A POTENTIALLY SERIOUS COMPLICATION WITH SWAN-GANZ CATHETER PLACEMENT BY THE PERCUTANEOUS INTERNAL JUGULAR ROUTE

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SUMMARY

Percutaneous insertion of a Swan-Ganz catheter through the internal jugular vein is presumed to have resulted in lodgement of the catheter tip in the wall of the internal carotid artery.

The flow-directed, balloon-tipped catheter was described by Swan, Ganz and Forrester (1970). A low failure rate of placement, a reduced incidence of cardiac arrhythmias, and relative simplicity have encouraged its increasing use in anaesthesia and intensive care units. It has become an invaluable monitoring aid in situations where left ventricle contractility is reduced (Forrester et al., 1971), and where relatively large changes in intravascular volume may occur.

Complications of its use include premature ventricular contractions, persistent atrial arrhythmia (Geha, Davis and Lappas, 1973), intracardiac knotting (Lipp, O'Donoghue and Resnekow, 1971), perforation of the pulmonary artery (Chun and Ellestad, 1971) haemoptysis (Lapin and Murray, 1972), adherent thrombi and thrombophlebitis (Swan, Ganz and Forrester, 1970).

The Swan-Ganz catheter has been introduced usually via an antecubital vein cut-down. However, central venous placement through a large-bore percutaneous catheter-introducer has become increasingly common because of the greater facility and shorter time of introduction.

This report describes an unusual complication of Swan-Ganz catheter placement through a percutaneous internal jugular catheter-introducer.

CASE REPORT

W.W., a 70-year-old white male entered hospital with symptoms of progressive congestive heart failure. On admission he was found to have developed atrial fibrillation with alternating bundle branch block, a blood urea concentration of 47 mg/100 ml, and x-ray evidence of heart failure. The patient had a history of at least 2 years of marked cardiomegaly with a grade IV pansystolic murmur and mild symptoms of congestive heart failure. On the 2nd day in hospital he became markedly dyspnoeic and diaphoretic with râles throughout both lung fields. Aggressive therapeutic measures for the treatment of pulmonary oedema were undertaken without success. Unremitting respiratory failure required tracheal intubation and mechanical ventilation.

Following the onset of arterial hypotension, it was decided to place a Swan-Ganz flow-directed catheter into the pulmonary artery. Percutaneous passage from the antecubital fossa was unsuccessful. An attempt was made at percutaneous insertion using a 12-gauge Angiocath inserted in the right internal jugular vein. The vein was readily cannulated by the method of Civetta, Gabel, and Gemer (1972), with normal venous flow. However, the Swan-Ganz catheter would not pass into the central venous system, and was withdrawn with some difficulty through the introducer. The inserting needle was again placed in the introducer to verify its patency. The Swan-Ganz catheter was then reintroduced and advanced centrally. Venous pressure recordings on a BD-Electrodyne monitor showed an unusual wave pattern, interpreted as compatible with marked tricuspid regurgitation and a low cardiac output. Despite insertion of most of the catheter, a pulmonary artery pressure trace was never achieved. At this time a chest x-ray (fig. 1) suggested catheter placement well into the cardiac shadow. Recalibration of the monitor revealed significantly increased pressures, comparable with the arterial pressure wave. Despite insertion of most of the catheter, a pulmonary artery pressure trace was never achieved. At this time a chest x-ray (fig. 1) suggested catheter placement well into the cardiac shadow. Recalibration of the monitor revealed significantly increased pressures, comparable with the arterial pressure wave. Simultaneous arterial and Swan-Ganz catheter oxygen tensions were found to be identical, suggesting that the catheter had entered the arterial circulation, possibly having breached a ventricular septal defect. An over-penetrated chest x-ray (fig. 2) showed the catheter tip
in the neck with the catheter looped through the heart. The catheter was then withdrawn under fluoroscopic control. It uncoiled as a loop from the atrium with the proximal tip lodged in the neck.

There were no neurological sequelae to this ectopic placement of the catheter. Repeated examinations of the neck revealed neither haematoma nor signs of persistent arteriovenous fistula. A Swan-Ganz catheter was subsequently passed under fluoroscopic control from a cut-down in the other antecubital fossa. Marked tricuspid regurgitation made forward insertion difficult and the catheter would not wedge. However, pulmonary artery diastolic pressures were increased (55/18 mm Hg).

DISCUSSION

In this case, introduction of the Swan-Ganz catheter into the internal jugular vein appeared to be without complication. The vascular pressure as monitored and the similar blood-gas values could have been explained by the catheter tip traversing a septal defect.

We consider the explanation to be as follows: on repositioning the needle in the introducer, the carotid artery was nicked but not penetrated, since there was no pulsatile arterial blood flow. The tip of the Swan-Ganz catheter then penetrated the carotid artery and lodged snugly in the arterial wall. In attempting to pass the catheter, the introducer must have slipped back into the internal jugular vein so that a loop of catheter was then passed down the venous side while the catheter tip remained firmly lodged in the carotid artery.

Several complications could have occurred, resulting in significant morbidity. Inflation of the balloon in the carotid artery could have caused reduced blood flow. Because air was used for inflation there was the added possibility of cerebral air embolism from balloon rupture. Balloon inflation in the arterial wall might have resulted in haematoma, dissecting aneurysm, or arteriovenous fistula.

There are several approaches to introduction of catheters for placement in the central venous system and pulmonary artery.

The internal jugular vein has constant anatomical features in the carotid sheath. It has a relatively wide bore, similar to that of the subclavian vein, even in shock (Daily, Griepp and Shumway, 1970; Jernigan et al., 1970). Direct access to the right heart is obtained without proximity to the pleura. The accessibility of the companion artery can reduce the morbidity associated with inadvertent puncture. The method of Mostert, Kenny and Murphy (1970), modified by Civetta, Gabel and Gemer (1972), is used commonly by us. Initial location of the vein with a small-bore needle reduces morbidity associated with repeated unsuccessful attempts.

Peripheral vein cut-down is time-consuming. Unsatisfactory catheter placement occurs in 23–41% (Deitel and McIntyre, 1971; Webre and Arens, 1973)
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of cases when basilic veins are used or 55% (Webre and Arens, 1973) when cephalic veins are used as c.v.p. lines. When the Drum-Cartridge catheter was used, satisfactory placement occurred more frequently, possibly because it is more flexible, having no stilette in its terminal portion (Shang and Rosen, 1973). However, Swan, Ganz and Forrester (1970) in their experience of 100 cases with the flow-directed catheter, reached the pulmonary artery in 92% of patients and the wedge position in 80%. The common practice of distal vein ligation results in loss of the vein for future use. In addition, there is risk of infection at the cut-down site.

Attempts to cannulate the venae comitantes of the brachial artery percutaneously can result in arterial puncture or median nerve trauma.

Frequent failure to thread catheters into the central venous system results when the external jugular vein is used, because it is thin-walled, has valves and runs an inconsistent antero-lateral course to form a plexus with the transverse cervical vein before coursing medially to join the subclavian vein.

Subclavian venepuncture has been reviewed (Defalque, 1968) and popularized as a method of assured entry into the central venous system. However, the complications of pneumothorax (Jernigan et al., 1971) or haemothorax (Davidson, Ben-Hur and Nathen, 1963) are especially significant in the intensive care unit where IPPV or PEEP may be used.

The percutaneous puncture of the internal jugular vein is usually a reliable means of access to the central venous system. Inadvertent puncture of the carotid artery can be minimized by initially locating the vein with a small-gauge needle. Even with this precaution, however, manipulation of both a large gauge needle-introducer and relatively stiff catheters can result in carotid artery invasion despite adequate initial placement in the internal jugular vein.

Ectopic placement of the catheter may not be ascertained readily if there are suspected lesions of right heart valves, low flow states, or intracardiac A-V shunts. In these circumstances we recommend additional monitoring by fluoroscopy and the use of nitrous oxide or carbon dioxide for balloon inflation.

REFERENCES

