

## Total Occlusion of the Left Main Coronary Artery

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### Abstract

Complete occlusion of the main LCA is associated with a poor prognosis if the RCA becomes severely occluded. The functional role of collateral circulation is critical in this situation. This study lends support to the hypothesis that coronary collateral circulation can provide critically needed myocardial blood flow via right to left collaterals. Not surprisingly, left ventricular function was maintained in 4 of the 5 patients studied who had main LCA occlusion and well-developed collateral circulation.

### Introduction

Atherosclerotic occlusive disease of the main left coronary artery is seen in approximately 10% of patients undergoing coronary arteriography.<sup>1</sup> However, total occlusion of the left main coronary artery (TOLMCA) is rarely seen at coronary arteriography.<sup>2-10</sup> The Coronary Artery Surgery Study (CASS) reported only 12 (0.006 per cent) TOLMCA of the 2000, 197 patients entered in the study.<sup>2</sup> Additionally only 53 patients with TOLMCA were identified in a comprehensive literature review by the same study.<sup>2</sup>

The present study focuses on the clinical experience with this entity at the community hospital level, over a twelve year period.

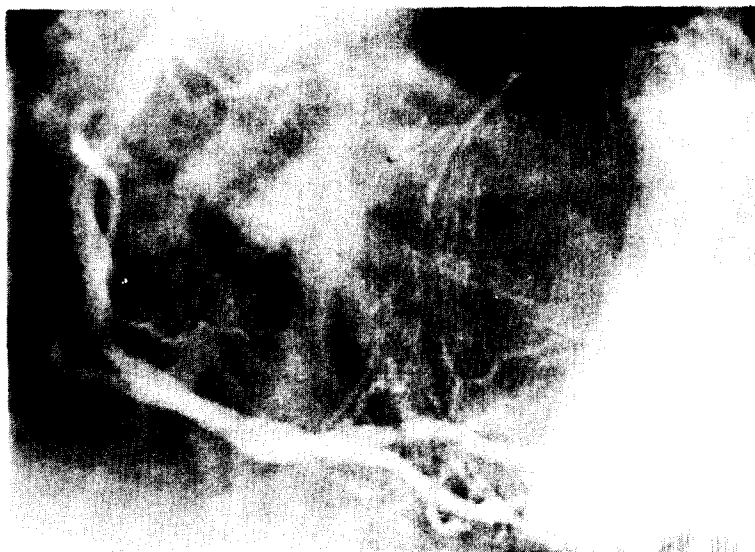
### Clinical Data

A retrospective review of the cardiac catheterizations done at St. Joseph's Hospital Health Center from 1968 through 1980 yielded five patients with total occlusion of the left main coronary artery. Six thousand (6,000) catheterizations were performed over that period, representing an incidence of 0.08 per cent.

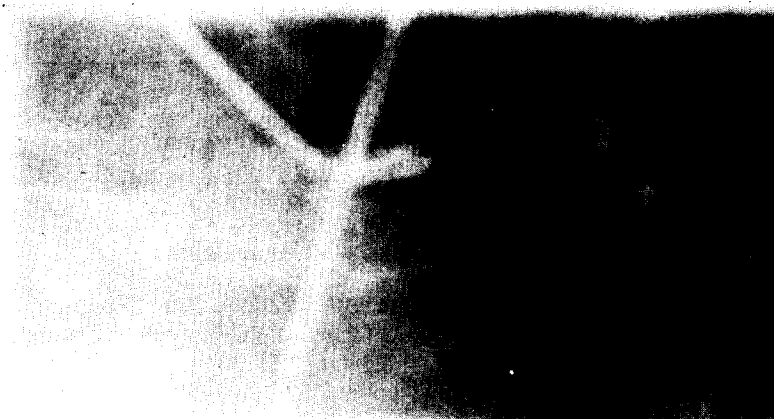
All cardiac catheterizations, electrocardiograms, chest roentgenograms, lipid profiles, and exercise tolerance tests were reviewed. Follow-up data was obtained by direct contact with the patient. Left heart catheterization and coronary arteriography were performed on all patients via the Sones technique. Diagnosis of total occlusion of the left main coronary artery was made if the left coronary system filled by collaterals from the right coronary artery (Figure one) and/or a definite stump was seen on injection of the left coronary ostium (Figure two)

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**Fig. 1.** Right coronary injection showing retrograde filling of the LAD and circumflex system.



**Fig. 2.** Left coronary injection visualizing only the left coronary artery stump with total occlusion distally.

## Results

Table one summarizes the clinical profile of the five patients with TOLMCA. All were male. The mean age was 54 years with a range of 40 to 64 years. All were New York Heart classification III-IV. All experienced angina greater than one year. Only two had ECG evidence of prior myocardial infarction. Of the three who had stress tests all were positive.

Risk factors included hypertension in one, diabetes mellitus in none, hypercholesterolemia in one, hypertriglycerademia in one, smoking in four, and positive family history in three.

Table two summarizes the hemodynamic and angiographic findings. Left ventricular function was evaluated in all. Ejection fractions (EF) were  $>50\%$  in four of five patients. Patient #4 had an EF of 26% with a left ventricular aneurysm. Three of five had extensive right to left collateral flow.

**Table 1.** Clinical Profile

Case No.	Age & Sex	NYHA Class/ Duration of Symptoms	ECG	Stress Test	Chest Film	*Lipid Profile Chol. Trig.	BP	Family History of CAD	Smok.	Diab.
1	59M	III/18 yr. progression last 2yr. AMI 18yr ago	LVH- Extensive Anterior MI	Treadmill >2mm ST at I Stage Bruce Protocol	Interstitial Pulmonary Fibrosis	236 146	N	No	Yes 20 p/y	No
2	64M	III/15 yr. progression over last 2 mo.	LVH	Not performed	Normal	232 162	N	Yes	No	No
3	52M	III/2 yr. progression over last 6 mo.	NS-ST-Twave changes	Treadmill >2mm ST I Stage Bruce Protocol	Normal	283 136	Y	Yes	Yes 100 p/y	No
4	40M	III MI/1 week prior	LVH Extensive anterior MI	Not performed	Mild Cardiomegaly	222 224	N	Yes	Yes 20 p/y	No
5	48M	IV/1 yr. Steady Deterioration	NS-ST-Twave Changes	Masters Test (single) 2mm ST	Mild Cardiomegaly	235 —	N	No	Yes 60 p/y	No

\*Normals: Cholesterol-up to 250  
Triglyceride-up to 210

Legend: LVH=left ventricular hypertrophy  
NS=non-specific  
BP=blood pressure  
N=normal  
Y=elevated

P/Y = pack years  
SMOK = smoking  
DIAB = diabetes mellitus  
CAD = coronary artery disease  
AMI = acute Myocardial Infarction  
LAD = Left anterior descending artery

Four of five patients underwent myocardial revascularization. Patient #5 declined operation and at autopsy one year later a patent right coronary artery and total occlusion of the left coronary artery was noted (Table III).

## Discussion

Total obstruction of the left main coronary artery is defined as total occlusion of the left main coronary artery before its bifurcation into the left anterior descending and left circumflex branches. Angiographically the present series included only those patients where a

definite stump was seen on injection of the left coronary ostium or where the left coronary system filled by collaterals from the right coronary ostium injection. Classification of collateral flow based on the CASS experience means substantial or extensive collateral flow occurs when part of the main channel of the LAD or circumflex vessel is seen. Limited or sparse collateral flow means no part of the left system is seen.<sup>2</sup> In our series extensive collateral flow occurred when the main left channel filled from the right system. Sparse collaterals occurred when only the distal LAD or circumflex vessels were visualized from right

**Table 2.**

Case No.	LVEDP (mm Hg) Rest/Angio/TNG	EF	LV Segmental Motion Abnormalities	Coronary Anatomy	Quality of Collaterals Extensive/Sparse
1	26 —	4 058	Ant. Lat. & Apical Hypokinesis	— Dominant RCA 75% Obstructed — MLCA 100%	From RCA to LAD From RCA to CX
2	6 27	3 0.69	None	— Dominant RCA 75% Obstructed — MLCA 100%	From RCA LAD & CX up to MLCA
3	8 30	12 0.66	None	— Dominant LCA 100% Obstructed plus LAD 50% & CX 50% — RCA Diminutive (no PDA) 50% Obstructed	From RCA LAD & CX up to MLCA
4	18 24	17 0.26	Ant. Lat. & Apical Aneurysm; Ant. Basal Hypo- kineses	Very Dominant RCA 75% Obstructed MLCA 1000%	From RCA to distal LAD From RCA to Obtuse Marginal Branch of CX
5	9 —	1 *	None*	— Dominant RCA 50% — MLCA 100% — CX 75% — LAD 50%	From RCA LAD & CX up to MLCA

RCA = right coronary artery  
MLCA = main left coronary artery  
CX = circumflex coronary artery  
LVEDP = left ventricular end diastolic pressure  
Angio = post left ventricular angiogram

TNG = post injection nitroglycerin  
ET = ejection fraction  
Ant. = Anterior  
Lat. = Lateral

\*Film partially destroyed LV & EF noraji from cthe report..

to left collaterals.

Total occlusion has been seen in congenital absence or atresia, syphilitic coronary ostial occlusion, congenital fusion of the left coronary cusp to the aortic wall, anomalous origin from the right sinus of Valsalva or proximal RCA, intimal dissection, and following prosthetic aortic valve replacement.<sup>3</sup> Yet the majority of cases are secondary to atherosclerotic obliteration as was the case in the present experience. The incidence of TOLMCA In the present series (0.08%) is similar to that of other reported series.

Knowledge of coronary artery anatomy and collateral circulation is necessary to understand the natural history of TOLMCA. The dominant coronary artery, usually right, is that main vessel which crosses the posterior intersection of the atrioventricular and interventricular grooves.<sup>11</sup> In 4 of our 5 patients, the RCA was dominant. Since TOLMCA jeopardizes over 40% of left ventricular myocardium, salvage of myocardium and patient survival is directly related to the degree or involvement of this RCA, and the development of collaterals. RCA obstruction in the dominant RCA ranged from

**Table. 3**

Therapy	Followiup
1) SVBG to CX & RCA	Class I-II 24 mos. Post op
2) SVBG to PDA LIMA to LAD	Class I-II 12 mos. post-op
3) Double SVBG to CX & LAD	Class I 32 mos. post-op
4) LV Aneurysmectomy SVBE to RCA	Class I-II 27 mos. post-op
5) Medical Therapy	Deceased 12 month post cath of acute MI Autopsy: Pulamony edema; Cardiomegaly; eol post MI; RC Patent;

Legend: SVBG = saphenous vein bypass graft  
LIMA = left internal mammary artery graff

59-75%. All developed significant collateral right to left flow.

This and other series suggest that TOLMCA is compatible with survival if adequate collateral supply develops from the RCA.<sup>2-10</sup> Yet, the precise quantitative relationship of collateral flow to LV function is unknown. Indirect supporting evidence for the protective role of collateral circulation comes from the observation that patients with left main disease and collaterals have a lower surgical mortality than similar patients without collagerals.<sup>4</sup> Certainly, gradual development of TOLMCA allows time for a functionally adequate collateral circulation to develop. A well-developed collateral circulation from a dominant RCA is sufficient to prevent catastrophic LV compromise and preserve LV function; it is insufficient to prevent ischemia or infarction when LV demand is increased.

In this series LV function was maintained in that angina was of long duration (>1 year) and CHF was not present in any patient. The ejec-

tion fraction of the LV was >500% in 4 of 5 patients.

This evidence supports the premise that collateral blood flow and retrograde filling of the left system from the right is important in maintaining both global and regional LV function.

Today there is virtual agreement that surgical myocardial revascularization is favored over medical management in patients with 50% or greater obstruction of the LMCA. This certainly applies to those with TOLMCA as well.

Crosby reported four patients with TOLMCA.<sup>5</sup> All underwent successful myocardial revascularization with long term benefit (9-38 months). Dlayda documents prolongation of life and alleviation of symptoms in a series of seven patients.<sup>6</sup> In the CASS experience, seven of twelve patients underwent myocardial revascularization.<sup>2</sup> Six were living at a mean follow-up of 46 months. Yet, only two of five patients not undergoing surgery were still alive at a mean of 45 months after entry into the study.

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## REFERENCES

1. proudfit WL, Shirey KS, Sones FM: *Distribution of arterial lesions demonstrated by selective cinecoronary arteriography. Circulation* 36:54-62, 1967.
2. Zimmern SH, Rogers WJ, Bream PR, et al: *Total occlusion of the left main coronary artery: The coronary artery surgery study (CASS) experience. Am J of Cardiology* 49:2003-2010, 1982.
3. Nili M, Vidne BA, Wurtzel M, Levy MJ: *Complete occlusion of the left main coronry artery: Successful surgical management by myocardial revascularization. Israel J Med Sci* 13:1118-1122, 1977.
4. Valle M, Virtanen K, Hekali P, Frick MH: *Survival with total occlusion of the left main coronary artery. Significance of*

- the collateral circulation. *Cath and Cardiovasc. Diag.* 5:269-275, 1979.
5. Crosby IK, Wellons HA, Burwell L: *Total occlusion of left coronary artery-incidence and management.* *J Thorac Cardiovasc Surg* 77:389-391, 1979.
  6. Elayda MA, Mathur VS, Hall RJ, Garcia EG, Decastro CM, Massumi GA: *Total occlusion of the left main coronary artery: Report of seven cases from 5312 cardiac catheterizations and review of the literature.* *Texas Heart Institute Journal* 9:11-18, 1982.
  7. Kershbaum KL, Manchester JH, Shelburne JC: *Complete left coronary artery obstruction.* *Chest* 64:539-540, 1973.
  8. Goldberg S, Grossman W, Markis JE, Cohen MV, Baltaxe Ha, Levin DC: *Total occlusion of the left main coronary artery-a clinical, hemodynamic, and angiographic profile.* *Am J of Medicine* 64:3-8, 1978.
  9. Greenspan M, Iskandrian AS, Segal BL, Kimbiris D, Bemis CE: *Complete occlusion of the left main coronary artery.* *Am Heart Journal* 98:83-86, 1979.
  10. Frye RL, Gura GM, Cheebro JH, Ritman EL: *Complete occlusion of the left main coronary artery and the importance of coronary collateral circulation.* *Mayo Clin Proc* 52:742-745, 1977.
  11. Gensini GG, Buonanno C, Palacio A: *Anatomy of the coronary circulation in living man, coronary arteriography.* *Dis Chest* 52:125-140, 1967.