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# A new method for localizing the landmark of axillary vein and its application

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ABSTRACT

*Background:* Axillary vein puncture is a popular puncture site for pacemaker implantation. However, due to the lacking of body surface markers, the current puncture method is too complicated and affect the popularization and application of axillary vein puncture. Here, we performed a new body surface landmark to make the blind axillary vein puncture simple and easy.

*Methods:* The study population included 30 patients referred for pacemaker implantation using axillary vein puncture. Digital subtraction angiography (DSA) was used to determine the direction and the surface landmarks of the axillary vein. Medial cusp of thoracic triangle and the coracoid process were directly touched with fingers. The puncture point was about 1 cm below the coracoid, and the needle tip pointed to the medial cusp of thoracic triangle with the angle of 30–60°.

*Results:* There was little variation in distribution of axillary vein. The body surface landmark of the junction of the axillary vein and the subclavian vein is on the medial cusp of thoracic triangle. In these 30 patients, blind axillary vein puncture was successful obtained in all patients. There was no pneumothorax and inadvertent arterial puncture. The pacemaker lead wire was placed smoothly. Moreover, the pacemaker pocket was ideally positioned when cut along the puncture point.

*Conclusions:* Blind axillary vein access using the body surface landmark of the thoracic triangle is an effective method for pacemaker implantation and can obvious avoid the complications usually observed with the traditional subclavian vein approach.



In recent years, axillary vein puncture has become a more popular puncture site for pacemaker implantation [1]. Because the complications caused by subclavian vein puncture often bother the doctors, such as “crush syndrome”, lead rupture, pneumothorax, and inadvertent arterial puncture [2,3]. However, due to the lacking of body surface markers, there is no recognized method for axillary vein puncture. Here, we use angiography to determine the surface location of axillary vein, and use this marker to guide axillary venipuncture site.

## 1. Method

A total of 30 patients with pacemaker implantation were selected, including 15 males and 15 females. Age was from 34 to 86 years old, and the weight was from 51 to 92 kg. The study was approved by the local ethics committee of the Affiliated Hospital of Qingdao University, and informed consent was obtained from all the subjects. The study protocol conformed to the ethical guidelines of the 1964 Declaration of Helsinki. All patients were in a natural supine position, with both upper limbs naturally drooping and placed on both sides of the body. Axillary venography was performed by digital subtraction angiography (DSA) to determine the direction and the surface landmarks of the axillary vein.

We found that there is little variation in distribution of axillary vein (Fig. 1.). The junction of the axillary vein and the subclavian vein is always at the junction of the clavicle and the outer edge of the first rib. It is same in both sides of the patients, and not affected by gender, age and weight. It is marked on the medial cusp of thoracic triangle.

The location of thoracic triangle on body surface: the upper boundary is the clavicle, the outer boundary is the coracoid process, and the inner boundary is the out edge of the rib. During axillary vein puncture, patients were in the natural supine position with their heads turned to the opposite side of the puncture site. Medial

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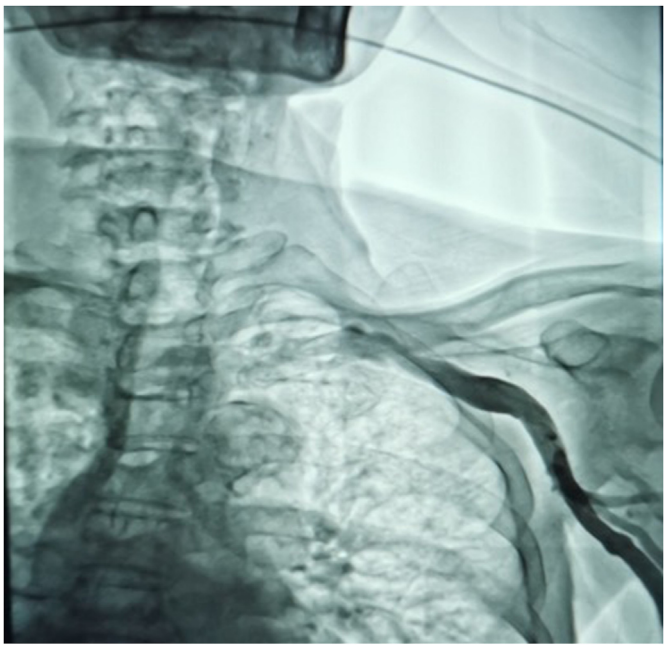

**Fig. 1.** The radiography of axillary vein.

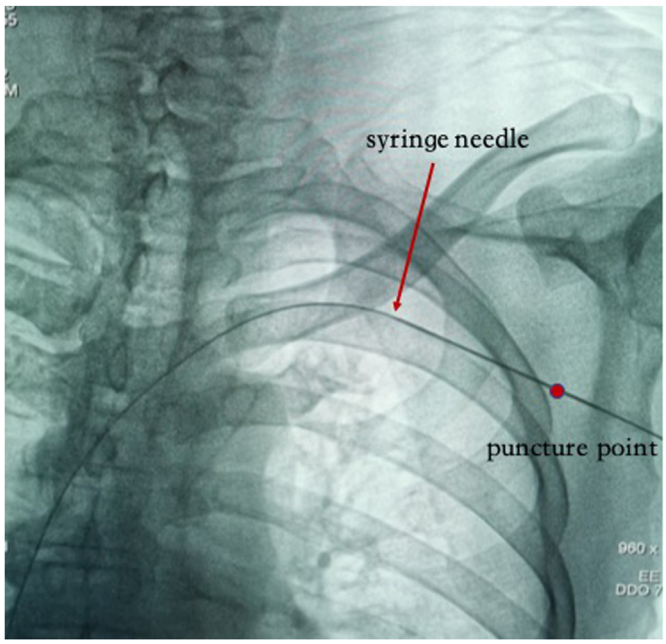


**Fig. 2.** The blind puncture point of axillary vein.

cusp of thoracic triangle and the coracoid process were directly touched with fingers. The puncture point was about 1 cm below the coracoid, and the needle tip pointed to the medial cusp of thoracic triangle with the angle of 30–60°. The third segment of the axillary vein was punctured with this method (Fig. 2.). All patients were blind punctured successfully.

Besides, we cut the pacemaker pocket along the puncture point, which can avoid to draw or replace the guidewire(Fig. 3.). In addition, it is an ideal place for the pacemaker pocket, as it does not cause the friction with the arm and the dislodgement of pacemaker resulted from the overly relaxed pocket (Fig. 4.).

## 2. Discussion

There are many methods for axillary vein puncture at present [4]. However, some surface markers are too complicated, some need to be performed under X-ray, and some require the assistance of echocardiography or other equipment, all of which affect the popularization and application of axillary vein puncture. Clinically, an easy-to-follow method is required to make the axillary vein puncture simple and easy.

The axillary vein originates at the lower border of the teres major muscle as a continuation of the basilic vein and becomes the subclavian vein at the lateral margin of the first rib [1]. The whole process passes outside the thorax below the clavicle, so it is not easy to injure the pleura during puncture and can reduce the incidence of pneumothorax. According to its course, it can be divided into 3 segments (shown in Table 1.).

Although the first and second segments can be directly compressed for hemostasis in case of inadvertent arterial puncture, the accompanying nerves might be damaged during puncture. Moreover, the axillary vein accompanies the axillary artery closely at the distal end, which makes it easily to puncture the artery. Variation of the axillary vein also occurs in the first and second segments. In addition, the lumens diameter of first and second segments also determines that they are not suitable for pacemaker lead wires. Therefore, the first and second segments are not ideal puncture sites for pacemaker implantation.

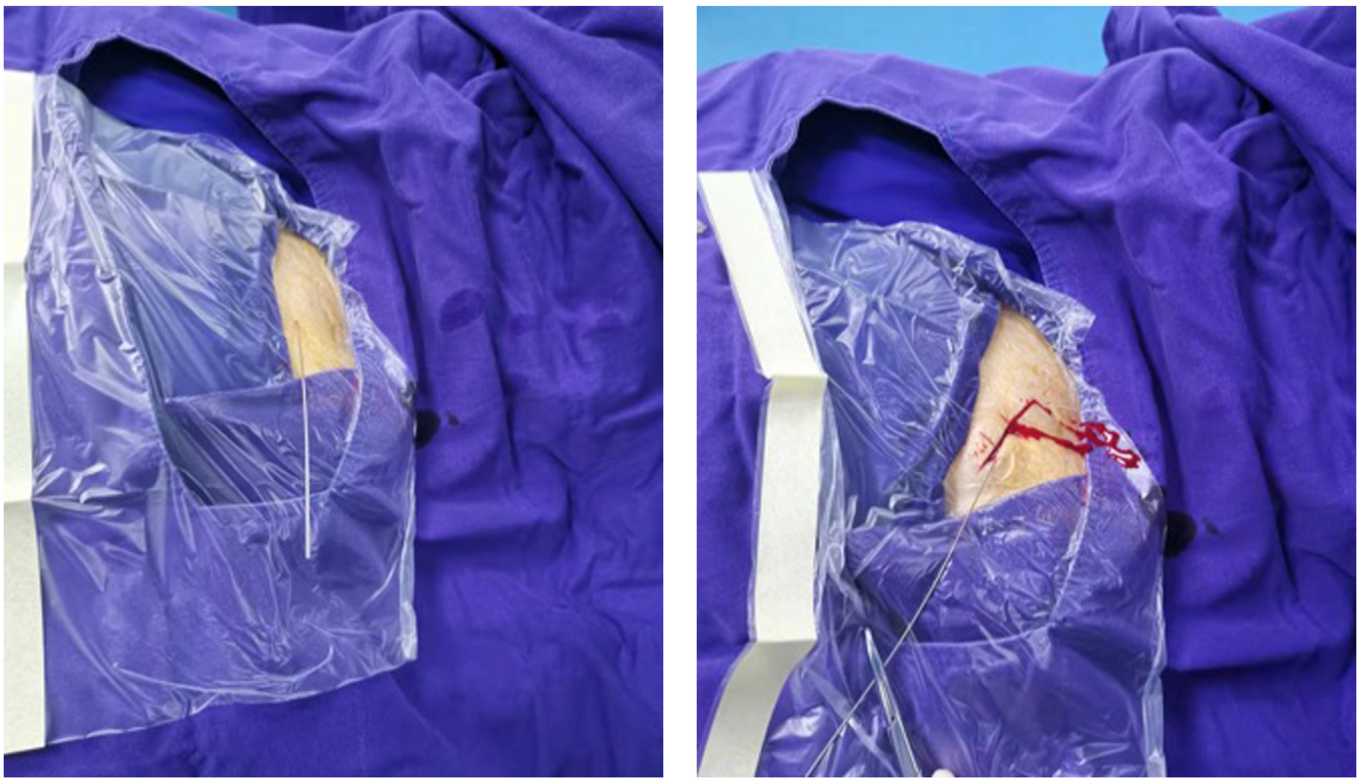

**Fig. 3.** A pacemaker pocket was created by an incision through the puncture point.

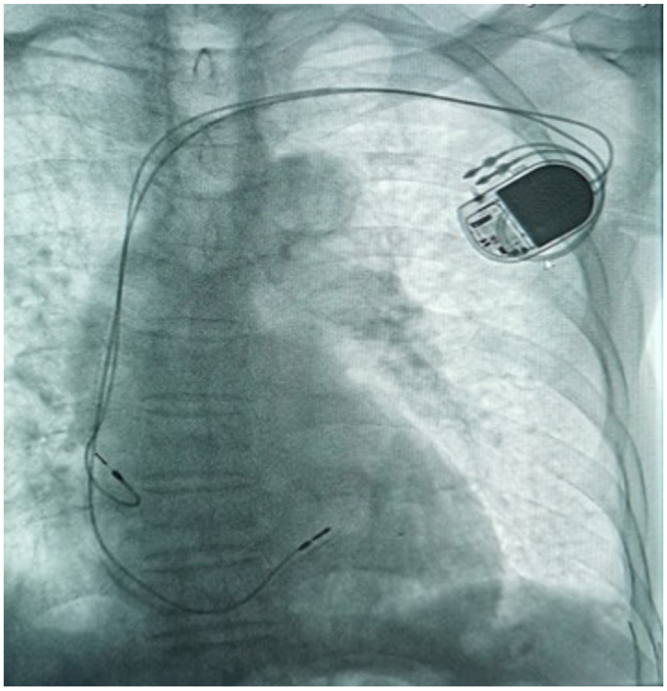

**Fig. 4.** The position of the pacemaker pocket.

The third segment of the axillary vein still runs outside the thorax, so it is not easy to cause pneumothorax during puncture. The position of the third segment is fixed, so there is a high success rate of puncture. Moreover, the artery and vein is separated by the anterior scalene muscle in this segment, so it is not easy to puncture the artery. In addition, there is no accompanying nerves and the lumen diameter is relatively thicker in this segment, which can avoid the "crush syndrome" of the pacemaker lead and lead breakage when the pacemaker is implanted. Therefore, the third segment of the axillary vein is an ideal puncture site for pacemaker implantation. It is crucial to find its body surface markers to make the puncture easier.

We determined the surface location of the axillary vein by axillary venography in 30 patients. It was found that the junction of the axillary vein and the subclavian vein was at the medial cusp of the thoracic triangle. In these 30 patients, the thoracic triangle was used as the body surface marker, and the puncture was performed about 1 cm below the outer edge of the coracoid process toward the medial cusp blindly. The success rate of blind puncture was 100%, and there was no pneumothorax and inadvertent arterial puncture. The lead wire was placed smoothly. Moreover, the pacemaker pocket was ideally positioned when cut along the puncture point. At present, we use this surface maker for blind puncture of axillary vein, and the effect is very satisfactory.

**Table 1**
The anatomy of axillary vein.

| Segment | Location | Adjacent relationship | Length (mm) | Diameter (mm) |
|---|---|---|---|---|
| First segment | From the lower border of the teres major tendon to the lower border of the pectoralis minor muscle. | The medial and lateral sides are close to the medial and lateral roots of the median nerve, and the posterior is close to the axillary artery. | 39.3 ± 3.2 | 7.8 ± 1.6 |
| Second segment | Between the upper and lower borders of the pectoralis minor muscle. | The posterior and lateral sides are close to the medial and lateral bundles of the brachial plexus, covered by pectoralis minor. The position is deep. | 31.9 ± 2.9 | 9.5 ± 2.5 |
| Third segment | Between the upper border of the pectoralis minor muscle and the lateral border of the first rib. | The axillary artery and axillary vein are separated here by the anterior scalene muscle. The distance is far. The position is shallow. | 19.5 ± 4.2 | 12.5 ± 2.7 |

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## Consent for publication

Not applicable.

## Declaration of competing interest

The authors declare that they have no competing interests.

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