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Complete heart block during central venous catheter placement in a patient with pre-existing left bundle branch block

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Heart block and arrhythmia are complications of pulmonary artery and cardiac catheterization. Injury to the conducting system of the heart often involves the right bundle causing right bundle branch block (RBBB). If patients already have left bundle branch block (LBBB), complete heart block (CHB) may result. After trauma, impairment of the right bundle is usually transient with recovery in hours, but complete heart block can lead to symptoms requiring invasive treatment. Similar complications are rare with insertion of central venous catheters, as they should not enter the heart. Injury to the right bundle during central venous catheter insertion can be by trauma from the guide wire or from the catheter itself. The function of the AV node and bundle of His in these patients has not been studied before. We report a patient with LBBB who developed CHB during insertion of a central venous cannula. Conduction through the AV node and His–Purkinje system was intact, showing that the transient RBBB was caused by traumatic injury rather than by other disease of the conduction system.

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Case report

A 60-yr-old female was admitted with worsening shortness of breath. She had a history of dilated cardiomyopathy, hypertension, hypercholesterolaemia and diabetes mellitus. She was being treated with digoxin, lisinopril, diltiazem, glipizide and furosemide. On examination, she had a heart rate of 94 beats min^{-1}, a blood pressure of 160/90 mm Hg, gross peripheral oedema, and a third heart sound was audible. Chest x-ray showed pulmonary congestion and the electrocardiogram (ECG) showed sinus rhythm with left bundle branch block (LBBB).

Central venous cannulation was attempted via the right internal jugular vein. Soon after the guide wire was passed, the patient complained of dizziness and became bradycardic and hypotensive. The cardiac monitor showed complete heart block (CHB) with a ventricular rate of 34 beats min^{-1}, which did not respond to atropine and required temporary

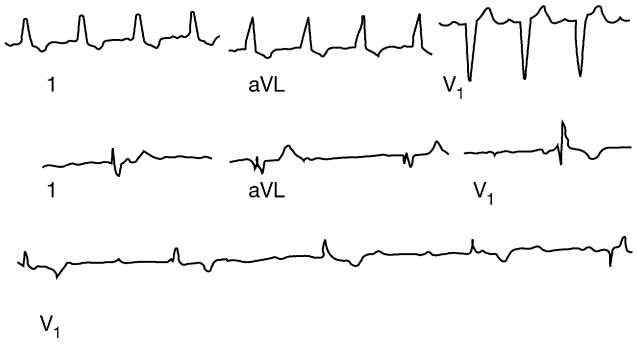

Fig 1 Top: admission ECG showing pre-existing LBBB. Middle: development of complete heart block during guide wire insertion. Bottom: rhythm strip showing complete heart block.

transvenous pacemaker insertion (Fig. 1). Plasma concentration of digoxin was 0.4 mg dl^{-1} and cardiac enzymes were normal. The patient remained pacemaker-dependent for the next few hours and then the previous cardiac rhythm returned; the pacemaker was removed after 48 h. An echocardiogram showed a dilated heart and severe left ventricular dysfunction, with an ejection fraction of 20%.

Because trauma from the guide wire was the possible reason for the onset of CHB, the patient was referred for assessment of the conducting system of the heart and evaluation of the need for a permanent pacemaker. The A–H interval was 100 ms and the H–V interval was 50 ms. The A–H interval is the conduction time through the atrium to the Bundle of His (normal: 55–130 ms) and the H–V interval is the conduction time from the Bundle of His to the earliest depolarization of ventricular myocardium (normal: 30–55 ms). These times are prolonged in patients with conduction disease. No structural disease was found, so the transient heart block was considered to be caused by trauma during guide wire insertion, and the patient was discharged without a pacemaker.

Discussion

In this patient, guide wire insertion caused CHB; the escape rhythm showed right bundle branch block (RBBB) morphology and right axis deviation, suggesting impulse origin in the anterior fascicle of the left bundle branch. Electrophysiology studies found normal AV node and conduction below the bundle of His showing that the block was caused by mechanical trauma by the guide wire. Guide wire insertion for central venous cannulation has caused asystole and non-conducted P-waves in a patient with pre-existing LBBB,[1] but confirmation of normal A–V conduction by electrophysiology studies has not been previously reported.

The incidence of RBBB during passage of wires and catheters into the heart is ~3–12%.[1–5] Occurrence of new left fascicular blocks, anterior and posterior, along with RBBB has also been reported, and is explained by longitudinal dissociation of fibres in the bundle of His.[1 5] RBBB, even transient, in a patient with LBBB can cause CHB and haemodynamic instability, as the block is usually below the bundle of His—an unstable escape rhythm.[1 2] The chance of developing CHB during pulmonary artery catheterization does not seem to be increased with pre-existing LBBB,[1–3] but some studies have found an increased risk (23 *vs* 5%).[6] Some authors suggest using a prophylactic temporary pacemaker in patients with LBBB undergoing right heart catheterization, because of the risk of CHB,[1 7 8] but others argue that the small chance of this complication and the complications of pacemaker insertion do not warrant the delays involved.[2 3]

In patients with this complication, the block is probably in the right bundle branch, rather than in the AV node or bundle of His.[1–4 9] However, when fascicular blocks accompany RBBB, the bundle of His is more likely to be the site of damage.[1 5] The ease of right bundle branch involvement is probably because it is placed superficially in the right ventricular endocardium below the tricuspid valves.[2 5 10] The left bundle is less susceptible because of its earlier branching in the septum and dispersed nature. Development of CHB in patients with RBBB and anterior fascicular block has been reported during left heart catheterization.[9]

Conduction block during insertion of a central venous cannula is rare compared with pulmonary artery or cardiac catheterization as placement should not involve entry into the heart.[1–5] However, onset of cardiac conduction abnormalities with central cannula insertion is important as, unlike the insertion of pulmonary artery catheters or temporary pacemakers, they can be inserted without ECG monitoring. The guide wire tips are less flexible and rigid, making them more arrhythmogenic compared with conventional or flow-directed balloon-tipped catheters.[1] Transient RBBB in a patient with normal baseline ECG may remain unrecognized, but in a patient with LBBB, RBBB may result in life-threatening complications; even asystole has been reported.[1]

Other cardiac complications from guide wire insertion include arrhythmias (premature ventricular contractions, ventricular fibrillation) or perforation resulting in cardiac tamponade.[1 5 11–14] Passage into the inferior vena cava can dislodge devices like vena cava filters.[15] External landmarks are not reliable predictors of insertion lengths and assessments from radiographs correlate poorly with direct measurements.[12 15] If the insertion of the guide wire does not exceed 22 cm, the incidence of complications is reduced by around 70%.[1] The mean distance from access sites to the junction of the superior vena cava with the right atrium was 18 cm; the right internal jugular vein was the shortest (16 cm) and left subclavian vein the longest (21.2 cm).[15] The usual upper limit of safe guide wire insertion in an adult patient is 18 cm,[15] and the length of guide wire inserted should only extend 2–3 cm beyond the final position of the catheter tip.[15] A catheter tip can move 1–3 cm with

movement of the patient's arms, head or neck, and the final position should provide for this movement without causing complications.[15] It is generally recommended that cannulae should be inserted to a depth of 13–16 cm via the right, and 15–20 cm via the left jugular vein.[16] Shorter cannulae catheters are available and 15–16 cm catheters reduce the potential for right atrial placement.[12]

In summary, central venous cannulation in patients with pre-existing LBBB should be done with caution. The insertion of the guide wire should not exceed 18–20 cm and the position of the catheter should be checked radiologically, at insertion and periodically, to confirm placement outside the heart.[11 13] Markings on guide wires may help decrease complications from insertion too far. In the case presented, we show that conduction block was caused by transient injury to the conducting system by the guide wire.

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