Complete heart block: A rare central venous catheter placement complication

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ABSTRACT

Central venous catheter (CVC) placement is an operation which can establish a fast, safe, and effective deep venous access to rescue patients under critical conditions, especially for those receiving hemodialysis. It is a simple operation with almost no complications, but different complications have been still reported, such as bleeding, infection, embolism, low blood flow, and cardiac arrhythmias. In this case, the patient with preexisting left bundle branch block suffered right bundle branch block, leading to complete heart block during CVC placement. When the patient developed complete heart block, we immediately treated him with isoproterenol, and the surgery was terminated as soon as possible. The patient gradually recovered the sinus rhythm after the treatment. This complication is rare but severe, and clinicians should recognize the risks and take strategies as early as possible. We think the cause of complete heart block in this patient may be related to mechanical trauma to the right ventricle by the guide wire or catheter insertion. Therefore, CVC placement should be performed with more caution, and the guide wire and catheter tip should be inserted less than 18 cm deep.

KEY WORDS

complete heart block; central venous catheter placement; complication
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As one of the common clinical invasive procedures, central venous catheter (CVC) placement can establish a fast, safe, and effective deep venous access to rescue critically ill patients, especially those receiving hemodialysis (HD). CVC placement is a simple operation, with almost no complications. Based on this, some clinicians paid little attention to the complications, but different complications have been reported\[1-6\], such as bleeding, infection, embolism, low blood flow, and cardiac arrhythmias\[1-4\]. However, the complication of complete heart block (CHB) is severe and rare\[5-6\]. In our study, the patient with preexisting left bundle branch block suffered a decline in heart rate twice during each right internal jugular vein catheter placement, and the severity was not recognized until the patient experienced a decline heart rate for the second time. We reported the case below hoping to draw clinicians’ attention to the occurrence of such complications during CVC placement.

1 Case report

An 88-year-old man was admitted to the Third Hospital of Changsha at 2016-06-02 because of repeated episodes of chest tightness and palpitations for more than 20 years, which had progressed with cough and sputum for 10 hours. He had a history of coronary heart disease (ischemic cardiomyopathy) with the following features: 1) paroxysmal atrial fibrillation; 2) cardiac function grade IV; 3) coronary artery stenting after the state, as well as hypertension grade 3 in the extremely very high-risk group and diabetes mellitus with diabetic kidney disease (chronic kidney disease stage 4). On the admission, examination revealed that his pulse rate was rapid but regular (122 min^{-1}), and his heart rate was 122 min^{-1}. He had a respiratory rate of 28 min^{-1} and a blood pressure of 140/80 mmHg (1 mmHg=0.133 kPa). He was conscious but looked acutely ill with orthopnea and sweating. Several dry and wet rales were detected in his lungs. His heart percussion was left-expanded and lower limbs were mildly edematous. Laboratory tests revealed infection with a leukocyte level of 11.8×10^{9}/L, percentage of neutrophils of 95.6%, and procalcitonin of 4.07 ng/mL. He had mild anemia with a hemoglobin level of 104 g/L. Other laboratory tests revealed blood urea nitrogen, creatinine, and uric acid levels of 19.9 mmol/L, 300.6 μmol/L, and 622.3 μmol/L, respectively. Electrocardiography (ECG) revealed sinus rhythm with complete left bundle branch block (LBBB) and partial ST-T change (Figure 1).

The treatment consisted of sodium nitroprusside, cedilanid for controlling heart failure, moxifloxacin for controlling infection, acarbose for controlling blood glucose, amlodipine for controlling blood pressure, bisoprolol for controlling heart rate, and clopidogrel antiplatelet. However, the patient had recurrent heart failure with decreased urine output level of approximately 350 mL/24 h after diuretic administration. He began receiving hemodialysis regularly with a left femoral vein catheter, but 1 month later, the catheter was removed because of a catheter-related infection. Then, temporary catheterization of the right internal jugular vein was arranged in the ward. During the operation, the patient showed a decline in heart rate to 46 min^{-1}. Isoproterenol was administered for 1 hour; thereby, his heart rate recovered to 60 min^{-1}. One month later, the patient failed to recover, with repeated heart failure and progressive renal failure; thus, long-term catheterization with a tunneled cuffed catheter (TCC) was advised. During the procedure, the patient was connected to a monitor to record ECG signals, blood oxygen saturation, and blood pressure. When suturing the skin incision, the patient’s heart rate decreased to 35 min^{-1} with a blood pressure of 150/60 mmHg and blood oxygen saturation of 96%. The patient underwent an emergency suture dressing. Bedside ECG revealed sinus rhythm and CHB (Figure 2). Isoproterenol was given immediately to increase his heart rate. Thereafter, bedside ECG showed II-degree two-type atrioventricular block. After 2.5 hours, the isoproterenol administration was discontinued when the heart rate increased to 120 min^{-1}, and then bedside ECG revealed sinus rhythm with a heart rate of 80 min^{-1}. Since then, the patient had regular blood purification treatment. When the ECG image was reviewed, sinus rhythm and LBBB were found.
2 Discussion

In this case, the patient underwent right internal jugular vein catheter placement twice. For the first time, he showed a decline in heart rate to 46 min⁻¹ during CVC placement, but recovered after using isoproterenol. However, the severity was not recognized, and 1 month later, TCC was advised. CHB manifested during the CVC placement.

Complications associated with CVC placement was reported to range from 5% to 19%⁹, including vascular injuries, pneumothorax, infection, and cardiac arrhythmias. Cardiac arrhythmias occurred during CVC placement procedures, mainly including sinus tachycardia, premature atrial contractions, premature ventricular contractions, and premature atrial contraction²⁻⁴. Only a small percentage of these cardiac arrhythmias have symptoms, which are usually transient after withdrawing the guide wire and without hemodynamic disorders. These factors make CVC placement easily underestimated. However, severe cardiac arrhythmias have been reported before⁵⁻⁷, such as CHB and cardiac arrest, which are rare but severe.

Among adults, the complication of CHB is rare during CVC placement when a contralateral preexisting right bundle branch block (RBBB) or LBBB is present. Usually, the central venous catheter tip is located in the superior vena cava or upper right atrium and the mid-point of the left innominate vein⁸⁻¹⁰. No significant difference in the incidence of complications, including arrhythmias, or in mortality attributable to catheter was found between the superior vena cava and upper right atrium tip⁸⁻¹¹. Although CHB is rare, its consequence is severe. It has been reported in patients with preexisting LBBB during CVC placement⁵⁻⁶. The incidence of RBBB in the
process of CVC placement is approximately 3%–12%\(^{(5,12)}\). Mechanical trauma induced by guide wire or catheter insertion is usually considered the cause of bundle branch block. The guide wire or catheter is not flexible, which makes them more invasive by causing direct trauma to the conduction system. However, the right bundle branch inside the right ventricle is more superficial, which makes it more vulnerable to mechanical trauma caused by guide wire or catheter insertion than the left bundle branch. Thus, it may result in CHB, while the right bundle branch is impinged with a preexisting LBBB, as bilateral bundle branches are blocked. In patients with preexisting LBBB, the incidence of CHB is 23%\(^{(12)}\). Mechanical trauma-induced RBBB is often transient with a duration of <24 hours and does not cause major clinical impacts, so no intervention is needed. By contrast, in preexisting LBBB, RBBB may cause life-threatening CHB and may induce hemodynamic instability. In the event of CHB, immediate retraction of the guide wire or catheter should be the first step, and then proper management by either temporary transvenous pacemaker or vasopressors should be taken. As in this case, the patient did not have hemodynamic instability, so only isoproterenol was used to treat the CHB. Usually, CHB is transient for several hours to days after proper strategies are implemented\(^{(13)}\).

Even if the incidence of CHB during CVC placement is rare, efforts should be made to avoid such complications, as CHB consequences are severe. The operator should recognize clearly the complications of CVC placement. Prevention of even the most unusual complication becomes a worthwhile initiative. The overall professional quality of the vascular access team should be enhanced, or experts must be invited to lecture or train operators. The longer the time it takes to insert the guide wire or catheter, the higher the incidence of cardiac arrhythmias. Lee et al\(^{(3)}\) demonstrated that limiting the length of the guide wire insertion to \(<20\text{ cm}\) for right internal jugular venous catheterization with a marked J-wire can reduce the incidence of arrhythmias. Thus, using a marked guide wire to ensure a guidewire insertion of less 18 cm can significantly reduce the risk of arrhythmias\(^{(8,14)}\). Moreover, fluoroscopic guidance, continuous periprocedural ECG monitoring, intravascular ECG monitoring, or ultrasonography guidance is also important in the prevention of CVC placement complications\(^{(15)}\).

In summary, in patients with preexisting LBBB, CVC placement should be performed with more caution. The guide wire and catheter tip should be inserted \(<18\text{ cm}\) deep. Once a complication occurs, immediate strategies should be taken. CHB is mostly transient and eventually leaves no permanent damage after appropriate strategies are implemented, such as withdrawing the guide wire or catheter to \(<18\text{ cm}\), external pacing, or use of vasopressors.

**Conflict of interest:** The authors declare that they have no conflicts of interest to disclose.

**References**


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