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Use of subclavian vein for permanent cardiac pacing

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SUMMARY The subclavian vein has been used to implant permanent pacing catheters in 40 patients with symptomatic heart block. Though the cephalic and external jugular veins are usually preferred for this purpose in Britain, the use of these veins has certain disadvantages. In this study subclavian venepuncture by the infraclavicular approach was performed without difficulty and found to be a safe procedure. Three months after implantation, 7.5 per cent of patients had developed catheter tip dislocation and 87.5 per cent of patients were entirely free of complications.

In Britain there is definite preference for initial permanent cardiac pacemakers to be implanted with a transvenous electrode; in 1975 91 per cent of pacemaker patients were managed in this way (Sowton, 1976). Though the cephalic and external jugular veins are not ideally suited as routes of access to the heart for permanent pacing catheters, these veins are commonly used (Siddons and Nowak, 1975; Sowton, 1976). The present study describes the results of using the subclavian vein for permanent cardiac pacing in patients with symptomatic complete atrioventricular block. The technique of subclavian venepuncture has been lucidly described (Parkinson, 1972) but has not gained widespread acceptance for permanent pacemaker implantation.

Patients and methods

Between 17 September 1975 and 1 March 1977, 23 men and 17 women were given initial pacemaker implants by the subclavian route. The patients' ages ranged between 46 and 87 years, mean 74.3 years. All had sustained Adams-Stokes attacks in association with complete atrioventricular block. They have been followed up for at least 3 months after implantation.

Before implantation of the permanent pacemaker, a temporary catheter was inserted percutaneously through the right subclavian vein. The technique of inserting the permanent catheter percutaneously into the left subclavian vein was as follows. The patient was placed in a slight Trendelenburg position to distend the subclavian vein and render air

embolism to the brain extremely unlikely. A pillow was placed beneath the scapulae to reduce the distance between the patient's skin and the point of entry to the vein. After infiltration of the subcutaneous tissue with local anaesthetic a 14 gauge Argyle 'Medicut' needle was inserted through a short $\frac{1}{4}$ inch incision $\frac{1}{2}$ inch below the mid point of the clavicle. The needle was directed just under the clavicle towards the suprasternal notch. When a free flow of blood was obtained the needle was removed and a guide wire inserted through the cannula which had been left *in situ*. Use of the large 14 gauge needle facilitated entry of a 'Desilet-Hoffman' F609 9F dilator and introducer over the guide wire. A Devices LC62 polythene catheter was inserted through the introducer and the electrode positioned at the apex of the right ventricle at a site where the pacing threshold was less than 0.8 volts. The catheter was either attached to a Devices 3821 DM pulse generator or modified and inserted into a Medtronic 5949 generator. The pouch over the pectoral muscle for the pacemaker was made by extending downwards the initial vertical incision. This procedure could be safely performed by medical staff without specialist surgical expertise in less than 30 minutes. After each subclavian venepuncture a chest x-ray film was performed to exclude pneumothorax and haemothorax.

Results

Of the 40 patients in the series, 35 (87.5%) have been entirely free of complications.

The complications of implantation are enumerated in the Table. They may be attributable to either insertion of the catheter or placement of the pulse

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Table Complications of transvenous pacemaker implantation through the subclavian vein in 40 cases

Complications	No.	%
Wound infections	1	2.5
Catheter tip displacement	3	7.5
Rise in ventricular threshold	1	2.5

generator itself.

Catheter insertion did not cause pneumothorax, haemothorax, subcutaneous emphysema, brachial plexus or phrenic nerve injury, septicaemia, infective endocarditis, or tamponade. In one patient the subclavian artery was penetrated without ill effects and after firm pressure over the artery the patient was subsequently catheterised through the ipsilateral subclavian vein. Implantation of the pulse generator was not associated with haematoma formation or wound dehiscence but in one case wound infection occurred 24 days after implantation. Using the same technique another pacemaker was successfully sited on the other side of the chest. The complication of skin erosion over the pacemaker, followed by extrusion, did not occur. In one 77-year-old patient a rising threshold of ventricular stimulation caused pacing failure 2 months after implantation. In this patient there was no radiological evidence of catheter tip dislocation. However, in 3 patients tip displacement caused symptoms of heart block 15, 28, and 50 days after implantation. Two of these cases were given epicardial electrodes after repeated episodes of catheter tip dislocation.

No patients complained that the site of the pacemaker was unsightly or uncomfortable nor did it restrict body movements. One hundred and seventy-five emergency pacing catheters have been inserted quickly and easily using the same route without serious complications.

Discussion

It has been estimated that in Britain by 1980 every year 150 new patients per million population will receive initial permanent pacemakers (Sowton, 1976). In a review of the possible methods of inserting catheters for central venous pressure monitoring, Craig and his colleagues (1968) concluded that use of the subclavian vein by the infraclavicular approach was superior to use of the external jugular and cephalic veins. Catheter insertion through the jugular and cephalic veins may be hindered or prevented by venospasm. This difficulty was not encountered using the subclavian vein. In addition the subclavian vein may be used repeatedly whereas it is difficult to use the cephalic or external jugular

veins more than once. Anatomical variations may preclude use of either the cephalic or external jugular veins (Borrie and Lichter, 1975), but the subclavian veins are constantly sited (Keeri-Szántó, 1956). When the cephalic vein is used a puckered scar may result (Siddons and Nowak, 1975) and the superficial position of a catheter in the external jugular vein renders it liable to extrusion (Bluestone *et al.*, 1965; Borrie and Lichter, 1975).

Although various complications have followed subclavian venepuncture, including septic thrombosis (Faden *et al.*, 1976), pneumothorax (Walker and Sanders, 1969), arteriovenous fistula (Farhat *et al.*, 1975), cardiac tamponade (Dosios *et al.*, 1975), air embolism (Yoffa, 1965), and phrenic nerve injury (Epstein *et al.*, 1976), these complications have been reported in a very small number of cases and are possibly related to poor technique. When the infraclavicular, as opposed to the supraclavicular, approach to the subclavian vein is used damage to the artery or phrenic nerve is particularly unlikely because they lie posteriorly to the vein. Gregg and his colleagues (1974) successfully used the infraclavicular approach for permanent pacemaker implantation but their technique required two separate incisions and pacemaker implantation was deferred several days after catheter insertion.

Catheter tip displacement is liable to occur with any method of pacemaker implantation and usually develops within 48 hours of operation (Bluestone *et al.*, 1965). Though a relatively small catheter with a small flange was used in this study only 7.5 per cent of cases required electrode repositioning. This compares with the reported British average figure of 10 per cent (Sowton, 1976). Possibly use of the subclavian vein renders catheter tip displacement less likely because movement of the neck and arms does not exert traction on the catheter. However catheter tip displacement remained a problem, and in 2 cases it occurred as a late complication. These cases were eventually successfully managed with epicardial electrodes. Though use of a larger catheter with a bigger flange might reduce the incidence of tip dislocation, insertion of a large catheter percutaneously through the subclavian vein is difficult because of the limited space between the clavicle and the first rib.

In this study implantation of permanent pacing catheters infraclavicularly through the subclavian vein was performed safely and without difficulty. The method appears a useful approach for pacemaker implantation.

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