Case Report

Subclavian Artery- Internal Jugular Vein Fistula and Heart Failure: Complication of Internal Jugular Vein Catheterization

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Abstract

Hemodialysis in patients with end-stage renal disease (ESRD) requires vascular access which can be either temporary or permanent. However, these procedures are not without complications. Arterial puncture is the most common immediate complication and pseudoaneurysm formation is the most common late sequel of internal jugular venous catheterization (IJVC). However, arterio-venous fistula (AVF) formation following IJVC is rare. We are reporting a case of AVF formation between subclavian artery (SCA) and internal jugular vein (IJV) following IJVC which later on leads to the development of cardiac failure.

Introduction

In patients with end-stage renal disease (ESRD), cannulation of the central venous system with large-bore double lumen catheter is used for hemodialysis until a functioning permanent vascular access is available. Internal jugular venous catheterization (IJVC) is the most preferred route as subclavian approach is frequently associated with stenosis. However, serious adverse events such as arterial injury, pneumothorax and nerve injury can occur with these procedures. Arterial puncture, especially of the carotid artery is the most common complication of IJVC. Rarely subclavian artery injuries can also occur. The most frequent sequela of accidental puncture of an artery is pseudoaneurysm formation. However, subclavian artery (SCA) to internal jugular venous (IJV) fistula after IJVC is extremely rare.

We are reporting a rare case of SCA to IJV-fistula formation after IJVC which lead to the development of congestive cardiac failure (CCF).

Case Report

A 45-years-old non-diabetic lady having chronic kidney disease (CKD) for the last three years progressed to ESRD and became dialysis dependent. The baseline physical examination and investigations revealed anemia, hypertension, stage I left ventricular diastolic dysfunction, mild mitral regurgitation (MR) and good systolic function with left ventricular ejection fraction (LVEF) of 63.82% without any regional wall motion abnormalities. She received renal replacement therapy (RRT) initially in the form of acute peritoneal dialysis and later on maintenance hemodialysis with femoral vein catheterization as the vascular access since November 2009. A radio-cephalic arterio-venous fistula (AVF) was constructed and IJVC was planned to be used till the fistula becomes mature.

On 21st January 2010 right IJVC was attempted using the blind landmark-guided technique with 18G introducer needle which resulted in an accidental arterial puncture. The needle was removed and firm pressure was applied for about 15 minutes till a good hemostasis was achieved. A pressure dressing was applied and patient was sent home. A double-lumen 11.5 Fr Quinton intrajugular catheter was inserted next day successfully by the same technique without any problem. At the end of the process vitals were stable and chest x-ray confirmed the position of the catheter tip at the junction of superior vena cava and right atrium. Patient was put on thrice weekly hemodialysis schedule since then. However because of exit site infection catheter was removed on 26th February 2010. Unfortunately the radio-cephalic fistula did not become functional and a brachio-cephalic fistula was constructed subsequently. Repeated femoral vein was used as access for hemodialysis for the next one and half months as patient did not give consent for other mode of access.

After, 45 days of removal of IJVC, patient presented in the hospital emergency with breathlessness and swelling of body. On physical examination she had features of CCF and a continuous murmur was audible in the right supra-clavicular fossa. An emergency echocardiography showed global hypokinesia with LVEF of 33%, stage III diastolic dysfunction, severe mitral regurgitation (MR), moderate pulmonary regurgitation, and moderate tricuspid regurgitation with mild aortic regurgitation without any regional wall movement abnormality. Color Doppler study of neck vessels showed a fistulous communication between right SCA and IJV with a high blood velocity of 481 cm/s (Figures 1 and 2). CT angiography of neck vessels confirmed the finding of AVF showing a vascular channel of maximum lumen diameter of 4.6mm and approximate length of 3 cm arising from the right SCA, coursing anteriorly and superiorly and communicating with right IJV about 19.3mm cranial to its junction with LV of the catheter. An emergency Doppler of the catheter tip at the junction of superior vena cava and right atrium. Patient was put on thrice weekly hemodialysis schedule since then. However because of exit site infection catheter was removed on 26th February 2010. Unfortunately the radio-cephalic fistula did not become functional and a brachio-cephalic fistula was constructed subsequently. Repeated femoral vein was used as access for hemodialysis for the next one and half months as patient did not give consent for other mode of access.

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Discussion

Anatomical variations of the internal jugular vein which occurs in about 5% of patients, makes it difficult to locate the vein using the blind technique. In the vast majority of cases, IJVC is successful and uncomplicated, but sometimes inadvertent arterial injury can result in the development of hematoma, pseudoaneurysm or AVF. The most common arterial injury associated with IJVC is carotid artery puncture and its incidence
is as high as 11%, which frequently leads to pseudoaneurysms (0.05–2%) formation.\textsuperscript{3,5} The actual incidence and frequency of SCA injuries following IJVC are unknown because many cases are probably underreported. Three cases of AV fistula between SCA to IJV had been reported so far.\textsuperscript{6-8} In our case, we assume that the fistula formation was because of arterial puncture during the needle insertion. The arterial lesion could have been temporarily closed, but reopened days later by increasing hypertension, use of anticoagulant, abnormal calcium and phosphate metabolism which usually occurs in eSrD patients.

AVF bypasses a good proportion of left ventricular (LV) output from systemic circulation to right atrium and thus increases preload of the right ventricle and LV in turn. Subsequently the left ventricle dilates and LVEF declines causing heart failure.\textsuperscript{9} Savage at el reported that a decrease in the subendocardial perfusion occurred immediately after AVF creation in ESRD patients leading to the development of cardiac failure in some patients.\textsuperscript{10} Location of the AVF also predicts its outcome, as fistulae located centrally near the heart as in our patient, are more likely to produce heart failure.\textsuperscript{11} Most dialysis patients can tolerate the increased hemodynamic disturbances imposed by a fistula. However, individuals with pre-existing cardiac disease as in our patient are more susceptible to develop high-output cardiac failure.\textsuperscript{12} CCF with a low EF can be present despite a concomitant high-output state if the high-output states superimpose on the underlying cardiomyopathy. Because LVEF is a proportion of cardiac output (CO) and preload, increase in preload in excess of increase in CO will yield a low LVEF and CCF will develop as in our case.

Iwashima et al observed that most of the increase in CO and left ventricular end-diastolic diameter occurred within the 7 to 10 days of AVF creation for hemodialysis.\textsuperscript{13} There was a positive correlation between the increase in atrial natriuretic peptide level and the elevation in CO as well as a direct positive correlation between the increase in brain natriuretic peptide level and the subsequent development of diastolic dysfunction.\textsuperscript{13} Previously it was thought that high-output failure was relevant only with longstanding fistulae but recently it was found that AVFs can reach their maximum flow as early as 6 weeks after creation and, thus, perhaps high-output cardiac failure can occur sooner than initially thought.\textsuperscript{14} This may explain the deteriorating cardiac status (from stage I diastolic dysfunction to stage III, severe MR and global hypokinesia, LVEF-33.69\%) two and half months after the cannulation in our patient. To the best of our knowledge this is probably the first case of heart failure which developed due to fistula formation between SCA and IJV following IJVC in a patient of ESRD.

In summary, one should be aware of development of arteriovenous fistula between SCA and IJV as a complication of IJVC which can lead to CCF later on.

References
7. Finlay DJ, Sanchez LA, Sicard GA. Subclavian artery injury, vertebral artery dissection, and arteriovenous fistulae following


