic occlusion times less than 100 mins Vs more than 100 mins and 0.5 and 2 respectively with bypass times less than 150 minutes versus more than 150 minutes, for increase in TBA-RM levels.

The number of grafts given was found to have a positive correlation with the peak levels of lipid peroxidation products (p less than 0.23, odds ratio 3.00 - although not statistically significant) with number of grafts more than 4 versus number of grafts less than 4. (p less than 0.69 odds ratio 0.5) (Table IV.c).

There was also no correlation to the post operative outcome variables like cardiac status score and death(IV.d). The odds ratio for those with evidence of graft occlusion at re-exploration or as evidenced by perioperative myocardial infarction or angina was 0.27 Vs 1.2 (p less than 0.5) (Table IV c) compared to those without graft occlusion, angina or infarction.

TABLE I

Patient Characteristics:

No.	15
Age	31-65(Mean 50 ± 9.5) years.
BSA	1.75 ± 0.1702m^2
H/o previous MI	7/15
Duration of symptoms	8 months to 6 years.
Average workload attained at exercise) stress testing)	5.38 ± 2.99 METS.
Diabetes Mellitus	7/15
Hypertension	3/15
Smoking	9/15
Hypercholesterolemia	2/15
Coronary Anatomy	2 vessel disease 1/15
	3 vessel disease 11/15
	LMCA + 3 vessel disease 3/15
CABG	4.2 ± 0.86 grafts per patient.
Aortic occlusion time	62 Mins - 292 mins. (Mean 108 ± 58.6 min).
Total bypass time	142 mins/338 mins. (Mean 204.8 ± 57.23 min).
Death	2/15
Graft occlusion angina	4/15
Postoperative infections	2/15
Perioperative MI	1/15
Cardiac status core	(1 - 4 on a scale of 4)

(See Legend below).

Score 1 - 10
Score 2 - 2
Score 3 - 1
Score 4 - 2

(Cardiac status core:

1. Good haemodynamics with no support needed after day 1.
2. Good haemodynamics with mild inotropic support.
3. Fair haemodynamics with moderate support.
4. Poor haemodynamics despite optimal support.

TABLE II

TIMING OF PEAK ENZYME VALUES

Hours/day	No.of patients
5 minutes	0
2 hours	1
Day 1	1
Day 2	1
Day 4	1
Day 6	9
Day 10	2

FIGURE I

CONCENTRATION OF THIOBARBITURIC ACID REACTIVE MATERIAL (Mean + SEM) IN PERIPHERAL VENOUS BLOOD AT DIFFERENT STUDY POINTS:

TIME	MEAN CONCENTRATION OF TBA-RM nm/gm ALBUMIN
0 hour	32.1 ± 14.13
5 Mins.	36.75± 8.25
2 hour	39.53± 9.79
day 1	40.9 ± 13.27
day 2	51.18± 11.9
day 4	54.6 ± 10.9
day 6	67.6 ± 21.8
day 10	57.37± 14.9

ANALYSIS OF VARIANCE

$F = 15.86\ (7/88)$ $P < 0.0001$

TABLE III

RESULTS OF UNIVARIATE ANALYSIS OF CLINICAL VARIABLES INFLUENCING PEAK VALUES OF LIPID PEROXIDATION PRODUCTS BY LOGISTIC REGRESSION ANALYSIS

Factor	P Value
Age	0.98
Body Surface Area	0.15*
Previous MI	0.72
Duration of symptoms	0.31
Exercise performance	0.49
Diabetes Mellitus	0.93
Hypertension	0.71
Smoking	0.83
Hypercholesterolemia	0.27
No.of vessel disease	0.48

* TREND P VALUE SIGNIFICANT

TABLE IV

RESULTS OF UNIVARIATE ANALYSIS OF SURGICAL VARIABLES INFLUENCING PEAK VALUES OF LIPID PEROXIDATION PRODUCTS BY LOGISTIC REGRESSION ANALYSIS

	Factor		P value	Odds ratio	
(a)	Aortic occlusion Time less than 100 mins.		1	0.50	P = 0.96(NS)
	Aortic occlusion Time more than 100 mins.		0.782	0.75	
(b)	Bypass time -				
	Less than 150 mins.		0.57	0.50	P = 0.95(NS)
	151 - 200 mins.		0.66	2.00	
	More than 200 mins.		0.62	2.00	
(c)	No.of vessels grafted				
	3		0.609	0.5	P = 0.236(NS)
	4		0.57	2.00	
	5		0.236	3.00	
(d)	Cardiac status score		0.335	NS	
	Post.op. MI		0.433	NS	
	Death		0.962	NS	
(e)	Grap occlusion	Nil	0.762	3	P = 0.56
		Yes	0.362	0.278	
	Infection	Nil	0.566	0.71	
		Yes	0.448	2.8	P = 0.714

TABLE V (a)

COEFFICIENT OF CORRELATION (r values)
PEAK TOTAL PLASMA LIPID PEROXIDATION PRODUCT LEVELS

Sl.No.	Factor	'r' Correlation coefficient
1	Number of vessels diseased	0.05
2	Number of grafts	0.32
3	Aortic Occlusion Time	0.013
4	Cross Clamp Time	0.021

TABLE V(b)

COEFFICIENT OF CORRELATION - (r values)
ABSOLUTE INCREASE IN LIPID PEROXIDATION PRODUCTS

Sl.No.	Factor	'r' Correlation coefficient
1	Number of vessels diseased	0.016
2	Number of vessels grafted	0.25
3	Cross Aortic Occlusion Time	0.0161
4	Bypass time	0.012

There was a trend towards higher levels of peak peroxidation levels in those with perioperative infection Vs no infection (odds ratio 2.8 to 0.71) although not statistically significant) (Table IVc). The correlation coefficient between the (Table 5a) peak levels of TBA-RM and number of vessels diseased (r = .05) number of grafts given (r = 0.32) aortic occlusion time (r = 0.13) and cross clamp time (r = 0.02) did not attain statistical significance. Also the correlation coefficient between absolute increase in levels of TBA-RM and number of vessels diseased (r = .016) number of grafts (.05), aortic occlusion time - 0.016), bypass time (-.012) did not attain statistical significance.

DISCUSSION

In this study we have demonstrated that there is a significant increase in concentrations of peroxidation productions as evidence of free radical activity in the plasma after aorto coronary bypass grafting. This rise begins within five minutes of release of the aortic side clamp and beginning of myocardial reperfusion; continues to rise to a peak about 6 days and then takes a gradual decline. We could not demonstrate the time at which the levels fall to basal value as no samples were collected after day 10 by which time most patients were discharged after operation.

There has been only one previous human study which has addressed the issue of free radical release after aortocoronary bypass grafting[14]. In that study Roystan et al did measurement of the concentration of peroxidation products in plasma as an index of oxidant free radical activity in 11 patients undergoing CABG. Thesamples were collected over the entire operative period and showed a highly significant (p less than .001) rise in peroxidation products from 2.8 $\pm$ 0.12 nmol/ml before bypass to a peak of 5.05 $\pm$ 0.13 nmol/ml at the end of bypass. These changes occurred only after release of the aortic cross-clamp. However they had not gone into the pattern of rise after 30 minutes of release of aortic cross clamp

and beyond day 1; nor had they attempted to evaluate the clinical and surgical correlates of this rise in free radical activity. Malondialdehyde is found only in extensive peroxidation after rupture of the carbon chain of unsatuarated fatty acids. Malondialdehyde is however not the only degradation product. Nevertheless this relatively simple and sensitive method has been a major analytic tool for the study of lipid peroxidation in biologic systems through out the last 3 decades. What are the possible causes of this increase in free radical activity after CABG? This increase possibly implies an increase in oxidation of tissue membranes during reperfusion of the ischaemic myocardium by aortocoronary bypass grafting. The washout products from the reperfused coronary vascular bed may play a role in early release of lipid peroxidation products. However the aortic occlusion induced ischaemia and the whole body inflammatory response that follows CPB[17] may also have contributed to the rise in the levels. A considerable body of evidence suggests a central role of complement activation associated with CPB. It has been shown that complement is activated during CPB[18] and that split products of C_3 are released into the circulation[19]. Complemented stimulated neutrophils, initiate release of free radicals. In our study we found no or inverse correlation betweeh the aortic occlusion time, total bypass time and the peak levels or

absolute increase in the lipid peroxidation products. The only surgical variable that correlated atleast weakly, though not statistically significant (possibly due to the small samples size) was the number of saphenous vein grafts used. This may suggest that the peak levels of TBA-RM are more influenced by the amount of already ischaemic myocardium getting reperfused rather than by the ischaemia induced by surgical aortic occlusion, the effects of which are mostly counteracted effectively by excellent myocardial protection and cardioplegia. However comparative studies of free radical activities after other non-CABG cardiac surgeries under cardiopulmonary bypass and identical aortic occlusion times are warranted.

Among the clinical variables we found a statistically significant correlation (trend p value less than .015) between body surface area of the individuals and peak levels attained. This may probably be explained by the whole body inflammatory response that follows cardiopulmonary bypass[17]. Also, obviously the cardiac size increases corresponding to the body surface area and larger ischaemic hearts when reperfused may release larger amounts of free radicals.

In an elegant study of free radical activity at the time of successful thrombolysis by streptokinase by Davies et al[13], it was demonstrated that those patients who had

patent infarct related artery, the TBA-RM increased after streptokinase therapy by 105 nmoles/gm albumin, whereas patients with an occluded infarct related artery the TBA concentration decreased by 147 nmoles/gmalbumin (p less than .01). In that study, there was a weak correlation between the rise in TBA-RM and left ventricular ejection fraction.(R-0.3, p less than .02) in patients with a patent infarct related artery suggesting that residual impairment of left ventricular function after successful thrombolysis was due to reperfusion injury involving free radicals. In our study, the odds ratio for a rise in TBA-RM was 2.8 in patients with no evidence of graft occlusion Vs 0.7 in patients with evidence of grafts occlusion, suggesting that patients with evidence of graft occlusion had much lower levels of peak peroxidation products. The clinical utility of this pointer needs to be explored in further studies.

There was a weak correlation between the presence of post operative infection and peak rise in free radical levels. This may again be explained by additional release of free radicals by activated neutrophils from the infected site.

The sustained and continued increase in peak levels of products of lipid peroxidation upto the 6th day in most of the cases in our series is interesting and has not been previously reported. However this may correlate with the

experimental studies which have demonstrated that the return of contractility in myocardial tissue salvaged by reperfusion is delayed for hours, days or even weeks[20]- a phenomenon that has been termed - stunning or prolonged post ischaemic LV dysfunction. Stunned myocardium[21], has recently become the focus of considerable interest because of its potential role in negating the benefits of reperfusion. Myocardial stunning may be mediated in part by the generation of cytotoxic oxygen derived from radicals. However in our study, we had not looked into the left ventricular contractility parameters associated with the rise or fall in peak levels of TBA-RM. A study in this direction would certainly be worth while especially with the current enthusiasm of preventing reperfusion induced myocardial dysfunction with antioxidant drugs like nifedepine[22], allopurinol[23] etc. in the setting of coronary bypass surgery.

CONCLUSIONS

1) In a series of 15 consecutive patients undergoing CABG we have demonstrated that there is a significant rise in the levels of free radical activity - as reflected by levels of TBA-RM immediately after release of the side clamp, on initiation of myocardial reperfusion, followed by further increases at 2 hours, day 1, day 2, day 4 and peaking around day 6.

2) There was no significant correlation with the increase with free radical activity and the aortic occlusion time or total cardiopulmonary bypass time.

3) There was a trend towards, a weak correlation between the number of grafts given and the peak levels and absolute rise in products of lipid peroxidation. This correlation, although not statistically significant (possibly due to small sample size) - was stronger than the correlation between the peak level of lipid peroxidation products and the aortic occlusion and bypass times.

4) Patients who had evidence of graft occlusion tended to have, smaller rises or decrease in peak TBA-RM

compared to those who did not have evidence of the same.

5) Persistent elevation of products of lipid peroxidation upto 6 days after CABG may probably reflect underlying myocardial stunning. Further studies are needed in this direction.

LIMITATIONS OF THE STUDY

The major limitation was of the study was the small sample size. Hence statistically significant conclusions regarding the clinical surgical-correlates of the peak levels and absolute rise of TBA-RM could not be drawn. Nevertheless certain trends could be observed.

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LIST OF PROCEDURES DONE
PROJECT REPORT

TITLE OF THE PROJECT:

LEFT MAIN CORONARY ARTERY DISEASE.
CLINICAL MARKERS.
ARTERIOGRAPHIC APPRAISAL AND
SHORT TERM SURGICAL RESULTS.

NAME..... Dr. K. SUNITHA KUMARI

PROGRAMME : D.M. CARDIOLOGY

MONTH & YEAR OF SUBMISSION : NOVEMBER 1991

Note:— (i) In the case compilation of procedures done, the contents and the subsequent pages should be made into different sections (a) Procedures done (b) Procedures assisted (c) Procedures participated (d) Procedures attended / participated etc. in Other Centres. Each section should be preceded by a leaf carrying the name of the section that is succeeding.

(ii) The Contents page will carry information as per model given under

PROCEDURES DONE

Closed Mitral valvotomy ---------- 124 (say)

Patent ductus arteriosus-ligation ---------- 10

Atrial septal defects---------- 20

PROCEDURES ASSISTED

Closed Mitral valvotomy ---------- 100 (say)

(iii) In the subsequent pages details of each procedure done/assisted should be given in the format given below :—

Heading : Closed mitral valvotomy

Date	Name of the patient	Age	Sex	Patient No.

(iv) In the case of Project Report in the page immediately following the Certificate page the under-mentioned details should be given :—

(a) Title

(b) Duration

(c) Aim and scope

(d) 50 word summary of work done

CONTENTS

*****

CERTIFICATE

I, Dr. K. SUNITHA KUMARI .....hereby declare that I have actually performed all the procedures listed / carried out the project under report.

Signature .....

Place : Trivandrum,

Name in capital letters Dr. K. SUNITHA KUMARI

Date :

Forwarded. He has carried out the minimum requirement of procedures / etc.

Signature

Head of the department

ABSTRACT

Fortytwo patients had significant left main coronary artery disease out of 582 consecutive patients who had diagnostic coronary arteriography at our centre. Risk factor profile showed smoking in 61%, hyperlipidemia in 43%, hypertension in 35% and strong positive family history in 11%. 52% had evidence of previous MI, 50% being in the inferior posterior territory. 29 patients could undergo exercise stress testing. 78% patients had unstable angina. 50% had rest pains. TMT was positive in all. Mean workload attained was 5.2 ± 2.5 METS with 2.37 ± 0.96 mm ST depression and normalisation in 13.3 ± 6.8 minutes. Most patients had significant involvement of other vessels. 5 patients had isolated LMCA lesion. 7 patients had total occlusion of LMCA. 34 patients underwent CABG. 28 survived surgery of which 81% are asymptomatic. 2 patients had Class II angina and 1 patient with Class III angina awaits coronary angiogram. AfterCABG, repeat exercise stress test showed significant (P less than .001) improvement in workload attained from 5.5 ± 2.5 METS to 8.5 ± 2.9 METS.

INTRODUCTION

The left main coronary artery provides most of the blood supply to the left ventricular wall. Obstructive disease of the short segment or of its ostium may jeopardise most of the left ventricular muscle. That this disease carries an ominous prognosis is well established by autopsy studies[1] and by clinical reports[2]. An increased mortality rate during coronary arteriography and coronary artery surgery and poor survival rates without surgical intervention were reported in these patients. These observations underscore the importance of identification and selection of patients with left main coronary artery stenosis from patients with coronary disease without left main obstruction. In this study, our experience with 42 cases of left main coronary artery disease, over a 3 years period is reported.

MATERIAL AND METHODS

From 1988 through 1991, 582 patients with coronary artery disease underwent coronary angiographic studies, at SCTIMST Thiruvananthapuram. LMCA obstruction of 50% or more was found in 42 (7.2%). This group constituted material for this study.

The records of coronary arteriograms performed before February 1989 were reviewed. In addition, from February 1989 to July 1991, all patients who had LMCA obstruction of 50% or more were entered into the study in a prospective fashion. Detailed history regarding frequency of angina pectoris, past history of acute myocardial infarction, family history of coronary artery disease, was obtained. All patients had basal ECG, Chest X-ray and lipid studies. 29 patients underwent treadmill test by either Bruce or Modified Bruce protocol. All the patients were evaluated for risk factors.

Coronary arteriography was performed in all cases by the Judkin's technique. In all cases Urograffin 76 and pressure injector was used. In 35 patients LV angiogram was performed in RAO 30^{o}.

There were 40 males and 2 females. Their ages

ranged from 36 to 68 years with a mean age of 52 ± 7.9 yrs. 34 patients underwent CABG. 8 patients refused surgery due to personal or financial problems. Follow up information was collected in all patients at routine clinic visits or by post.

RESULTS

All except one patient had risk factors. Smoking was the most common risk factor as seen in 26 cases (61%). 18 patients had adverse lipid profile (43%), 15 patients (35%) were hypertensive, and 19 patients (45%) were diabetic. 5 cases (11%) had a strong family history of coronary artery disease. 29 patients had 2 or more risk factors.

78% patients had unstable angina. 50% had rest pains. 19% had stable angina. Total duration of symptoms was 1 month - 14 years (4.37 $\pm$ 4 years). There were 34 previous myocardial infarctions in 22 patients (52%). Of these, 12 (50%) had inferior wall myocardial infarction. 10(45%) had anterior wall myocardial infarction and 2(4%) had posterior or posterolateral wall myocardial infarction. 17 patients were in Killips Class I at the index myocardial infarction. 12 of these patients had inferior wall myocardial infarction. 4 patients were in Class II Killips all of whom had either Q wave or non Q wave anterior wall myocardial infarction. 1 patient who sustained an extensive anterior wall infarction was in Killips Class III.

Exercise stress testing was performed in 29 patients. In the remaining 13 patients, exercise

stress testing was deferred due to severe unstable angina.

In all cases exercise stress test was positive - 23 cases (80%) had strongly positive exercise stress test. The mean workload attained was 5.2 ± 2.5 METS. 5 patients (17%) had significant hypotension during the test. The magnitude of maximum ST depression was 2.8 ± 0.96 mm. All patients had downsloping or horizontal ST depression. Onset of ST depression was 2.37 ± 1.71 minutes with Bruce and 2.8 ± 1.2 minutes with modified Bruce protocols. 70% of patients did not attain target heart rate. 22 patients (70%) had ST changes in more than 5 leads. 21 patients attained less than 6 mets. 4 patients attained 10 mets or more (Table I) . ST segment normalisation post exercise took a mean of 13.3 ± 6.84 minutes.

At coronary angiography, there was no mortality. 10 patients had severe post procedural angina. Of these, 1 developed pulmonary oedema following LV angiogram and 1 patient had VF during RCA injection. Two patients had severe bradycardia with hypotension, of which one occurred 6 hours post procedure necessitating temporary cardiac pacing. 5 of the patients who developed post procedural angina underwent emergency CABG. All the five survived.

Mean basal LVEdp was 12.6 ± 6.1 mm Hg. 18 patients (42%) had regional wall abnormalities. Mean LVejection fraction was 59.7 ± 8.02%. 9 patients (21%) had calcified coronary arteries (Table II).

24 patients (57%) had 50 - 74% stenoses of LMCA. 11 patients (26%) had 75-99% stenoses. 7 patients (16%) had totale occlusion of LMCA (Table III).

In 38 patients (78.5%) the site of obstruction was the distal LMCA. 7% had osteal stenoses. 5 patients (11%) had lone LMCA lesion. Most patients, however, had significant involvement of other coronary arteries (Table IV). LAD was involved in 37/42 (88%). RCA was diseased in 33 cases (78.5%). Circumflex artery was involved in 24 cases (57%).

Coronary artery bypass graft surgery was performed in 34 cases (81%) 2.3 ± 1.9 months after diagnostic coronary angiogram. 8 patients refused surgery due to personal problems. 5 patients underwent urgent CABG following severe angina after coronary angiography. On an average each patient received 3.85 ± 1.3 grafts. 7 patients received IMA grafts. 2 also underwent endarterectomy of LAD. 1 patient had repair of LV aneurysm.

There were 6 perioperative deaths (17%). 3 of these had diabetes mellitus with diffusely diseased vessels. 1 patient was a redo CABG. The remaining 2 patients had total obstruction of LMCA. One of them was a 44 year female with 100% osteal stenoses of LMCA. None had any problem during induction of anaesthesia. 2 patients who died did not come off by pass. 1 had postoperative MI. 1 had primary pump failure. 1 patient developed fatal VF 6 hours after surgery. PM examination in the patient with perioperative MI showed extensive atherosclerotic plaques in all coronary arteries. In the last 12 cases of CABG, there was one death (8%).

The 28 surgical survivors had a follow up of 2 months to 28 months (mean 12 $\pm$ 11.8 months). 24 cases (86%) were asymptomatic. 2 patients (8%) had Class II angina. In one of these patients repeat coronary angiography showed tight stenoses at distal anastomotic site of LAD graft. One patient who continued to have Class III angina awaits repeat coronary angiograph. One 36 year old male, who underwent CABG for 70% LMCA stenoses developed recurrence of disabling angina 14 months after CABG. Repeat coronary angiography showed all grafts to be occluded with total obstruction of LMCA. He refused surgical intervention. 7 months later he died suddenly while quarrelling with somebody after an alcoholic bout.

The 8 patients who refused surgery had a mean follow up of 13.5 ± 8.5 months after diagnostic coronary angiogram. 1 of these was lost to follow up. 2 of these had no angina. Both had 50% stenoses of LMCA. 2 patients had class II angina. They also had 50% stenoses of LMCA. 2 patients had Class III angina, despite stiff anti-anginal medication. 1 patient had extensive anterior wall myocardial infarction and died of CHF 8 months after diagnostic coronary angiogram which had shown 90% LMCA obstruction with three vessel disease.

In 11 patients who had both pre CABG and post CABG exercise stress testing, the test was negative in 8 patients. The mean workload attained improved from 5 ± 2.8 METS pre CABG to 8.5 ± 2.9 METs post CABG (P less than 0.001)

TABLE I

WORKLOAD ATTAINED IN PATIENTS WITH LEFT MAIN CORONARY ARTERY DISEASE Vs PERCENTAGE OF LMCA OBSTRUCTION

METS attained.	% LMCA stenoses				Number of patients.
	50	51-75	76-99	100	
1 - 3	2	2	1	1	6
4 - 6	5	-	4	6	15
7 - 9	2	1	1	-	4
More than 10	3	1	-	-	4

TABLE II

CORONARY ARTERY CALCIFICATION IN PATIENTS WITH LEFT MAIN CORONARY ARTERY DISEASE

Number of patients.	Vessels calcified
1	LMCA
2	LM + LAD
1	LM + RCA
2	Circumflex
1	LMCA + LAD + Cx
2	LAD + Cx

LM : Left Main Coronary Artery.
LAD : Left anterior descending
Cx : Left circumflex coronary artery
RCA : Right Coronary artery.

TABLE III

TOTAL OCCLUSION OF LMCA
Patient characteristics

Age 49 ± 5.6 years.

Female 1 Male 6

7/7 Unstable angina 5.8 ± 2.6 months duration.

6/7 No previous MI

7/7 STS negative

5/7 Isolated involvement of LMCA

TMT 3.8 ± 0.98 METS

CORONARY ANGIOGRAM

3/7 - 100% osteal stenoses

3/7 - 100% Proximal LMCA stenoses

1/7 - 100% Stenoses of distal LMCA

TABLE IV

LMCA STENOSES - DISEASE IN OTHER VESSELS

%Stenoses	Number of patients		
	LAD	RCA	Cx
100%	12(27%)	13(30%)	4(9.5%)
75 - 99%	20(46%)	13(30%)	13(30%)
50 - 74%	5(11%)	7(18%)	7(18%)
Normal	7(16%)	9(22%)	8(43%)

DISCUSSION

LMCA disease constitutes a significant subset[1] of patients undergoing coronary arteriography. The incidence varies from 4.3% to 18.36%. Krishnaswami et al showed ostial lesion in 4.86% cases and stem lesion in 13.5%. Cases from 185[3] coronary angiograms. Pahlajani et al reported an incidence of 12% out of 425 consecutive coronary angiograms[4]. Cohen and Gorlin noted an incidence of 4.3% patients referred for diagnostic evaluation[5]. Proudfit et al reported an incidence of 5.9%[6]. De Mots et al reported 50 cases of LMCA obstruction out of 2100 coronary angiograms performed between September 1967 and May 1973 at the University Oregon School Hospital[7]. Dhar et al reported the incidence of 12.4%[8]. In our present study, 7.2% patients had LMCA lesion out of 582 consecutive coronary angiograms.

It has been suggested that presence of severe angina and marked ST depression induced by exercise allow preangiographic prediction of LMCA disease[9]. Cohen et al[10] also reported ST segment shifts of greater magnitude in LMCA patients. They demonstrated that ST depression greater than 2 mm is far more common in patients with LMCA disease than in patients with three vessel coronary disease not involving left main stem. Furthermore, patients

with LMCA stenoses appear to have a blunted chronotropic response to exercise and to achieve a lower maximal heart rate than the majority of patients with coronary artery disease[11]. In our patients, target heart rates, were achieved in only 30% of cases. Mean maximal ST depression produced at exercise stress testing was 2.8 ± 0.96 mm in our series.

Nonetheless, distinction of patients with left main and three vessel disease by clinical and exercise test variables remains largely unpredictable. Using 5 clinical and 11[12] exercise test variables, in 35 patients with left main disease versus 89 patients with three vessel disease, Donald et al found that patients with left main coronary artery disease had an earlier onset of ST segment depression 2.1 ± 1.4 mins. versus 2.8 ± 1.7 mins (P less than 0.05), which was more prolonged - post exercise - 8.7 ± 3.6 mins versus 6.9 ± 3.3 min (P less than 0.05) and appeared in a greater number of electrocardiographic leads (6.4 ± 2.2 versus 5.0 ± 2.2 leads, P less than 0.001) than did patients with three vessel coronary disease. Individual clinical or exercise test variables were unable to detect LMCA disease because of their low sensitivity or predictive values. The pattern of 2 mm or greater down sloping ST depression, which starts in Stage I, lasts at least 6 minutes into recovery and is displayed

in atleast five electrocardiographic leads was highly predictive (74%) and reasonably sensitive (49%) for the detection of either left main or three vessel coronary disease. These criteria had a sensitivity of 74% and predictive value of 32% for detection of isolated left main coronary artery disease. Hence Donald et al concluded that combining exercise test variables facilitates detection of severe coronary disease. However the specific presence of left main coronary artery disease nevertheless remains largely unpredictable even with this approach. Our patients also had onset of ST depression at 2.37 ± 1.71 minutes of Bruce Protocol. 85% of our own patients had ST changes in more than 5 electrocardiographic leads. This is in concordance with the series of Donald et al.[12]

In Pahlajani's series[4], there was one case with negative exercise test. Venkat Rao et al[13] did not have any case with negative stress test. We also did not have any case with negative stress test. We also did not have any case with negative stress that having LMCA disease in this series.

22/42 (52%) of our cases had evidence of old myocardial infarction. Of these, 50% had inferior wall myocardial infarction. This can be explained by the associated RCA involvement in 33 cases. Venkat Rao[13]

et al also reported previous myocardial infarction in 58% of their patients. In Pahlajani's[4] series only two patients had anterior wall MI, whereas we had 10 cases.

Although, fluoroscopy may identify calcification in the region of LMCA, this finding carries no prediction of severity or localisation of atherosclerotic obstruction[14]. 9 cases in our series (21%) had calcified coronaries at fluoroscopy. This incidence is much lower compared to Wasir's[15] series where incidence of coronary artery calcification in 35 cases with LMCA stenoses was 40.5%. In his series, sensitivity of fluoroscopy for detection CAD was low (13.8%) in patients with suspected CAD, though specificity was high (100%). Presence of coronary artery calcification, indicates high probability of severe multivessel CAD.

Early reports from 1972-74 concerning coronary angiography in patients with LMCA stenoses suggested a high risk with mortality approaching 20%[10,16]. Khaja et al reported no mortality in 28 patients in 1974[17]. Venkat Rao et al reported 1 death related to cardiac catheterisation in a series of 135 LMCA stenoses[13]. Presently, lower risk is reported with mortality figures approaching that for coronary angiography in other forms of coronary artery disease. The reasons for this improved risk is uncertain. It is possibly due to the precautions widely employed in

most laboratories also improved imaging techniques. We did not have any mortality in our series. Of particular note is the fact that in all cases Urograffin 76 was used and was delivered in most cases by pressure injector.

One of our patients had prolonged hypotension and bradycardia with angina six hours after the procedure and needed resuscitation and temporary cardiac paucing. This event was possibly precipitated by dehydration and hypovolemia in the post procedural period. Because dehydration, bradycardia and hypotension appear to be critical dangers for patients with LMCA disease, these patients should routinely be transferred to the Coronary Care Unit directly from the catheterisation laboratory and blood pressure, heart rate, fluid intake and electrocardiogram monitored for atleast 24 hours.

LMCA stenoses is generally accompanied by disease of the other coronary arteries[5,16,17]. In Venkat Rao's series[13] LAD was involved in 95%, circumflex artery in 65%, RCA in 121% cases and ramus intermedius in 2%. In our series 90% of patients, had involvement of LAD, 79% had RCA involvement and 57% had involvement of circumflex artery (Table IV).

5 out of 42 of our patients had isolated LM disease (11%) and 0.8% out of 582 coronary angiograms. Cohen and Gorlin reported 6 cases of lone LMCA lesion out of 735

coronary angiograms. Pahlajani[4] et al reported one case of syphilitic aortitis having lone LMCA obstruction. None of our own patients with total obstruction of LMCA had positive serologic tests for syphilis. Isolated obstruction of LMCA is exceedingly rare. The Coronary Artery Surgery Study reported the incidence as 0.06%. Our incidence of isolated obstruction of LMCA of 0.8% is significantly higher. Venkat Rao et al did not find any case of total occlusion in their series[13]. 7 out of 42 patients in our series had total obstruction of LMCA. The left ventricular function was normal in most cases. Mean LV ejection fraction was 59.7 ± 8.02% 42% patients had regional wall motion abnormalities. Pahlajani et al also reported normal LV function in most patients[4]. However Patrick J.Scanlon et al noted normal LV function in only 17% of their cases[18].

Surgical treatment for LMCA disease began in 1957. Sabiston et al in 1960 reported successful endarterectomy[19]. Subsequently mortality rates remained at 30-40% in 1970-71. In the VA Co-operative Randomized Study[20] the operative mortality declined from 25% during the first 2 years to 7% during the third year in patients with LMCA disease. Our experience reveals parallel trends. During first 2 years 27% of patients (6/22) had perioperative death. During the last one year, there was only one death out of 12 patients

who had CABG(8%). This can possibly be attributed to improved operator experience and careful patient monitoring and care during anaesthesia and perioperative period and better identification of high risk patients.

Bernard R. Chaitman et al[21] evaluated the clinical angiographic and surgical variables in 1172 patients with left main coronary artery stenoses of atleast 50% or more who underwent CABG in the Collaborative Study in Coronary Artery Surgery. The operative mortality was 4.2% overall and less than 3% in 7 of 15 participating hospitals. In that study emergency operations resulted in higher mortality rate (23%) than urgent (4%) or elective (2%). This mortality was much lower compared to the average mortality rate of 8% reported in other studies. Operative mortality increased with increasing degrees of LM coronary artery stenoses, was higher in left dominant systems and impaired LV function. Historical variables associated with an increase in operative mortality were age more than 60 years, female sex and duration and severity of angina.

Of the 6 patients in our series who died, 3 had diffusely diseased vessels, 2 had 100% stenoses of LMCA. 1 patient was over 63 years, one was of female sex. 1 case was a repeat revascularisation. Also learning curve may als o have been partly responsible as exemplified by only 1

mortality in the last 12 cases (8%). The patient characteristics of our surgical nonsurvivors are concordant with the results of the Collaborative Study in Coronary Artery Surgery regarding operative risk factors in left main coronary artery disease. Hence, aorto-coronary bypass grafting in patients with left main coronary artery disease can be performed with a low mortality and perhaps patients at high risk can often be identified before surgery and appropriate precautions taken. Recent advances in the preoperative management of the patient at high risk[22] and the use of newer techniques for intraoperative myocardial protection may help to reduce operative mortality further.

CONCLUSIONS

Our observations are in concordance with those of others regarding clinical, profile and incidence of LMCA disease.

Most patients with significant LMCA stenoses have strongly positive TMT at low workloads. More than 7 METs decreases the pick up rate. Upsloping ST depression is rare. Majority have ST depression in inferior, anterior and lateral leads. Coronary arteriography if carefully done is quite useful to delineate anatomy and is usually uncomplicated. Nevertheless, careful post procedural surveillance is warranted. Isolated LM stenoses is not really unusual. CABG provides effective symptom relief in most. Urgent CABG can usually be accomplished safely.

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