Coronary Revascularisation in Cardiac Amyloidosis

Alexander Smith[1], Joy Edlin[1], Charles Hinds[1], and Shirish Ambekar[2]

[1]St Bartholomew's Hospital
[2]Saint Bartholomew's Hospital

July 20, 2020

Abstract

We present a case of coronary artery bypass grafting in a 78-year-old man with triple vessel disease and concomitant cardiac amyloidosis. Postoperatively he developed a profound low cardiac output state and multi-organ failure. He died 3 weeks following surgery. Bypass surgery is rarely performed in patients with cardiac amyloidosis, and there is little in the literature regarding outcomes. The few published cases present a bleak picture, and hence percutaneous coronary intervention should always be preferred.

Introduction

We present a case of coronary artery bypass grafting (CABG) in a patient with cardiac amyloidosis (CA) complicated by low cardiac output state (LCOS), multiorgan failure and death 3 weeks following surgery.

Case presentation

A 78-year old gentleman with wild type CA was referred for consideration of CABG. During an amyloid clinic walk test he suffered a cardiac arrest secondary to ventricular fibrillation. Spontaneous circulation returned after a single direct current electrical cardioversion. Myocardial ischaemia was thought to be causative and coronary angiography revealed triple-vessel coronary artery disease with left main stem involvement (Fig 1). Cardiac magnetic resonance imaging (Fig 2) was characteristic of CA, with severe biventricular hypertrophy, mildly reduced left ventricular ejection fraction (LVEF) of 58%, and severely reduced longitudinal function of both ventricles. On tissue characterisation transmural late gadolinium enhancement was present with biventricular involvement.

Other medical history included percutaneous intervention (PCI) to the left anterior descending artery (LAD) 2 years previously and paroxysmal atrial fibrillation. The patient's baseline functional classification was New York Heart Association II.

The case was discussed in the coronary intervention multi-disciplinary team meeting. Input from amyloid specialists suggested that if the patient were not to have coronary artery disease, prognosis for CA would be 60-84 months. Euroscore II suggested a 2.32% mortality risk, but due to the severity of CA this was felt to be a considerable underestimate. Given complex coronary anatomy and left main stem involvement, albeit in the presence of CA, consensus decision was for high risk inpatient CABG. Considering good LVEF of 58% and excellent functional baseline, a balanced mortality risk of 5-8% was quoted.

Surgery took place two weeks later. The heart was extremely hypertrophic and beefy, and cardiac manipulation was impossible. Peri-operative TOE revealed severe biventricular hypertrophy with preserved systolic function. Three bypass grafts were undertaken: saphenous vein conduits to the posterior descending artery and first obtuse marginal, and pedicled left internal mammary artery to the LAD. The patient came off

cardiopulmonary bypass easily on low dose milrinone. In view of severe LV hypertrophy, an intra-aortic balloon pump was placed via the right femoral artery.

Over the next 24 hours the patient became increasingly hypotensive and vasoplegic. Worsening metabolic acidosis ensued despite fluid resuscitation and increasing vasopressor and inotropic support with noradrenaline, vasopressin and milrinone. A Swan-Ganz catheter was inserted, and cardiac index calculated at 1.8L/min/m2 with low systemic vascular resistance. TOE showed a small pericardial collection. Given continued deterioration, the patient returned to theatre for re-sternotomy to exclude tamponade. All conduits were patent, and whilst some clot was evacuated from the pericardium there was no consequent change in haemodynamics. The chest was closed, and the patient returned to ICU with an adrenaline infusion added.

Over the following days the clinical condition slowly improved. Inotropic and vasopressor requirements decreased, and the balloon pump was removed 3 days postoperatively allowing tracheal extubation. As a result of prolonged LCOS, liver and renal failure ensued. The patient developed marked jaundice and required continuous renal replacement therapy. Haemodynamics continued to stabilise over the subsequent 2 weeks allowing weaning of inotropic support. Despite this, there was no resolution of organ failure and he remained jaundiced and filter dependent. Three weeks following surgery the patient again deteriorated with a profound LCOS, requiring increasing doses of noradrenaline, milrinone and adrenaline. Echocardiogram showed severe biventricular impairment with low stroke volume and high filling pressures, but no evidence of tamponade. In the context of CA and multi-organ failure, consensus opinion was that further intubation, ventilation, and organ support would be futile. Following family discussions, a do not resuscitate order was completed and decision for no further escalation in treatment agreed. The patient died shortly thereafter.

Comment

Amyloidosis is a group of rare heterogenous diseases characterized by the abnormal extracellular deposition of toxic insoluble fibrillar protein that aggregates in different tissues. The incidence of CA is estimated at 18-55 per 100000 person-years and is commonly associated with immunoglobulin light chain (AL) or transthyretin amyloid (ATTR) (1). AL is a result of extracellular deposition of fibril-forming monoclonal immunoglobulin light-chains, usually secreted by a plasma cell clone. ATTR is most frequently wild-type (wtATTR) and acquired, associated with a male gender, and increasing age, but may be hereditary with mutated forms of transthyretin (2). The dominant pathophysiology of CA is biventricular restrictive cardiomyopathy and resultant diastolic followed by systolic heart failure. Common complications include conduction disorders, embolic events, and syncope. In the absence of epicardial coronary artery disease, angina is associated with obstructive intraluminal coronary microangiopathy. CA carries a poor prognosis, with a median survival of 24-66 months in AL, and 75 months in ATTR (2).

Treatment involves management of heart failure using loop diuretics and aldosterone antagonists; beta blockers and ACE inhibitors are often not tolerated. The underlying disease can be targeted with chemotherapy +/- autologous stem cell transplantation to eradicate the plasma cell clone responsible for AL amyloid, and in wtATTR Tafamidis given (a drug which stabilizes the transthyretin tetramer and therefore may reduce the formation of ATTR amyloid) (3).

Management of coronary artery disease with co-existing CA is challenging. What angiographically appears as surgical disease does not exclude underlying obstructive intraluminal microangiopathy, and results of revascularisation are therefore difficult to predict. Current preoperative risk models such as Euroscore II are invalid in patients with CA, as diastolic dysfunction is not considered. Usual indicators for pre-operative risk such as functional status and LVEF may offer false reassurance.

There is a growing body of evidence for the association between aortic stenosis and CA, with this subgroup of patients at increased risk following surgical valve replacement (4). Although more limited, current evidence of mitral valve surgery in patients with concomitant CA report excellent outcomes (5). Data on bypass surgery is far more limited but given reasonable reported outcomes in other cardiac surgical procedures, our initial view was that surgery, whilst high risk, was a reasonable approach. Subsequently, we are aware of only four published case reports (comprising five patients) of CABG in patients with CA. Four patients died

shortly after surgery due to profound LCOS (6-8); and one survived the initial post-operative period only to succumb to electromechanical dissociation a few months later (9). Given our experience and the evidence available, we now conclude that percutaneous coronary intervention (PCI) must be preferred to CABG, even when coronary anatomy would normally suggest surgery the intervention of choice.

Summary

Cardiac amyloidosis is a rare disease associated with poor prognosis. Although there is some evidence that cardiac surgery can be offered to select patients with concomitant valve disease, outcomes following surgical revascularization are universally poor. Even in highly selected patients surgical intervention is difficult to justify, and percutaneous options must be preferred.

References

1. Merlini G, Bellotti V. Molecular mechanisms of amyloidosis. N Engl J Med. 2003;349:583-596.
2. Mankad AK, Seray I, Shah KB. Light-chain cardiac amyloidosis. Curr Probl Cancer. 2017;41:144-56
3. Maurer MS, Schwartz JH, Gundapaneni B, Elliot PM et al. Tafamidis treatment for patient with transthyretinin amyloid cardiomyopathy. N Engl J Med. 2018;379:1007-16
4. Treibel TA, Fontana M, Gilbertson JA, Castelletti S, et al. Occult transthyretin cardiac amyloidosis in severe calcific aortic stenosis. Circ Cardiovasc Imaging. 2016;9(8):e005066.
5. Xu B, Godoy RC, Rodriguez ER, Tan C, et al. Unrecognized cardiac amyloidosis at the time of mitral valve surgery: incidence and outcomes. Cardiology. 2019;1429(4):253-258
6. Massoudy P, Szabo A, Dirsch O, Wienecke H, van de Wal H, Jakob H. Amyloid of heart and lungs in a patient with low output syndrome after coronary artery bypass grafting. Herz. 2003:28(5):453-6
7. Fitzmaurice G, Wishart V, Graham A. An unexpected mortality following cardiac surgery: A post-mortem diagnosis of cardiac amyloidosis. Gen Thorac Cardiovasc Surg. 2013;61(7):417-21
8. Zacek P, Medilek K, Lonsky V, Laco J. Cardiac amyloidosis in the cardiosurgical operating room – a rare but fatal trap. Thorac Cardiovasc surg. 2007;55(2):65-67
9. Massias S, Vyssoulis G, Rizos I, Barbetseas I, Stefanadis C. Progressive heart failure in a patient after coronary artery bypass grafting. Hell J Cardiol. 2006;47:114-117

Acknowledgements

No funding or conflict of interest to declare

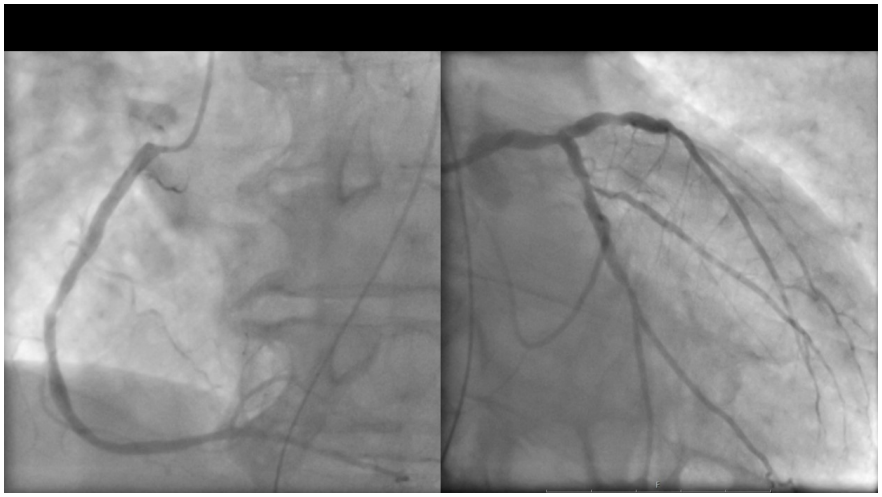

Figure Legends

Fig. 1 – Coronary Angiogram

* a: right coronary artery showing a mid-vessel lesion

* b: left coronary artery revealing left main stem, proximal circumflex and LAD lesions.

Fig. 2 – Cardiac magnetic resonance image, axial slice through the left ventricle