

Venous puncture in permanent pacemakers implantation, when easy become difficult

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¹Substantial contributions to the conception or design of the work; or the acquisition

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³Data analysis and review

⁴Data Collection

⁵Review and reference writing

⁶Data Collection and analysis

Funding Source: None

Conflict of Interest: None

Received: June 29, 2020

Accepted: Jan 07, 2021

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ABSTRACT

Objective: To share our experience in the field of device implantation with particular emphasis on the venous punctures.

Methodology: This study was conducted in Cardiology Department at Hayat Abad Medical Complex Peshawar from June 2011 to December 2017. All those patients who presented to Cardiology department Hayat Abad Medical Complex Peshawar for implantation of permanent pacemakers due to any reason were brought to catheterization laboratory after explaining the procedure. Chest scrubbed and draped and after venogram of the desired side axillary vein was punctured by Seldinger technique and if there was failure to puncture the vein after a few attempts, the position of the vein reconfirmed with venogram and reattempted. In few cases vein used to change its path after the initial failed attempts. After venous access skin incision was made superolateral to the puncture side, pocket constructed and lead position and pulse generator attached and wound closed in layers.

Results: A total of 484 pacemakers were implanted in the study period. Dual chamber pacemakers were 136 (28.09%) and single chamber pacemakers were 348 (71.90%). There were left sided persistent SVC in 2 cases and totally obstructed vein on both side in one patient. Procedure was shifted to right side in 10 patients due to unsuitable veins on left side. Vein change its tract in 07 cases.

Conclusion: Sound anatomical understanding venous course is crucial for safe venous puncture and successful PPM implantation.

Keywords: Permanent Pace Maker (PPM), Venous Puncture, Axillary Vein, Seldinger Technique.

Cite this article as: Saidullah S, Shah B, Niaz MA, Shoaib M. Venous puncture in permanent pacemakers implantation, when easy become difficult. 2020; 16(4):224-228.

Introduction

Implantation of permanent pacemakers is an integral part of cardiology training. Though it is considered the domain of electrophysiology but since the field of electrophysiology is in its infancy, particularly in under developed and developing countries,¹ so mostly the general cardiologists and intervention cardiologists are involved in the implantation procedures.²

Different operators use different techniques of implantation depending on their expertise and convenience. Nevertheless, no single technique is perfect nor can it be under estimated. There is a continuous revolution in the techniques of implantation, in order to

bring down the complication rate and make every implantation a success with convenience to both to the operator and patient.

Cephalic vein^{3,4} was used mostly in the past but the major drawback of this technique is to dissect the area to expose the cephalic vein first, lift it, and then do the cut down procedure and ligate the vein proximal and distal to the insertion side of the lead. The only advantage of this procedure is: the chance of pneumothorax is negligible. But it is a small size vein⁴ and accommodation⁴ of leads is cumbersome at time.^{5,6} The procedure involved a lot of surgical skill and cardiologists are not surgeon by and large. Moreover, there is cut down of the vein and ligation so vein cannot be reused. Sometime the

connection of cephalic vein with the axillary vein is very tortuous⁵ or the angle with axillary vein is sometime very abnormal⁶ so placement of the pacemakers leads in the right ventricle is not very easy. There are report of cephalic vein drainage to subclavian vein which further complicate the dissection.⁷ Occasionally, the cephalic vein crosses superficial to the clavicle to join the external jugular vein, making it unsuitable for this purpose.⁸ The caliber of the vein is some time very small so for dual chambers pacemakers the accommodation of two leads are cumbersome.^{9, 10}

The subclavian vein¹¹ is another popular site which is approached by seldinger technique. The beauty of the vein is its relatively fixed anatomy.¹²⁻¹⁵ It is relatively big vein¹⁶ as compared to the axillary and cephalic veins so there is no problem of accommodation. However, since the course of the vein is intra-thoracic and it is accompanied by subclavian artery, so the chance of pneumothorax is very high and incidental puncture of subclavian artery is another unpleasant complication mostly leading to hematoma formation.^{17, 11} Subclavian crush syndrome is one of the cumbersome complication with this technique.¹⁸ However the vein can be punctured most of the time very safely and easily in experience hands.

The 3rd site which is considered very favorable is the axillary vein.^{19, 20} It has a reasonable size. The course of the vein is extra thoracic. So the chance of pneumothorax is less in trained hands. But the vein is accompanied by axillary artery so most of the time there is accidental puncture of the artery.²¹ This vein is also approached by seldinger technique. As the vein passes through loose axillary tissue, therefore, the vein can change its position with movement of the upper limb. Therefore, at time patient who is fully awake, due to slight pain, if patient moves around, vein change its location on the operating table which leads to repeated failed attempts to puncture the vein.

Sometime even the body position remains unchanged but the vein changes its course possibly due to the collection of hematoma in the loose space, particularly in patient whose dual anti-platelets cannot be stopped or there is an insufficient dual anti-platelet free period or accidental pricks of the artery.

Sometime the vein is pricked but guide wire fail to negotiate, so repeated attempts leads to hematoma collection around the vein and the vein is pushed up or down. This makes the easiest looking procedure difficult

and at times if the venogram is not repeated in these cases, it will increase the rate of failure of implantation and also the rate of complication. This study was conducted to shear our own experience in the field of implantation with particular accent on methods of venous puncture.

Methodology

After approval from the hospital ethical committee, all those patients who presented to Cardiology department Hayat Abad Medical Complex for implantation of permanent pacemakers due to any reason were admitted. Informed consent obtained from the patients. Chest shaved in male patient and in both gender chest painted with pyodine solution night before. Patient was started on intravenous antibiotics night before and if needed temporary pacemaker implanted. It was a randomize controlled study. Sample collection was done on non probability sampling type. Chi square test was sued for statistical difference between the groups. Statistical analysis was done on SPSS version 22.

Patient was brought nil by mouth to catheterization laboratory and venogram performed of the left upper limb. If vein found suitable then patient scrubbed and draped and if there was left side persistent superior vena cava or the venous anatomy was not suitable then the procedure was performed on right side. To approach to the procedure, we divided patients into two groups.

In group A: incision was made first at the desired site and pocket constructed, and vein punctured by seldinger's technique and device implanted.

In group B we did venous prick first and then superolateral to venous prick skin incision was done. Guide wires external end pulled in and brought out through the incision site.

We performed skin prick we the help of pervious venogram or during venogram or at time just keeping the needle near the outer boarder of rib cage toward the clavicle. Sometime if this was not successful then we targeted the medial costo-clavicular joint to hit the vein. In some cases after initial failed attempt, when the venogram was repeated the vein was found shifted superolaterally or inferomedially and then we change our strategy accordingly.

After getting the vein, sheath was passed over the guide wire lead position in the desired chamber and the secured with silk 1/0 and pulse generator attached and wound

closed in layers. Dressing applied and patient shifted to ward and kept on antibiotics according to our ward protocol.

Results

There were total 484 cases in the study period. Results of the study are tabulated in table I. In 200 (41.32) cases venogram performed while in the rest prick was done without venogram. In 80 (16.52%) cases subclavian vein was used for implantation while in 404(83.47%) cases axillary vein was target for prick. In 90 (18.59%) cases skin prick was done before skin incision while in 394 (81.40%) cases prick was performed after skin incision and construction of pocket for pulse generator. Repeat venogram was performed in 11 (2.27%) cases and in 07 (1.4%) patients we noted that the vein has changed its initial path. In one case there was total venous obstruction on both upper limbs so with help of surgeon after thoracotomy lead was implanted in the right ventricle from superior vena cava. In one case the vein shifted inferomedially from its original path and in the rest superolaterally. Another caveat is left side persistent superior vena cava (SVC).²² In these cases positioning the right ventricular lead is cumbersome. Therefore defining the anatomy before prick and incision makes the procedure much easier for both the patient and operator. We got 4 (0.826%) cases of left side persistent SVC out of total 484 cases done in study period. In our initial approach we shifted the procedure after the prick and pocket formation in two cases. In other two cases the anatomy was define before the procedure so the procedure was started from the right side.

Table: Procedure done in study period.

Device /procedure	n (%)
Total	484
VVIR	104 (21.48%)
VVI	244 (50.41%)
DDDR	136 (28.09%)
Venogram	200(41.32)
Through Subclavian Vein	80(16.52%)
Through Axillary Vein	404(83.47%)
Over the Skin Venous Prick	90(18.59%)
Prick After Incision	394(81.40%)
Failed implantation	00
Vein Changed its tract	07(1.4%)
Repeated venogram	11(2.27%)

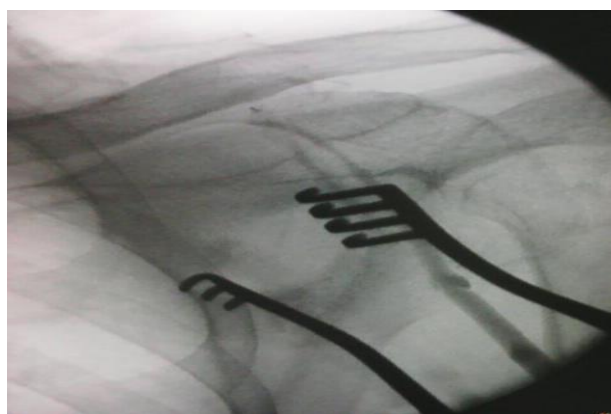


Figure 1. Initial venogram: vein just lateral to rib cage

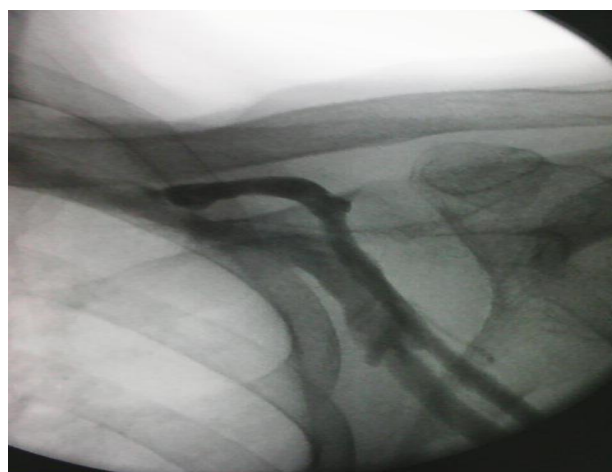


Figure 2. Repeat venogram: vein far away from its initial position

Discussion

Venous puncture is the first step in PPM implantation. Most of the time everything goes very smoothly but at time an obviously looking simple and easy venous access becomes difficult.

As most of the operators use the left subclavian area to implant the devices because mostly people are right handed so they are not handicapped soon after implantation. The venous connection are such that leads are position in the cardiac chambers very well and easily if they are implanted from the left side. The other possible reason is the operator convenience. They are much comfortable because they are using their right hand very effectively as compared if they are on the right side.

It is therefore, most of the well train operators like to define the venous anatomy by venogram before doing anything to avoid unnecessary incision on the left side. Some time there is venous stenosis²³ or constriction²⁴ or

abnormal connection^{6, 7, 8} which impede the lead passage so it is better to define the anatomy before trying to go in.

Nevertheless, despite the obviously looking suitable anatomy and the well experience hands one can fail to hit the vein. At time when the operator is targeting the axillary vein, which is consider the most suitable site, if a few failed attempts are made, the vein change its tract and if a second venogram is not performed the chance of complication increased many fold.

It mostly happened to us in those patients who present with acute coronary syndrome (ACS) or they were on dual antiplatelets where possibly due to collection of hematoma in the loose axillary tissue, which pushed the vein up or down (Figure 1, 2).

In such cases repeated venogram will not only help in access to the vein but also will prevent complication and save time. Sometime venous tract remain the same and the caliber of the vein is reasonable but still somehow we fail to get the vein. In these cases we do our puncture during venogram when still the dye is running in the vein or directing our needle to the clavicle keeping the needle on the external edge of the rib cage or parallel to the cage at 45 degree.

This will solve the problem in almost 80% of cases. If still not successful then we used to direct the needle to the medial costo-clavicular joint. It will be helpful in the rest. If still not successful, then change of hands will be the last resort.

In our practice of implantation, it is our routine to define the anatomy first, then do the prick first by targeting the axillary vein and then incise the skin superolateral to the pricking site. By blunt dissection we locate the guide wire and pull in the external end of the wire and brought it out the incision. This will take everything inside the pocket for pulse generator and will save the time and reduce the chance of lead of erosion.²⁵

However, in very obese patient prior skin incision and dissecting the fatty tissue is necessary because it will not allow the needle to meet its target. At time in very risky cases like the one on dual antiplatelets and very fragile patient or the one where the chest anatomy is such that repeated pocking can lead to complication, then if a single prick is successful, sheath is passed and second wire is inserted in the same sheath.

Conclusion

Permanent Pacemakers' implantation is an art which demand delicacy but safe and successful implantation needs sound awareness of anatomy and timely decision by the operator on individual bases. Venous puncture is the first step in the implantation technique, and I think there is no perfect method for piercing the vein, but it should be a routine to define anatomy first and repeat the venogram if the initial few attempts fail particularly in those where the risk of bleeding is high and better to attempt puncture during venogram.

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