Surgical treatment for a case of coronary steal from a traumatic coronary artery-cameral fistula after blunt cardiac injury

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ABSTRACT

INTRODUCTION: Blunt cardiac trauma covers a spectrum of injuries from clinically insignificant myocardial contusions to lethal ruptures of cardiac valves and chambers. Traumatic coronary artery-cameral fistulas (TCAF), abnormal connections between the coronary arteries and chambers of the heart, are a rare sequela of blunt chest trauma. They have an incidence of approximately 0.002% amongst the general population accounting for 0.1% of coronary anomalies [1]. Coronary artery fistulas secondary to trauma are rare and infrequently described in the literature with a majority as a consequence of penetrating injuries [2]. These fistulas may be asymptomatic at initial presentation but can progress to pulmonary hypertension, endocarditis, myocardial ischemia or life-threatening heart failure. Treatment options include surgical correction with ligation of the coronary artery, percutaneous closure, or the use of covered stents depending on patient presentation [1–3]. We present a case, in line with the SCARE criteria, of a TCAF secondary to a motor vehicle collision (MVC) that was diagnosed and managed operatively via coronary artery bypass due to coronary artery steal phenomenon [4].

1. Introduction

Blunt cardiac trauma covers a spectrum of injuries from clinically insignificant myocardial contusions to lethal ruptures of cardiac valves and chambers. Traumatic coronary artery-cameral fistulas (TCAF), abnormal connections between the coronary arteries and chambers of the heart, are a rare sequela of blunt chest trauma. They have an incidence of approximately 0.002% amongst the general population accounting for 0.1% of coronary anomalies [1]. Coronary artery fistulas secondary to trauma are rare and infrequently described in the literature with a majority as a consequence of penetrating injuries [2]. These fistulas may be asymptomatic at initial presentation but can progress to pulmonary hypertension, endocarditis, myocardial ischemia or life-threatening heart failure. Treatment options include surgical correction with ligation of the coronary artery, percutaneous closure, or the use of covered stents depending on patient presentation [1–3]. We present a case, in line with the SCARE criteria, of a TCAF secondary to a motor vehicle collision (MVC) that was diagnosed and managed operatively via coronary artery bypass due to coronary artery steal phenomenon [4].

2. Case report

The patient is a 53-year-old male who was involved in a MVC vs tree with loss of consciousness and was transferred to Advocate Christ Medical Center, a Level I Trauma Center. He had a history of hypertension, diabetes, hyperlipidemia, and alcohol abuse without known history of congestive heart failure (CHF) or cerebrovascular accident. Prior to transfer, he was intubated, had a right chest tho-
racostomy tube placed with 1 L of bloody output, and received 4 L of crystalloid and 4 units of packed red blood cells at an outside hospital. Upon arrival, he was tachycardic to 130’s and hypotensive with an initial BP of 90/53. There was no jugular venous distension or peripheral edema. A focused assessment with sonography for trauma (FAST) exam was negative for fluid in the 3 abdominal views and pericardial view, however, the heart appeared globally hypokinetic. An initial chest x-ray demonstrated a widened cardiac and mediastinal silhouette with further computed tomography angiography (CTA) imaging that demonstrated multiple bilateral rib fractures, pulmonary contusions, bilateral hemothoraces, and a retrosternal mediastinal contusion without evidence of dissection, aneurysm, or aortic injury (Fig. 1). Vasopressors were weaned off within the first day in the intensive care unit after continued resuscitation and blood pressures normalized, however the patient remained tachycardic.

Cardiology was consulted due to a concern for cardiac contusion with associated cardiogenic shock. Electrocardiogram demonstrated intermittent bifascicular block and the patient had an elevated troponin which peaked at 69.15 ng/mL. Initial echocardiogram on admission demonstrated normal systolic function, an ejection fraction of 55–60%, and no regional wall motion abnormalities. He was not a candidate for cardiac catheterization due to his hemothorax and given the low likelihood of thromboembolic etiology causing non-ST elevation myocardial infarction (NSTEMI), the patient was managed with systemic heparinization for 48 h, aspirin, statin, and beta blockers after blood pressure normalized. His hospital course was complicated by ventilator dependent respiratory failure from alcohol withdrawal and pulmonary edema.

He was extubated, and a repeat echocardiogram was performed on hospital day 9 demonstrating decreased ejection fraction to 45–50% and hypokinesis of the mid anteroseptal myocardium.

Subsequently on hospital day 16, a cardiac catheterization was performed demonstrating an abnormal oval structure associated with the left anterior descending and diagonal system suggestive of a pseudoaneurysm or aneurysmal segment of the left ventricle filling with contrast, but no significant obstructive coronary disease. Unfortunately, a cardiac magnetic resonance imaging (MRI) study was unable to further characterize the lesion secondary to body habitus and arrhythmias. Cardiac surgery was consulted to manage the coronary artery pseudoaneurysm and the decision was made to continue conservative management as the patient had pleuritic and positional chest pain, but no anginal symptoms.

The patient was discharged to cardiac rehabilitation, but two months later developed chest pressure and shortness of breath. A nuclear perfusion scan was performed and demonstrated reversible anterior wall ischemia in the distribution of the distal left anterior descending artery (LAD) concerning for steal phenomenon without elevated troponin. Coronary CTA was able to define a lesion posterior to the LAD that filled with contrast and became continuous with the right ventricle (Fig. 2). After extensive discussions, the decision was made to proceed with a staged approach starting with surgical revascularization of the LAD to bypass the fistula and perfuse the distal myocardium. Subsequently, further imaging would be performed to identify and potentially coil the fistula.

The patient was taken for a single vessel CABG using the left internal mammary artery (LIMA) to LAD. He was noted to have dense pericardial fibrosis intra-operatively increasing the likeli-
hood of a TCAF as compared to a chronic congenital anomaly. The patient tolerated the procedure well with an uneventful postoperative course and was discharged home without the need for further coiling.

3. Discussion

TCAF are a rare occurrence, even amongst penetrating thoracic trauma. The first successful surgical repair of a traumatic coronary artery fistula was reported by Kirklin and Barratt-Boyes in 1960 [5].

They can present dramatically with penetrating injuries and large fistulas leading to myocardial ischemia and cardiogenic shock or insidiously in the case of blunt trauma or smaller injuries with slowly progressive pulmonary hypertension, disabling angina and CHF. Due to the insidious nature of the presentation and progression, there is great variability in the delay to treatment with a wide range in the reported interval from injury to definitive fistula closure (1 week–36 years). However, as imaging technology has improved, the time to definitive treatment has decreased with an average interval of 65.8–71 months in the 1960’s down to 26–46.7 months in recent decades [2]. In our patient, surgical repair was performed 119 days after initial presentation utilizing cardiac catheterization, coronary CTA, and coronary MRI to pre-operatively characterize the lesion.

Potential fistula-related complications include coronary steal syndrome with secondary myocardial ischemia, coronary artery aneurysm, delayed coronary artery aneurysm rupture, and potentially irreversible CHF [2]. The natural history of TCAF with conservative management is unabated disease progression. The risk of morbidity from unrepaired fistulas outweighs the risk of operative management, thus early intervention is recommended to prevent the late complications. This is particularly true for symptomatic patients and traumatic etiologies which are less likely to resolve [6].

Indications for surgery include angina, myocardial ischemia, coronary steal phenomenon, hemodynamically significant left-to-right shunt with pulmonary-systemic blood flow ratio of more than 2:1, enlarging coronary artery or evidence of cardiac failure [2,3,5–10]. Coronary steal is described in cases in which ischemia of the myocardium distal to the fistula can be demonstrated through evidence of ischemic changes or infarction on electrocardiography, echocardiography, angiography, or on myocardial perfusion scintigraphy [7]. In the hemodynamically stable patient, a delayed repair can be considered to allow fibrosis of the defect edges to facilitate the repair and avoid recurrences [5].

The two best described operative approaches to surgical closure of the fistula are either via external ligation or direct visualization and repair from within the recipient chamber. In either approach, a bypass graft distal to the fistula site can be considered. Historically, there was a trend towards lower recurrence rates with closure from within the recipient chamber. However, in recent decades there has been no reported recurrences regardless of which fistula closure technique was utilized [2].

Additionally, in recent literature and specialized centers, transcatheter closure and conservative management has been described for select patients with congenital or small iatrogenic and traumatic fistulas [11–14]. Some techniques involve the use of coils, detachable balloons, covered stents, and vascular plugs when there is favorable anatomy [11,12]. The potential for transcatheter management requires a multidisciplinary approach involving interventional cardiology, interventional radiology, and electrophysiology with extensive preprocedural planning using both CT and routine coronary angiography [11]. Alternatively, small iatrogenic fistulas can be managed conservatively with one large series demonstrating a 76% incidence of spontaneous fistula resolution and 18% incidence of unchanged fistula size [2].

4. Conclusion

High levels of clinical suspicion and utilization of advanced imaging modalities are necessary for the early detection and diagnosis of TCAF. Early repair using the techniques of external ligation/obliteration, repair from within the chamber, or transcatheter interventions, with or without bypass, can help prevent late complications from disease progression such as congestive heart failure, myocardial ischemia, and death.
Conflicts of interest

The authors have no conflict of interest.

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Ethical approval

The Institutional Review Board (IRB) of our institution was consulted and appropriate ethical approval was granted.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Kevin L. Chow MD – data collection, wrote the paper.
Philip J. Alexander MD – operating surgeon, data collection and interpretation.
James P. Sur MD – consulting cardiologist, data collection and interpretation.
Ellen C. Omi MD – senior investigator, study concept, data interpretation and paper writing.

Registration of research studies

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Guarantor

Kevin L. Chow, MD.

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