Case report

Recurrent pulmonary edema induced by coronary-subclavian steal syndrome during hemodialysis

Sudip Nanda a,*, Santo Longo b, John Pamula a, Thompson H. Dale c

a Department of Internal Medicine, St. Luke's Hospital, 801, Ostrum Street, Bethlehem, PA 18015, United States
b Department of Pathology, St. Luke's Hospital, 801, Ostrum Street, Bethlehem, PA 18015, United States
c Department of Cardiology, St. Luke's Hospital, 801, Ostrum Street, Bethlehem, PA 18015, United States

Received 10 November 2008; received in revised form 6 January 2009; accepted 7 January 2009; Available online 23 February 2009

Abstract

We describe a case of recurrent pulmonary edema after hemodialysis despite the patient being at ideal dry weight. Coronary-subclavian steal syndrome can cause serious complications in end-stage renal disease patients on hemodialysis. This is a case of subclavian steal, made worse by hemodialysis, using an upper limb hemodialysis fistula. Complete resolution of symptoms followed percutaneous stenting of the arteriosclerotic subclavian artery. A high index of suspicion of this physiological phenomenon is needed for diagnosis.

© 2009 European Association for Cardio-Thoracic Surgery. Published by Elsevier B.V. All rights reserved.

Keywords: Coronary-subclavian steal syndrome; Proximal subclavian artery stenosis; Recurrent pulmonary edema

1. Introduction

Coronary-subclavian steal (CSS) was originally described in 1970. It may be present in up to 3.4% patients after coronary artery bypass surgery (CABG) [1]. CSS occurs in patients who undergo CABG with an internal mammary artery (IMA) conduit and have a concomitant proximal subclavian artery stenosis (SAS) or occlusion. This diagnosis is being increasingly made as IMA accounts for 75–90% of all conduits used in CABG [2]. Significant subclavian artery atherosclerosis is present in approximately 20% of patients with coronary artery disease (CAD) [3]. Proximal subclavian artery stenosis is most commonly due to atherosclerosis. Other etiologies of SAS include Takayasu’s arteritis, giant cell arteritis and radiation. The usual presentation of CSS is angina. Other clinical presentations described in the literature are silent ischemia, heart failure, and myocardial infarction.

2. Case report

A 58-year-old woman with a history of coronary artery disease, CABG at age 54, diabetes mellitus, peripheral arterial disease and end-stage renal disease presented with three episodes of pulmonary edema within 1 h of a hemodialysis session. She was not hypertensive, had adhered to dietary and fluid restrictions, was compliant with her medications and was at ideal dry weight, post-hemodialysis. Angiographic evaluation revealed multi-vessel coronary artery disease. The left anterior descending artery (LAD) was bypassed with a patent IMA as well as a well functioning vein graft to a distal portion of the vessel. Aortic arch angiography revealed severe stenosis of the proximal left subclavian artery (SA). Abnormal retrograde flow from the LAD to the IMA was demonstrated by cineangiography (Figs. 1 and 2 and Video).

The patient underwent stent placement and dilatation of the proximal subclavian artery (Fig. 2). Subsequent dialyses were uneventful. The patient is currently on a full regimen for endothelial protection using aspirin, statin, and angiotensin converting enzyme inhibitors. Serial Doppler evaluation of the stented left SA has not revealed any recurrence of stenosis in the last two years.

3. Discussion

Hemodialysis through a left upper arm AVF, in patients with ipsilateral IMA graft may be expected to cause a
reduction of blood flow through the IMA graft. In our patient, two very significant hemodynamic abnormalities were demonstrated by angiography. First, a severe stenosis of the proximal 2–3 cm of the left SA prevented adequate blood flow to the IMA. Second, there was a reversal of blood flow in the LAD backward into the IMA graft. The latter caused a portion of the blood flow in the venous bypass graft (into the distal LAD) to flow backwards into the IMA graft. These hemodynamic abnormalities are likely to acutely worsen by the additional ‘steal’ effects of hemodialysis, via the left upper arm AVF. It is understood that these abnormal reversals of flow create ischemic hypokinesia of anterior and lateral walls of the left ventricle, which is evidenced by sudden onset of pulmonary edema within 30–60 min of dialysis.

The CSS phenomenon should be suspected if there are symptoms of vertebrobasilar insufficiency, arm claudication, supraclavicular or cervical bruits, asymmetric upper arm pulses and differential upper arm systolic blood pressure of greater than or equal to 20 mmHg. The last has the highest predictive value for diagnosis [1]. Bilateral axillary or subclavian arterial stenoses can confound the clinical signs [4]. CSS is more common in patients with diabetes and peripheral vascular disease. Angiographic evaluation of the aortic arch, before CABG, is the best means of detecting SAS. A high index of suspicion of a subclavian steal syndrome is needed in CABG patients with an IMA who exhibit these symptoms. Diagnostic confirmation of subclavian steal syndrome requires angiography.

The common indications for subclavian artery revascularization are subclavian steal syndrome, arm claudication, CSS and non-healing wounds [5]. The treatment options for SAS are surgery and endovascular stenting. Since the first report of percutaneous angioplasty for subclavian stenosis...
in the 1980s significant progress has been made in the endovascular stenting of supra-aortic vessels. Primary success and reasonable long-term patency makes endovascular stenting the procedure of choice for proximal SAS. Primary success for subtotal occlusion is achieved in 98% of patients and major complications occur in less than 1% patients [6]. Most procedures are approached by femoral access. In cases of complete and near-complete occlusion access is either brachial or through a combined femoral-brachial approach. A totally occluded subclavian artery may not be accessible to stenting in up to 50% of cases [7]. Balloon expandable stents are preferred for lesions in the proximal subclavian artery. Self-expanding stents are limited to lesions distal to origin of the vertebral artery [8]. Potential complications include embolization, stroke, damage to the subclavian artery and mycotic aneurysms. Recent development of a distal protection device to protect the internal mammary graft prevents complications. The success, safety and long-term patency of stents make them preferable over surgical interventions. However in cases of total occlusion of subclavian artery, multiple lesions with complex anatomy, a surgical approach may become necessary. A correction of significant carotid stenosis by stenting or endarterectomy is necessary before complex revascularization of supra-aortic vessels. The above frequently results in resolution of symptoms [9]. Surgical revascularization of supra-aortic vessels is associated with considerable risk of stroke and death with the traditional transthoracic approach. The safer extrathoracic approach is more technically challenging. Recent conservative estimates of restenosis after subclavian vein stenting are approximately 10% at 36 months [5]. Medical therapy of cardiovascular risk factors is imperative for good outcomes. All patients who have received therapy for CSS need close follow-up. Regular Duplex examination before and after arm exercise can detect recurrent stenosis, with a high degree of accuracy [10].

Acknowledgements

Anne Kemp, Joe Klepeiss and Betsy Toole of Media Services, St. Luke's Hospital Bethlehem for their expertise in image and video sequences.

References


Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ejcts.2009.01.008.