

Correlation between Left main artery diameter derived by Finet's Law and direct angiographic quantitative coronary dimension analysis

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Abstract

Background and Aims: In the era of left main angioplasty, the aim of this study is to evaluate the applicability of Finet's law in left main diameter calculation and establish this as a useful feasible alternative tool to intravascular ultrasound in the left main intervention.

Methods: A total of 164 patients who underwent coronary angiography at PAHS due to suspicion of coronary artery disease between 1st January 2017 and April 2020 were included. The left main diameter (d_0 -QCA) was calculated using the Quantitative coronary angiographic (QCA) method and correlated with the Left main diameter (d_0 -finets) derived from Finet's law which takes into account the diameter (d_1) of the proximal left anterior descending (LAD) and left circumflex (LCX) artery diameter (d_2) derived from QCA, added together and multiplied by the factor of 0.678 i.e d_0 -finets = $0.678(d_1 + d_2)$.

Results: Using the Bivariate Pearson correlation method, d_0 -QCA was found to have a positive correlation with d_0 -finets with a correlation coefficient of ($r=0.721$) significant at the level of P value 0.01 (2-tailed).

Conclusion: The application of Finet's Law using the QCA method has been found to be a handy feasible alternative tool to intravascular ultrasound in calculating the left main diameter for the left main intervention where intravascular ultrasound is not available or economic constraint prevails.

Keywords: Coronary Angiogram, Left main coronary artery, Coronary artery disease.

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Introduction

Coronary artery disease (CAD) is the leading cause of mortality¹ and morbidity in both developed and developing countries like Nepal. Since the advent of the left main intervention by angioplasty, it is considered a science where mathematics has a vital role to play. The patients with multiple comorbidities are turned down by the heart team for surgery at times or denied by the patient themselves where left main intervention by angioplasty remains a last resort. Besides these, those with isolated left main disease and with double or triple vessel CAD with left main with a low syntax score 22² are more amenable to left main angioplasty. Left main angioplasty has become possible with the use of intravascular ultrasound (IVUS)³ which helps to determine the stent size, optimal stent apposition, and stent edge dissection. But in developing countries, the unavailability of IVUS and its high cost makes left main intervention difficult and at times impossible. Finet's law helps to calculate the diameter of parent vessel by adding the diameter of two daughter vessels multiplied by a factor of 0.678 elaborating the fractal nature of the geometry of the epicardial artery.⁴ When the left main is completely diseased it's almost impossible to guess or compute the size of the stent to be implanted in the absence of IVUS. The application of Finet's law may enable us to calculate the

left main size⁵ even without the help of IVUS and the cost incurred where resources and finances are limited.

The present study aimed to evaluate and establish the applicability of Finet's law as a feasible alternative tool to IVUS in left main intervention in order to compute the obscured left main size.

Methods

A descriptive retrospective observational study was conducted from Jan 2017 to Jan 2020. Purposive sampling was performed. 164 Patients with suspicion of coronary artery disease who underwent angiography during the aforementioned period were included. Patients whose left main, proximal LAD, and LCX was moderate to severely diseased, obscured left main and trifurcating left main were excluded from the study.

Proximal diameters of the main epicardial coronary arteries were measured quantitatively using automated QCA⁶ software analysis (Axiom, Philips). Calibration for the coronary diameter was performed with reference to the catheter diameter. This quantitative angiography with the help of the edge detection method helped in the calculation of the diameter of coronaries.

Two sets of data were generated for each record by two working groups for QCA analysis i.e Left the main diameter calculated by

QCA and another using QCA derived Proximal(P) LAD (d_1) and LCX (d_2) and feeding into Finet’s law formula i.e (diameter of the left main) d_0 -finets= $0.678(d_1 + d_2)$. (Figure 1).

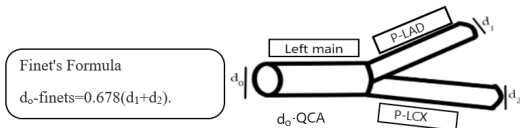


Figure 1: Finet’s Formula and Fractal geometry of Left main

Statistical analysis and result: Statistical analysis was performed using IBM SPSS for Windows version 21.0 software. The minimum age included in this study was 40 years and the Maximum was 88 years with a mean of 61.5 years comprising 48.4% Male and 51.6% Female respectively. The Minimum Left main diameter (d_0 -QCA) calculated by the direct QCA method was found to be 3.10 mm and the maximum was found to be 6.43 mm with a mean value of 4.69 mm. Similarly, the minimum left main diameter calculated by Finet’s law (d_0 -finets) was 2.82mm, and the maximum was found to be 6.72 mm with a mean of 4.78 mm.

Using the Bivariate Pearson correlation method, “ d_0 -QCA” was found to have a positive correlation (Figure 2) with “ d_0 -Finet’s” with correlation coefficient of ($r=0.721$) significant at the level of P value 0.01 (2-tailed).(Table 1.)

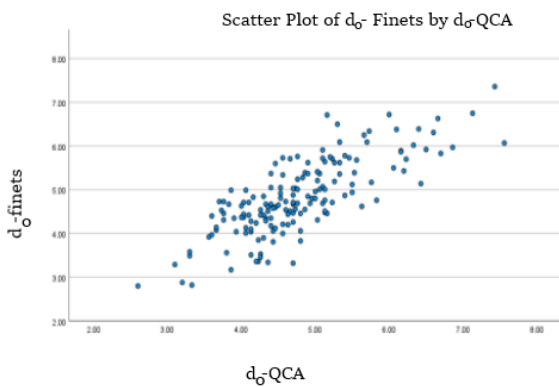


Figure 2: Positive correlation between d_0 -QCA & d_0 -finet’s

Table1: Bivariate Pearson correlation statistics. **Correlation is significant at the 0.01 level (2-tailed)

Correlations

		d_0 -QCA	d_0 -finets
d_0 -QCA	Pearson Correlation	1	.781**
	Sig. (2-tailed)		.000
	N	164	164
d_0 -finets	Pearson Correlation	.781**	1
	Sig. (2-tailed)	.000	
	N	164	164

Discussion

In this very era of left main angioplasty, it is an important factor to select a stent size as per the true estimate of the left main diameter in order to avoid any possible stent failure.⁷ In developed countries where IVUS is available, has become an integral part of the left main angioplasty as it helps to calculate the left main diameter and optimizes adequate stent expansion. But it adds on more cost to the patient. Additionally, the unavailability of IVUS in most of the intervention centers in developing countries discourages left main angioplasty. With a view to obviating the cost and making left main angioplasty service available, we have studied the feasibility of Finet’s law as a tool to calculate left the main diameter without using IVUS. To our expectation, the left main size calculation by Finet’s law had a positive correlation with direct QCA measurement with a significant P value of <0.05 .

Even in the absence of IVUS, obscure Left main diameter can be computed using Finet’s law and make left main angioplasty feasible without adding extra cost to the patient.

Limitations

QCA tracing method may produce inaccurate data. In order to minimize this, investigators with experience in doing more than 100 QCA were included in this study. Though this study is not fully blinded an attempt to minimize observer bias⁸ has been made by deploying two groups: one group measured the Direct QCA derived the left main diameter and another group deduced the left main diameter by using Finet’s law after feeding the QCA derived proximal LAD(d_1) and proximal LCX(d_2) diameter in the formula.

This study has not taken into account of head to head comparison of Finet’s law with IVUS analyzing hard clinical outcomes in terms of Major cardiovascular Events⁹ (MACE) and the need for repeat revascularisation but has obviously opened doors for such research in the future.

Conclusion

The application of Finet’s Law using the QCA method has been found to be a handy tool in calculating the Left main diameter for left main intervention as a feasible alternative to IVUS where IVUS is unavailable or economic constraint prevails.

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