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Case Report

Feasibility of transfemoral hepatic vein/wedged portal venous pressure measurement in total artificial heart

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ABSTRACT

The development of technology and limitation of numerous ventricular assist devices has increased usage of the total artificial heart (TAH) for mechanical circulatory support. A primary important feature of TAH is that it is one of the few mechanical circulatory support devices that provides biventricular support. As the number of patients with TAH rises, spreading awareness about the device in the interventional radiology community is important.

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Introduction

Management of patients with total artificial heart (TAH) requires patient monitoring, volume/hemodynamic management, and anticoagulation management in addition to the routine care that end-stage heart failure patients require. The REMATCH trial [1], which compared a durable left ventricular assist device (HeartMate XVE) to medical management in end-stage heart failure, has shown that long-term survival of the patient is dependent on liver function along with other parameters. Liver failure and congestive hepatopathy if present

before TAH surgery are poor prognostic indicators for long-term survival. Interventional radiology is important in the management of these patients as they may require central lines, liver biopsies, and portal pressure measurements. Transvenous procedures in these patients must be closely monitored as fatal accidents have been reported from migration of the catheters and wires into the devices [2,3]. A transjugular liver biopsy has been performed in a TAH patient [4] but can result in complications. We are reporting the first transfemoral hepatic vein/wedged portal venous pressure measurement in a TAH patient.

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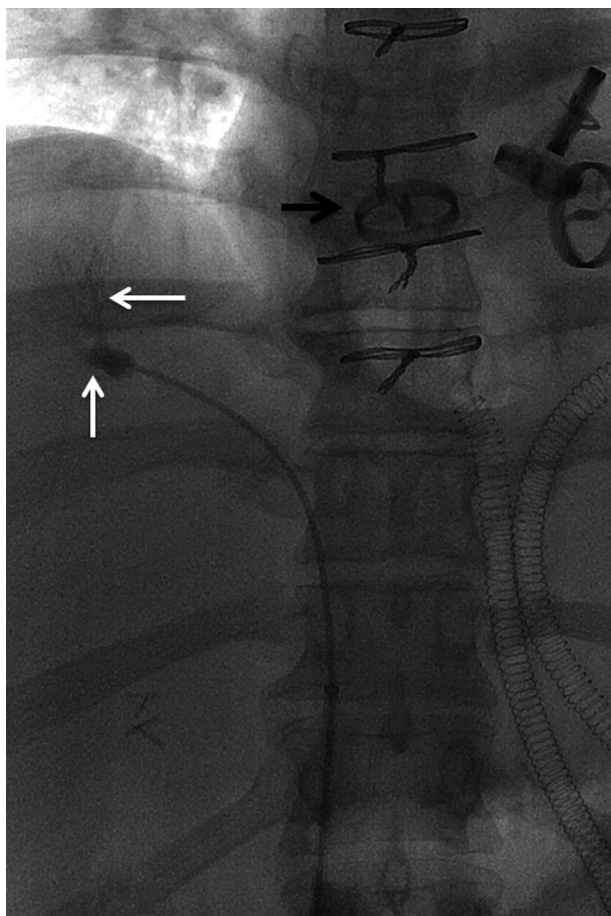


Fig. 1 – Venogram with balloon catheter (vertical arrow) in the right hepatic vein, injection of iodinated contrast outlining segment 7 hepatic veins. Also noted is artificial tricuspid valve (horizontal black arrow) close to the catheter but above the diaphragm.

Case report

A 39-year-old man with hypertension, type-2 diabetes mellitus, obesity, obstructive sleep apnea on continuous positive airway pressure, nonischemic cardiomyopathy due to arrhythmogenic right ventricular dysplasia, and atrial septal defect (repaired in 2005) underwent TAH implantation and was being evaluated for heart transplantation. The patient had an ultrasound of the abdomen before TAH placement along with liver function tests which did not show any significant abnormalities. He presented with recurrent ascites within 1 month of TAH, requiring frequent paracentesis (every 1-2 weeks). Liver function tests were slightly elevated with AST (113), ALT (17), alkaline phosphatase (45), total bilirubin (1.1), and indirect bilirubin (0.8). The patient was referred to interventional radiology for a liver biopsy as well as infradiaphragmatic inferior vena cava and hepatic vein/wedged portal pressure measurements to further differentiate between underlying chronic liver disease with sinusoidal portal hypertension and posthepatic causes of portal hypertension. A percutaneous transhepatic liver biopsy was opted (through coaxial needle) to be performed in the setting of

INR of 1.7 and embolization of the tract by gelfoam after the biopsy. A transfemoral (instead of transjugular) venous route was chosen (over direct portal vein puncture and pressure measurements, as it was deemed more invasive) for hepatic vein/wedged portal pressure measurements to keep the catheter and wire below the diaphragm and avoid the rare fatal complication.

With the patient positioned supine, the right common femoral vein was accessed and 5-F sheath was placed. A 5-F vertebral catheter was advanced in the inferior vena cava under fluoroscopy (Fig. 1). The catheter tip was advanced to the level of the liver, and venography was performed (keeping the catheter below the diaphragm) to determine the level of the hepatic veins (Fig. 2). A glide wire was used to advance the catheter into the segment 7/8 hepatic veins. A Rosen wire was passed into the hepatic vein, and the vertebral catheter was replaced with 6-F balloon catheter, and hepatic vein/wedged portal pressures were measured. The catheter placement was surprisingly very easy.

Discussion

The primary risk during transvenous catheterization (transjugular or transfemoral) in patients with TAH is entrapment of the catheter or the wire in the tricuspid valve, which is potentially fatal [3,4]. Fatal complications have occurred from bedside placement of percutaneously inserted central catheter line (explanted TAH revealed a remnant of the

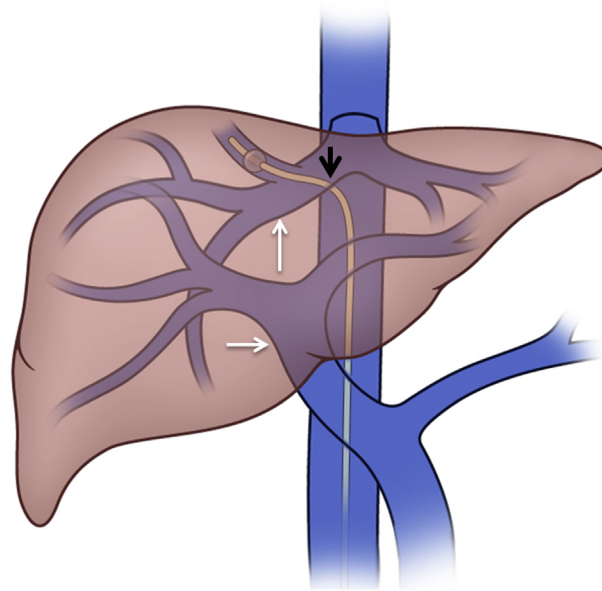


Fig. 2 – Diagram shows the orientation of the balloon catheter while placement into the segment 7/8 branches is easier than placement in the segment 5/6 branches. Hepatic veins (vertical arrow) and main portal vein (horizontal arrow) are marked. The catheter enters the liver via hepatic vein confluence at the inferior vena cava (IVC) (black arrow).

percutaneously inserted central catheter line extending through the tricuspid valve leading to the resultant jamming of the valve in a semiclosed position), bedside transjugular triple lumen catheter placement which was later found to be entrapped in the tricuspid valve, and accidental advancement of the central venous wedged catheter into the tricuspid valve leading to valve dysfunction with subsequent circulatory collapse.

Avoidance of catheter or wire entrapment in the TAH is critical, so we recommend that all the transvenous procedures in these patients be performed under fluoroscopic guidance. Transjugular intrahepatic hepatic vein/wedged portal pressure measurements are routinely performed in interventional radiology; however, there is always the risk of a wire or catheter drifting toward the tricuspid valve due to the natural flow of blood. We recommend, in patients with TAH, a transfemoral intrahepatic approach as an easy and safe way to measure hepatic vein/wedged portal pressures.

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