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Case Report

Pulmonary artery catheter knotting: are conservative measures always successful? a case report

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ABSTRACT

Pulmonary artery catheter (PAC) or Swan-Ganz catheter is a flow directed balloon tipped catheter routinely used in patients undergoing Coronary Artery Bypass Grafting (CABG). The reported rate of complications with PAC is 3-17% including arrhythmias, pneumothorax, pulmonary embolism, bacteraemia and death1. Knot formation is an uncommon complication of PAC and is usually managed conservatively2. Here we report about a patient with knotted PAC who required operative intervention after failure of conventional measures as the knot engulfed the tricuspid valve chordae and was fixed.

Keywords: Coronary artery bypass, Knot, Tricuspid valve

INTRODUCTION

Pulmonary artery catheter (PAC) or Swan-Ganz catheter is a flow directed balloon tipped catheter, which is routinely used in patients undergoing Coronary Artery Bypass Grafting (CABG). The procedure of putting the PAC is usually blind, in the operation theatre (OT), without any fluoroscopic guidance. The reported rate of complications with its use is 3-17% and includes arrhythmias, pneumothorax, intra-cardiac rupture, pulmonary embolism, bacteraemia and death.[1] Knot formation, a known complication of PAC, usually dealt with conservative measures.[2] However, we recently encountered a situation in which knot appears to be fixed and conservative measures were unsuccessful.

CASE REPORT

A 72 years male patient with no co-morbidity, admitted with the diagnosis of triple vessel coronary artery disease and underwent off-pump coronary artery bypass. All pre-operative laboratory studies including chest x ray were normal.

Routine monitors were applied which included radial and femoral artery lines, electrocardiogram, pulse oximetry, Central Venous and Pulmonary Artery pressure monitoring line via PAC. Right Internal Jugular Vein was assessed without difficulty for sheath introduction. Catheter was introduced and balloon inflated at 20 cm mark with 1.5 cc of air. While looking at the pressure tracing on the monitor, catheter was pushed in. Initial attempts to place catheter tip in a wedge position were unsuccessful, the anesthetists was able to float the catheter to the correct position on third attempt and the catheter length achieved at wedge position was 60 cm. Surgery was uneventful. Multivessel off pump grafting was done. Patient shifted to intensive care unit with stable hemodynamics. Patient was mechanically ventilated and chest X-ray (CXR) was done. After the patient was hemodynamically stable, attempt was made to remove the PAC but at 30 cm mark it offered resistance. Knotting

was suspected and CXR revisited which showed that tip of PAC in the right ventricle with a knot located 5-6 cm from its distal end (Figure 1).

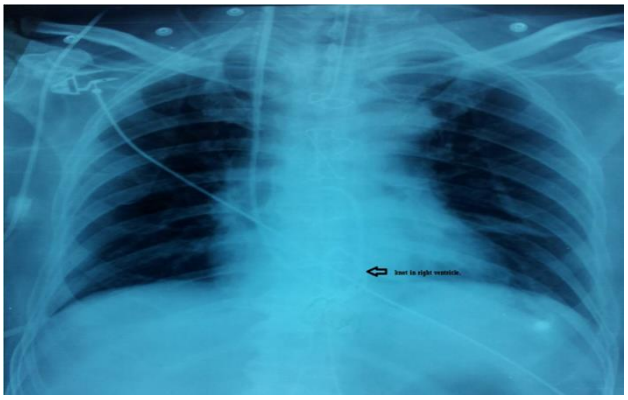

Figure 1: Chest X-ray showing knot in the right ventricle.

Attempt was made to release the knot by guide wire, but failed. PAC was withdrawn as much as possible and 2nd CXR obtained to locate the position of the knot. In CXR, knot now appears to be more tightened and short but the position is relatively fixed somewhere in the Right Ventricle. Patient was shifted to Catheterization laboratory (lab) and help was sought from interventional cardiologist. In lab, femoral vein cannulated and attempts made to pull the catheter along with knot out, but failed. Knot appeared to be relatively fixed. Echocardiography done which revealed the knot to be in the vicinity of tricuspid valve apparatus. After discussion with cardiologists, radiologists and ourselves the consensus was that the PAC was most likely caught in the tricuspid valve apparatus. Patient was taken to OT again and sternotomy done. Manipulation was done to pull out catheter, but failed. Patient was taken on cardio-pulmonary by pass, right atrium opened which revealed a tight knot of PAC which has engulfed chordae of the tricuspid valve and sub-valvular apparatus (Fig. 2). PAC was cut and delivered. RA closed. Patient shifted to ICU with stable hemodynamics. Extubated the next day and discharged two days later.

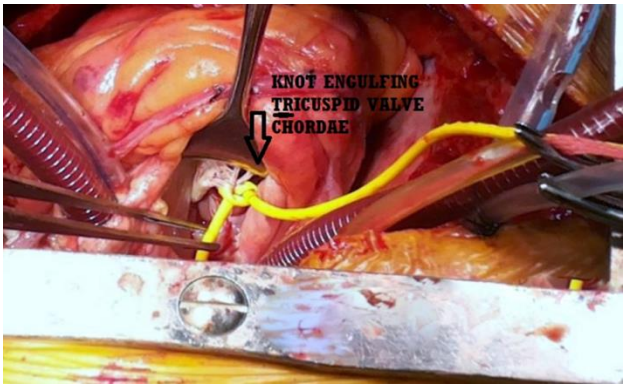

Figure 2: Knot of PAC engulfing the tricuspid valve apparatus.

DISCUSSION

Knotting of an intravascular catheter was first reported by Johansson et al in 1954. Various types of devices have been implicated in knot formation including cardiac catheters, PAC's, arteriography catheters, guidewires, pacemaker electrodes. PAC"s were responsible for more than two-thirds of the total reported intravascular knots.[3] This may be because these catheters are thin walled, long, and soft and are usually placed without fluoroscopic guidance.[4] Knotting should be anticipated if there is an excessive advancement of the catheter beyond the normal expected distance. Knotting can occur within the vascular space or inside the heart. Repeated insertions would make the catheter softer and liable to knot. Kinking and looping, which are the precursors of knotting, occur when excessive length of catheter is inserted. After a right ventricular pressure tracing has appeared during insertion, not more than 10 to 15 cm of cathter should be required to obtain PA pressure tracing. Dilated heart chambers and repeated cathter manipulations, especially without fluoroscopy are predisposing factors. Therefore, coiling should be suspected whenever a wedge pressure tracing is observed at a catheter insertion of greater than 50 cm through the right jugular vein.[5]

Knotting can be minimized by using large gauge catheters, injection of 10 to 20 ml of cold solutions into the catheter during insertion to make it stiffer, full inflation of the balloon in a large central vein before advancing the catheter to right atrium. The possibility of knot formation must be considered whenever resistance is met on withdrawal of catheter and therefore removal should never be force when resistance is encountered.[6] Forced removal can cause avulsion of the tricuspid valve, papillary muscle and chordae or catheter embolism. To conclude, although the widespread use of simple maneuvers like insertion of the guidewire and de-knotting or pulling up the knot up to the level of neck and its consequent retrieval by a small skin incision or retrieval by conservative fluoroscopic and intervention cardiological techniques have largely replaced open surgical method for the removal of knotted PAC"s but still open surgery should be considered whenever there is large multiple loops (bow tie loops) or knots that are fixed within the cardiac chambers.

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