

Ultrasonography - The Need of Present Time for Central Venous Catheter Insertion in ICU

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Abstract: ***Background:** This case report describes a subclavian vein cannulation that inadvertently led to an arterial puncture which led to haemothorax. This case emphasizes the importance of post - procedural imaging and the disadvantages of not using ultrasound guidance in central venous catheterization. **Case Presentation:** A 48 - year - old Caucasian female with history of CKD stage V on maintenance hemodialysis and hypothyroidism presented herself in emergency department with complain of breathing difficulty, generalized weakness and giddiness. Recently fistula was made on left upper limb, hence dialysis catheter was planned to insert in right subclavian vein. Ultrasound was not used; catheter was inserted with help of anatomical landmark technique. Inadvertently subclavian artery was punctured during the procedure. Pressure was applied & catheter was inserted in Right Internal Jugular Vein. Post procedure chest X ray showed large hematoma. USG Chest & CT Angiography was done. Surgical evacuation of hematoma was done under general anesthesia & Intercostal drainage was inserted. **Conclusion:** Use of ultrasound guidance for central venous catheter insertion allows direct visualisation of needle approach, direction & guidewire location. Real time guidance leads to decrease complications & improve the chances of success. The probability of success is higher as compared with traditional landmark technique. Homogeneous opacity in thorax immediately post procedure should raise the suspicion of haemothorax. This is a preventable complication with the help of ultrasound guidance.*

Keywords: Subclavian catheterization, Central venous catheterization, Arterial puncture, Subclavian artery, Haemothorax

1. Background

Hemodialysis catheter insertion is a common procedure in Intensive care unit. Over 5 million central venous catheters are inserted every year in the United States alone, accounting for 15 million central venous catheter days [1, 2]. Procedural complications during the insertion of central line catheters occur at approximately 15% [3]. All catheter insertion routes have their own set of complications. Although, subclavian catheterization is associated with lesser complication rates of between 0.3% and 12%, which varies according to the experience of the physician [4]. Arterial puncture constitutes 3.7% of risk all complications [5]. If not recognized early, it causes significant morbidity and mortality. From the year 2001 to 2004, multiple prospective, randomized trials and meta - analyses addressing real - time ultrasound guidance in central venous catheter placement consistently demonstrated lower rates of complication, shorter procedure times, and higher success rates. Considering these studies, its adoption as standard of care has been recommended by several healthcare organizations, including the Centres for Disease Control and Prevention, Institute of Medicine, National Institute for Health and Care Excellence, Agency for Healthcare Research and Quality, and several medical specialty societies [3].

We present a case wherein subclavian vein cannulation was done using anatomical landmark technique without USG guidance and this led to arterial puncture causing catastrophic haemothorax.

2. Case Presentation

A 48 - year - old Caucasian female with history of CKD stage V on maintenance hemodialysis and hypothyroidism presented herself in emergency department with complain of breathing difficulty, generalized weakness and giddiness. The patient's vital signs revealed blood pressure of 140/86

mmHg, heart rate of 110 beats per minute, respiratory rate of 22 breaths per minute. On physical examination, she was found to have recently made AV fistula on left hand (1 week back), on chest auscultation she had B/L Crepts. Blood investigation showed Hb 8.9 g/dl, TLC 16610/cumm, Platelet 2.51 lakh/cumm, Urea 103.5mg/dl, Creatinine 8.17 mg/dl, Sodium 140.3mmol/l, Potassium 7mEq/l. So, initial clinical impression was that of pulmonary edema, uremia and hyperkalemia. Patient was planned for hemodialysis. Arterial Venous fistula was made one week earlier in left upper limb, which was not ready to be used. Hence it was planned to insert hemodialysis catheter in right subclavian vein. In house ultrasound machine was not working due to some technical problem, so right subclavian vein cannulation was attempted by using anatomical landmarks. The needle inadvertently punctured the Right Subclavian Artery. Pressure was applied over right subclavian area continuously for 25 minutes, there was no apparent bleeding. Right internal jugular line was placed as patient need urgent dialysis. Patient was clinically & hemodynamically stable post procedure. No complaints of dyspnea or tachypnea, vitals were stable. Post procedure Chest X ray was done which showed large opacity compressing the lung. Immediately ultrasound chest was done with another machine which revealed a heterogenous hyperechoic lesion measuring 5 x 4 cm is seen in upper part of right chest suggestive of hematoma. No obvious vascularity is seen in the lesion. Thoracic surgeon reference was given, advised for CT Venography, showed the right subclavian vein show subtle hypodense area in the proximal 2/3rd segment with severe luminal narrowing and irregularity of distal 1/3rd segment - likely site of trauma. A large hematoma is seen in the anterior chest wall on the right side with fluid level compressing the underline lung parenchyma. Repeat Hb was done 7.3 g/dl (Morning Hb 8.1 g/dl). Surgery was planned & after PAC clearance, evacuation of hematoma was done under GA. Right side ICD was inserted. Chest X ray was repeated on daily basis, no further increase in hematoma was noted. Patient gradually improved & after recovery patient was shifted out of ICU in stable condition. After proper

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recovery ICD was removed & patient discharged to home in stable condition.

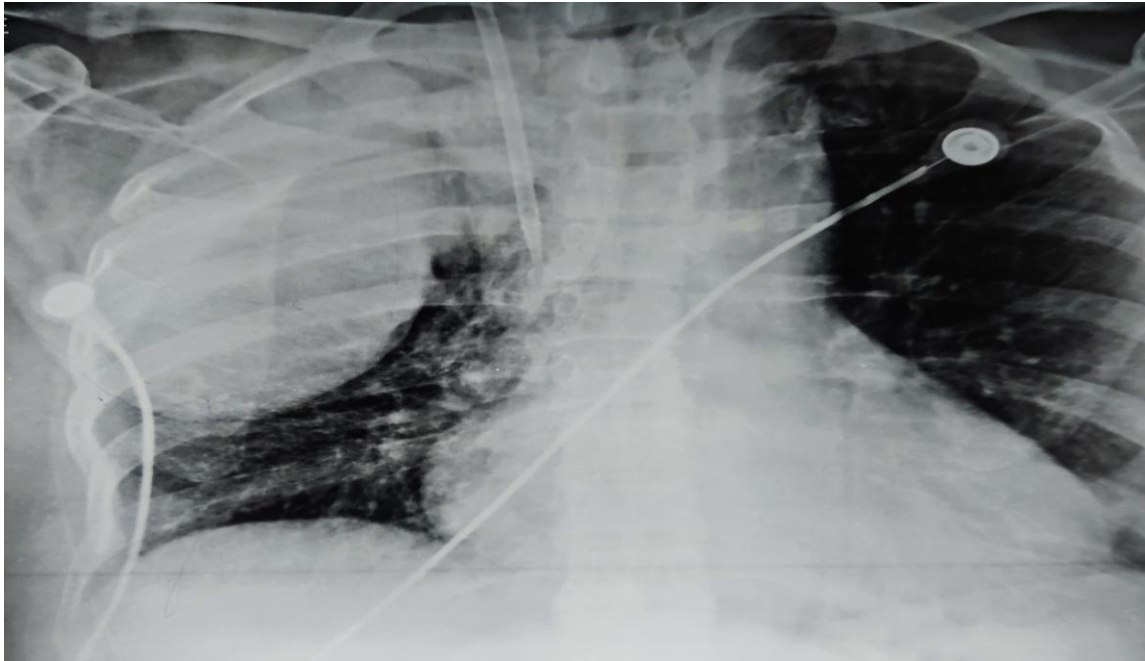


Figure 1: Chest X ray after Procedure

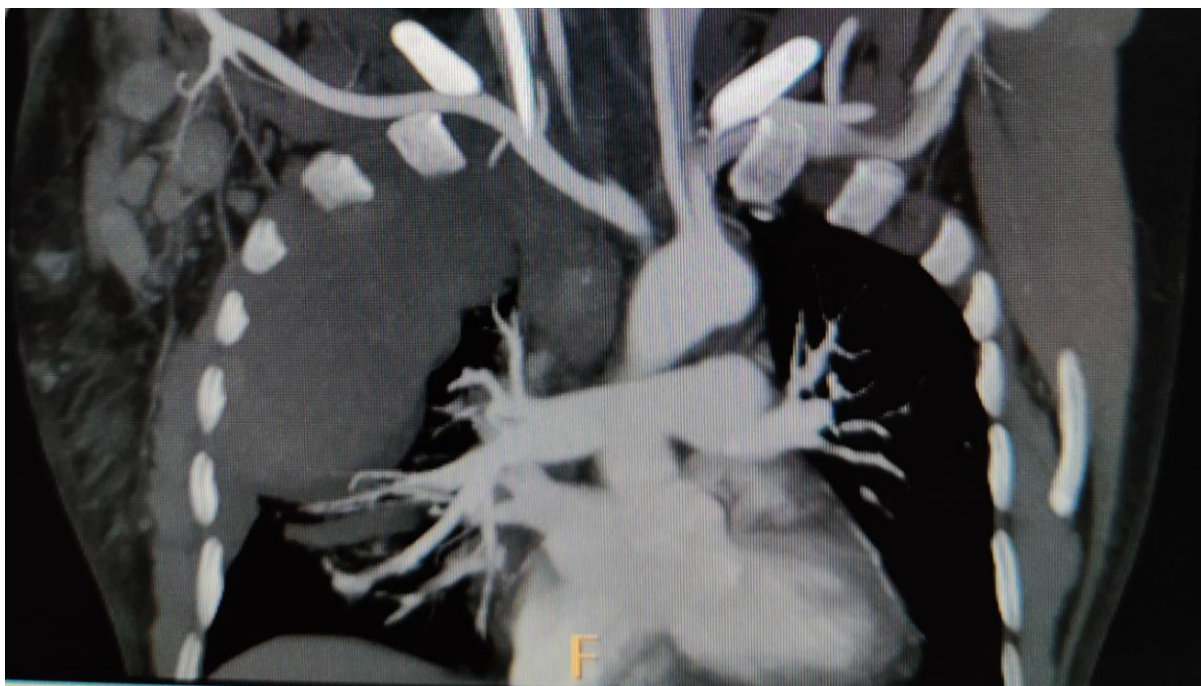


Figure 2: CT Venography

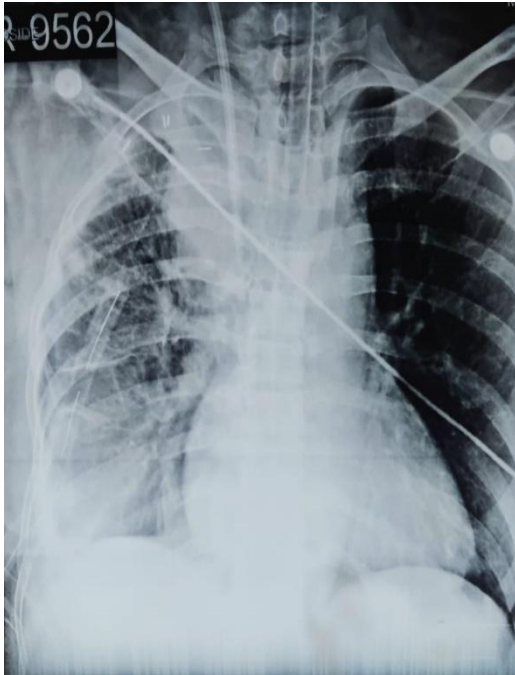


Figure 3: Chst X ray post surgery Day1

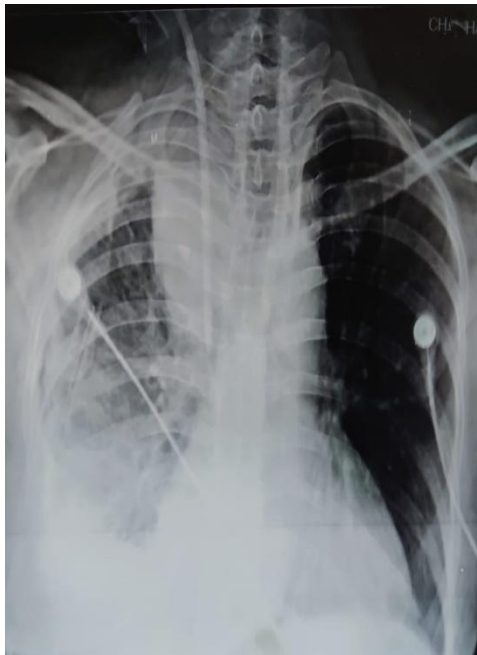


Figure 4: Chest X ray Post Surgery D2



Figure 5: Chest X Ray Post Surgery day4



Figure 6: Chest X Ray Post Surgery Day 5

3. Discussion

Aubaniac in 1952 described the CVP insertion by subclavian technique [6]. In the India alone, multiple central venous catheters are placed yearly for hemodynamic monitoring, medication delivery, and nutritional support. Over 5 million central venous catheters are inserted every year in the United States alone, accounting for 15 million central venous catheter days. As there is increase in number of catheter insertions, so did the immediate & late complications associate with catheterisation. Traditionally it was inserted by using anatomical landmarks which require clinician's experience to identify the site and palpation of arteries next to the veins. These landmark techniques cannot account for anatomic variations at the CVC insertion site. Anatomic variations to the "normal anatomy", however, have been described in a relevant proportion of patients for the internal jugular vein (IJV), the subclavian vein (SV), and the femoral vein (FV). In addition to anatomic variations, venous thrombosis that is especially common in oncologic and critically ill patients can make CVC placement impossible or dangerous for the patient [7].

The incidence of inadvertent subclavian artery puncture is reported at 3.7% due to its location [5], behind and slightly

superior to the path of the subclavian vein [6]. Arterial punctures are directly proportional to the number of attempts made at catheterization, occurring at a rate of 50% after three attempts at cannulation according to studies by Lefrant et al. and Sznajder et al. Numerous risk factors play an important role for inadvertent arterial puncture during subclavian catheter insertion, like anatomical alterations, obesity, oedema, coagulations disorders, previous surgeries, radiotherapy of neck & chest region, neck stiffness, previous catheterisations, coagulation disorders, multiple cannulation attempts, and inexperienced operator [6]. Inadvertent subclavian artery cannulation brings risks such as occlusion, embolism, pseudo - aneurysm, dissection, perforation, exsanguination, and hemothorax [8]. Since the location of the subclavian artery is in an anatomically noncompressible area, it may require surgical intervention such as surgical repair with first rib excision, thoracotomy, percutaneous stent grafting, intraarterial balloon compression, and local percutaneous treatment [6]. In order to minimize the complications, ultrasound guidance is highly recommended in subclavian catheterization because it allows for direct visualization of the anatomical structures as the needle traverses into the vessel. Post procedure chest X ray for positioning & arterial blood gas analysis can be used to differentiate arterial & venous blood. Connecting the central line to a transducer also ensures that the location of the catheter is not in the arterial circulation [5, 9]. Numerous studies have shown that it is preferable to use ultrasonography technique to insert venous lines which will reduce probability of complications. Post procedural chest X ray also plays an important role for confirmation of catheter position & to look for any complications. But in most developing nations ultrasound machines are not available in all critical care areas. With maintenance of skills for anatomical landmark technique it is better to use ultrasound technique for venous line insertion which will reduce the complication rate.

4. Conclusion

In intensive care units Subclavian vein cannulation is a preferable option for securing venous line or for haemodialysis catheter insertion. Among all other complications unintentional puncture of artery have 3.7% risk. But this dreaded complication can be avoided by using Ultrasound guidance for direct visualisation of needle insertion & adjacent anatomical structures, guide wire location & directionality. By using ultrasound guidance real time guidance is helpful even by using compression of vessels which can differentiate artery from vein. As compared to landmark technique usage of ultrasound guidance is superior. This case report should raise awareness regarding the importance of real - time ultrasound in performing central line placements. Due to the reflection of the clavicle when ultrasound is used via the subclavian route, the landmark technique is often used and this option had fallen out of favour despite its importance. The ability to dampen artifactual reflections should be a consideration when future progress in ultrasound technology is achieved. It is also worth mentioning the paramount importance of a postcatheterization Chest X ray to confirm proper cannulation and to rule out any trauma to adjacent structures & vessels. If any injury is recognised than clinician should

intervene early to prevent significant morbidity and mortality. We highly recommend using ultrasound technique for venous line insertions.

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Declarations

Ethics approval and consent to participate: Not applicable.

Consent for publication: Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor - in - Chief of this journal.

Competing interests: The author has no conflicts of interest to declare

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