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BRIEF COMMUNICATION

Is Fractional Flow Reserve Useful in Assessing Coronary Artery Fistula: A Case-Based Discussion and Review

Samual Hayman, MBBS, MSc, FRACP [a,b], Aashish Goela, MD [a,b], Shahar Lavi, MD, FRCPC [a,b*]

[a]Division of Cardiology, Department of Medicine, London Health Sciences Centre, London, Ontario, Canada
[b]Schulich School of Medicine, University of Western Ontario, London, Ontario, Canada

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We present two cases where fractional flow reserve (FFR) was utilised to guide management of coronary artery fistula (CAF), an approach advocated in recent case studies. CAF is a coronary anomaly that may present with a variety of syndromes though is frequently asymptomatic. When to exclude the fistula (surgically or percutaneously) is not always clear. A way to quantify if the fistula is physiologically meaningful would be advantageous. Our findings suggest FFR may only be assessing the concomitant epicardial coronary artery disease (CAD) rather than the degree of coronary steal and its routine use in this setting is not supported.

Keywords Coronary artery fistula • Fractional flow reserve • Coronary physiology • Adult congenital heart disease

Introduction

Coronary artery fistulas (CAF) have a reported incidence of ~0.2%. The majority are congenital and typically arise from one or more coronary arteries and terminate in the pulmonary vasculature or a cardiac chamber. Many remain asymptomatic but they can also present with a variety of syndromes including angina pectoris, dyspnoea, heart failure, arrhythmia and even myocardial infarction [1–3]. Reviewers of CAF have focussed on anatomic evaluation and symptoms alone to guide management [1,3]. Coronary steal and/or shunting are the usual proposed mechanisms of symptoms [2,4]. As CAF are often diagnosed at the time of angiography, an invasive method to quantify the physiological effect of the fistula may be advantageous in guiding management.

Case 1

A 59-year-old male underwent urgent angiography for chest pain and ST elevation. Examination revealed no murmurs and no evidence of pulmonary or systemic venous congestion. Background included transient ischaemic attack, smoking and hypertension. Angiography (Figure 1A) showed two moderate sized fistulae arising from the left main coronary artery (LMCA) and proximal left anterior descending (LAD) and terminating in the pulmonary artery (PA). There was a mild stenosis in the mid LAD. There was also a fistula arising from the right coronary artery (RCA). We performed a shunt evaluation and found a Qp:Qs of 1.0. Fractional flow reserve (FFR) of the LAD beyond the second fistula showed a baseline of 0.96 and a nadir of 0.92 after 240 mcg intracoronary (IC) adenosine.

Abbreviations: CAD, coronary artery disease; CAF, coronary artery fistula; FFR, fractional flow reserve; IC, intracoronary; LCA, left coronary artery; LCX, left circumflex; LMCA, left main coronary artery; MPS, myocardial perfusion scan; NSVT, non-sustained ventricular tachycardia; PCI, percutaneous coronary intervention; PA, pulmonary artery; RCA, right coronary artery

*Corresponding author at: Division of Cardiology, Department of Medicine, London Health Sciences Centre, 339 Windermere Road, London, Ontario, Canada., Email: shahar.lavi@lhsc.on.ca

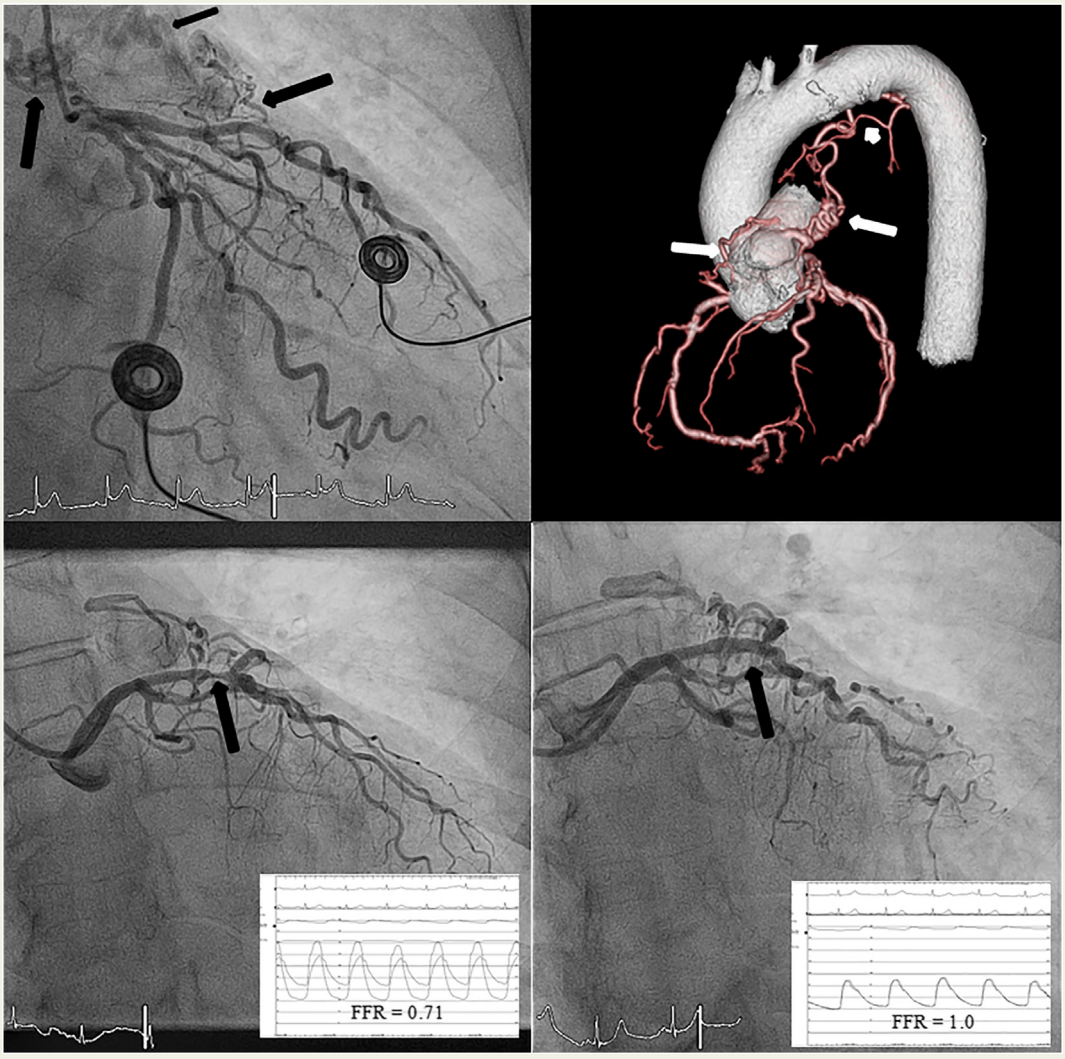

Figure 1 Case 1: Diagnostic angiography showing CAF terminating in the PA (small arrow) with origins arising from the LMCA and LAD (large arrows) (A). Computed tomography confirmed these findings (large arrows) and revealed an additional fistula from the aortic arch (small arrow) (B). Case 2: Angiography showing CAF and stenosis (C) (arrow). Post PCI with DES (arrow) (D).
Abbreviations: CAF, coronary artery fistula; PA, pulmonary artery; LMCA, left main coronary artery; DES, drug eluting stent; LAD, left anterior descending artery.

An echocardiogram showed no chamber dilatation or dysfunction. He was managed as pericarditis and the fistulae managed conservatively. Computed tomography coronary angiography (CTCA) confirmed the three fistulae seen at angiography and showed a fourth fistula arising from the descending thoracic aorta terminating in the PA (Figure 1B). He was asymptomatic at 6-week follow-up.

Case 2

A 72-year-old female with exertional dyspnoea, palpitations and presyncope came for coronary angiography after developing non-sustained ventricular tachycardia (NSVT) on her exercise test. Examination revealed no murmur or evidence of heart failure. Background included hypertension and gastro-oesophageal reflux. Echocardiogram showed no chamber dilatation and normal cardiac function. Coronary angiography showed a 75% stenosis in the proximal LAD just prior to a moderate sized tortuous CAF arising from the proximal LAD (Figure 1C). The FFR in the LAD with 120 mcg IC adenosine was 0.71. The patient opted for percutaneous coronary intervention (PCI) and a drug eluting stent (DES) (3.0 × 18 mm Xience Xpedition, Abbott Vascular, Santa Clara, CA, USA) was successfully deployed and post-dilated jailing the fistula (Figure 1D). The flow in the fistula did not decrease. The FFR post PCI with 120 mcg IC adenosine was 1.0 and the fistula managed conservatively. At 4-week follow-up the patient's symptoms (except palpitations) had improved.

Discussion

Current guidelines recommend closing CAF when there is: i) a large fistula, regardless of symptoms; or ii) a small or moderate fistula with ischaemia, arrhythmia, unexplained systolic or diastolic dysfunction or enlargement, or endarteritis (Level of evidence: C) [5]. We present two cases where FFR was utilised to guide management of CAF. The use of FFR to guide revascularisation in intermediate coronary lesions has been shown to improve outcomes and is a guideline recommendation [6,7]. Recently, a number of authors have utilised FFR in their assessment of CAF and advocated its use [8–11]. In the case of concomitant coronary artery disease (CAD) distal to the CAF, FFR has guided PCI with successful reduction in FFR and resolution of symptoms [8,11]. However, the residual FFR is not necessarily an assessment of the degree of coronary steal, with those authors reporting post PCI FFRs in a range of 0.87–0.96 [8,11], which is expected post routine PCI in the absence of CAF [12]. It is unclear how much contribution to the residual FFR is from the concomitant disease and how much from the fistula. The weight of evidence favours a small or even negligible contribution from the fistula. Our first case had a negative FFR (0.92) despite two moderate sized fistulae off the LCA and in our second case, the FFR post PCI, despite brisk flow in the fistula, was 1.0. It should be noted that PCI here limits treatment options to the fistula (percutaneous and surgical). Other authors report a negative FFR (0.87) guiding conservative management even in the setting of a ''huge" CAF and tandem stenosis beyond [10] (where one may expect coronary steal) or a negative FFR (0.91) even with a 50–60% concomitant stenosis [9]. We were only able to find one case where there was objective evidence of ischaemia in the apparent absence of concomitant CAD [2]. Our findings mirror those seen when assessing flow in internal mammary graft side branches, where significant steal has been questioned and disputed [13]. Another method of invasive assessment of a fistulas significance is shunt detection (Qp:Qs) by right heart catheter (FFR has no role here). Our first patient did not have evidence of shunting in keeping with the clinical picture. Patients with CAF frequently have small or normal Qp:Qs. Higher shunt fractions may be associated with higher likelihood of symptoms or complications [4], however, there is limited data associating shunt properties and outcomes [5].

Conclusions

Additional functional coronary assessment, rather than only anatomical, can enhance clinical reasoning and help guide management. This is clearly true in the setting of CAF and concomitant CAD. Whether FFR has any value in guiding management to the fistula is unanswered and further well-designed studies are required before routine use of FFR to assess CAF could be advocated.

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