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ORIGINAL ARTICLE

Efficacy and safety of ultrasound-guided placement of central venous port systems via the right internal jugular vein in elderly oncologic patients: our single-center experience and protocol

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Abstract

Background Ultrasound-guidance has become the routine method for internal jugular vein (IJV) catheterization reducing dramatically failure and complication rates for central venous port (CVP) placement.

Aims The aim of this study was to determine the safety and efficacy of ultrasound-guided IJV CVP placement in elderly oncologic patients.

Methods Between January 2013 and December 2015, 101 elderly oncological patients underwent right IJV CVP placement under ultrasound-guidance. The length of catheter introduction ranged from 18 to 21 cm. Intraoperative fluoroscopy (IF) was always performed intraoperatively. Chest X-ray (CXR) was always performed 30 min after the end of the procedure.

Results The morbidity rate was 1.98%; two arterial punctures were reported with one self-limiting hematoma. Two patients (1.98%) had catheter misplacements, recognized by intraoperative IF. No patients (0%) experienced pneumothorax (PNX), confirmed at CXR. Patients were all discharged at maximum 6 h from the procedure.

Discussion The risk of catheter misplacement, PNX, and arterial/nerve puncture remains present with this technique. Lower rates of catheter misplacement have been reported after right IJV puncture, probably for its straight vertical course. Our results are in accordance with literature (1 counter-lateral subclavian vein and 1 counter-lateral internal jugular vein misplacements). All misplacements were detected intraoperatively. The PNX rates after cannulation of the IJV vary between 0.0 and 0.5%. We had no PNX occurrence.

Conclusion Ultrasonography (US) has improved safety and effectiveness of port system placements. While routine post-procedural CXR seems avoidable, IF should be considered mandatory.

Keywords Central venous port · Elderly patients · Ultrasound-guidance · Cancer · Internal jugular vein

Abbreviations

IJV	Internal jugular vein
CVP	Central venous port
USG	Ultrasound-guidance
IF	Intraoperative fluoroscopy
CXR	Chest X-ray
PNX	Pneumothorax
US	Ultrasonography

Introduction

A long-term venous access is usually required in oncological patients for blood monitoring laboratory tests, chemotherapy, and nutritional treatment. Implantable CVP systems are the preferred access in these patients. CVP positioning is related to early post-procedural complications such as neural and vascular injury, PNX, and catheter malposition [1, 2]. Various methods have been suggested in order to reduce such complications: anatomical guided procedures, ultrasound-guided procedures, postoperative CXR, and IF. Since numerous studies have demonstrated the advantage of ultrasound-guided IJV cannulation,

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ultrasound-guidance has become the routine method for IJV catheterization reducing dramatically failure and complication rates [3, 4]. Elderly oncologic patients (>65) have often comorbidities and require a fast-track procedure in order to reduce the hospital stay. Many authors state that routine post-procedure CXR is unnecessary [5]. The aim of this study was to determine the safety and efficacy of ultrasound-guided IJV CVP placement in elderly oncologic patients.

Materials and methods

We retrospectively analyzed our series of 156 ultrasound-guided IJV CVP placements performed between January 2013 and December 2015 in our department of General Surgery; of these, 65% (101 patients) were over 65. All patients gave written consent to the procedure and to data collection for our database. The CVP was implanted in patients affected by neoplastic diseases requiring chemotherapy and nutritional treatment. The oncologic diseases were mainly breast cancers and gastrointestinal tumors. One hundred and one patients were included in the study. During preoperative evaluation, the exclusion criteria for the ultrasound-guided neck procedure were previous neck surgery, fever, sepsis, low platelet count $<50.000/mm^3$, and INR >1.5.

Four different surgeons with experience in USG performed the procedures. Local anesthesia (mepivacaine 10 ml in concentration of 2%) was administrated step by step during the procedures.

All CVP placements were performed under local anesthesia with US control. Patients were placed in 10° Trendelenburg position with the head rotated toward the left side. Ultrasonography was performed with a 5–7.5 MHz superficial probe in order to assess anatomy before starting the procedure. The right IJV was identified based on its anatomical landmarks, and Valsalva maneuver was performed only when the imaging showed collapsed veins. Under real-time USG, a 16-gauge needle was introduced into the vein approximately on the transverse line crossing the thyroid cartilage, at a 30° angle with the skin plane, in the direction of the vein axis. Aspiration of venous blood confirmed the correct introduction assessed by USG. The catheter was then inserted with the Seldinger technique. IF was performed after the Seldinger positioning and after the catheter positioning to confirm its tip position within the superior cava. The length of catheter insertion was calculated with anatomical measures and ran from 18 to 21 cm. US was performed after the procedure to check catheter right placement. Misplacement was defined as catheter tip entering the ipsilateral/counter-lateral subclavian vein or counter-lateral jugular vein. The catheter was then joined to a reservoir in the subclavian area via a subcutaneous tunnel. Finally, after port testing, the port pocket was stitched without port fixation. All patients performed a CXR after the procedure and were observed for 3 h before discharge. If PNX was diagnosed, patients were hospitalized.

Results

Data of 101 patients were analyzed. Men/women ratio was 1.1 (53 vs. 48). The average height was 172.8 cm (range 151–185 cm), and the mean age was 69.2 years (range 65–83). The morbidity rate was 1.98%: Two arterial punctures were reported with one self-limiting hematoma. Two patients (1.98%) had catheter misplacements recognized by intraoperative IF. No patients (0%) experienced PNX, confirmed at CXR. Patients were all discharged at maximum 6 h from the procedure.

Discussion

Cancer patients usually require a long-term venous access in order to grant chemotherapy and nutritional support. Various port placement techniques have been proposed in order to reduce procedural complications and improve patient's quality of life. Nowadays, percutaneous direct puncture of the subclavian or internal jugular vein is the most frequently performed technique because of its high success rate (>98%) [6]. However, this technique maintains the risk of catheter misplacement, PNX, and arterial/nerve puncture. In most centers, post-procedural CXR and/or IF are routinely performed to check for these complications.

Catheter misplacement after central venous catheter placement may reach 11% [7]. Lower rates of catheter misplacement have been reported after right IJV puncture, probably for its straight vertical course [7, 8]. Our results are in accordance with literature: Only 1.98% of patients had catheter misplacement (1 counter-lateral subclavian vein and 1 counter-lateral internal jugular vein misplacement). All misplacements were detected intraoperatively with IF, and Seldinger/catheter's repositioning with IF maneuvers was always obtained.

Catheter malposition can also be considered as positioning the tip of the catheter either too proximal or too distal; dysrhythmias and venous thrombosis have been reported in the literature as a consequence of misplacement [9, 10].

There is no exact method to establish the perfect length of catheter insertion. Many authors consider 16.5 cm as the mean safe insertion length in right IJV cannulation and use

patient's height in various formulae to determine the right length [11]. In our center's protocol, we standardly insert the catheter from 18 to 21 cm preferring 18–19 cm if the patient's height is lower than 1.7 m and 20–21 cm if above 1.7 m. Mean insertion length in our 101 patients was 19.1 cm. IF and CXR are the most standardized techniques to check catheter position [12]. Correct positioning of the catheter was assessed primarily with IF in all cases; CXR was performed in order to confirm IF finding and had 100% match with IF findings.

The PNX rates after cannulation of the IJV vary between 0.0 and 0.5% [13, 14]. CXR has a sensitivity and specificity to detect PNX that ranges from 27 to 82% and 89–100%, respectively [15]. Many authors had shown how US can be a valid and quick method to assess PNX [4, 16]. Frankel et al. had suggested that a detailed post-cannulation USG to confirm the catheter location and exclude PNX can replace standard postoperative CXR [4].

Even if the results of these studies on USG are very promising, we have to admit that US can replace CXR only if performed by a trained operator.

The PNX incidence in our series was 0, and this rate agrees with the PNX rates reported in right IJV cannulation [13]. When the subclavian approach is used, higher rates of PNX are reported and the reason has to be found in the anatomical proximity of the pleural space to the puncture site [17].

The most used technique to detect early PNX is the USG. Thanks to this approach, the intraprocedural PNX is diagnosed when lung sliding (the hyperechogenic line corresponding to visceral and parietal pleura) stops following respiratory movements and disappears through a US superior intercostal window.

Literature data show that PNX is more frequently diagnosed from clinical symptoms instead of CXR. The mean interval of time between venous cannulation and the onset of clinical symptoms is 8 h (range 3–18 h) [11]. Moreover, CXR often confirms PNX only several hours after the cannulation of a central vein. Therefore, CXR after cannulation of a central vein can be considered a useless consumption of money.

Accordingly, a 6–8 h long clinical observation can be useful before discharge in order to monitor CVP placement and the absence of complications.

Conclusion

Ultra-sound-guided right IJV catheterization is a safe and effective procedure in elderly oncological patients. In our series, the procedure grants a 100% success rate and a 1.98% morbidity rate. The right IJV should be preferred to the subclavian vein as entry site because of the lower risk of possible intraoperative and post-procedural complications. USG seems to grant high success rate in the procedure and helps the identification of entry site complications (arterial puncture). IF results to be mandatory in order to identify intraoperative misplacement of the catheter and to attempt its repositioning. The routine CXR after right IJV USG catheterization does not add any other information after IF in terms of catheter positioning and seems useless to detect PNX in terms of its extremely low incidence.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest. On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval For this type of study, formal consent is not required.

Statement of human and animal rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Patel RY, Friedman A, Shams JN et al (2010) Central venous catheter tip malposition. J Med Imaging Radiat Oncol 54:35–42. doi:10.1111/j.1754-9485.2010.02143.x
2. Plumhans C, Mahnken AH, Ocklenurg C et al (2011) Jugular versus subclavian totally implantable access ports: catheter position, complications and intrainterventional pain perception. Eur J Radiol 79:338–342. doi:10.1016/j.ejrad.2009.12.010
3. Rabindranath KS, Kumar E, Shail R et al (2011) Use of real-time ultrasound guidance for the placement of hemodialysis catheters: a systematic review and meta-analysis of randomized controlled trials. Am J Kidney Dis 58:964–970. doi:10.1053/j.ajkd.2011.07.025
4. Frankel HL, Kirkpatrick AW, Elbarbary M et al (2015) Guidelines for the appropriate use of bedside general and cardiac ultrasonography in the evaluation of critically ill patients—part I: general ultrasonography. Crit Care Med 43:2479–2502. doi:10.1097/CCM.0000000000001216
5. Vezzani A, Brusasco C, Palermo S et al (2010) Ultrasound localization of central vein catheter and detection of

postprocedural pneumothorax: an alternative to chest radiography. Crit Care Med 38:533–538. doi:10.1097/CCM.0b013e3181c0328f
6. Pikwer A, Bååth L, Davidson B et al (2008) The incidence and risk of central venous catheter malpositioning: a prospective cohort study in 1619 patients. Anaesth Intensive Care 36:30–37
7. Yilmazlar A, Bilgin H, Korfali G et al (1997) Complications of 1303 central venous cannulations. J R Soc 90:319–321
8. Miao J, Ji L, Lu J et al (2014) Randomized clinical trial comparing ultrasound-guided procedure with the Seldinger's technique for placement of implantable venous ports. Cell Biochem Biophys 70:559–563. doi:10.1007/s12013-014-9956-x
9. Eisen LA, Narasimhan M, Berger JS et al (2006) Mechanical complications of central venous catheters. J Intensive Care Med 21:40–46. doi:10.1177/0885066605280884
10. Sivasubramaniam S, Hiremath M (2008) Central venous catheters: do we need to review practice on positioning? JICS 9:228–231
11. Miccini M, Cassini D, Gregori M et al (2016) Ultrasound-guided placement of central venous port systems via the right internal jugular vein: are chest X-ray and/or fluoroscopy needed to confirm the correct placement of the device? World J Surg 40:2353–2358
12. Gebauer B, El-Sheik M, Vogt M et al (2009) Combined ultrasound and fluoroscopy guided port catheter implantation. Eur J Radiol 69:517–522
13. Pikwer A, Bååth L, Perstoft I et al (2009) Routine chest x-ray is not required after a low-risk central venous cannulation. Acta Anaesthesiol Scand 53:1145–1152. doi:10.1111/j.1399-6576.2009.01980.x
14. Lessnau KD et al (2005) Is chest radiography necessary after uncomplicated insertion of a triple-lumen catheter in the right internal jugular vein, using the anterior approach? Chest. doi:10.1378/chest.127.1.220
15. Hourmozdi JJ, Markin A, Johnson B et al (2016) Routine chest radiography is not necessary after ultrasound-guided right internal jugular vein catheterization. Crit Care Med. doi:10.1097/CCM.0000000000001737
16. Donmez H, Tokmak TT, Yildirim A et al (2012) Should bedside sonography be used first to diagnose pneumothorax secondary to blunt trauma? J Clin Ultrasound 40:142–146. doi:10.1002/jcu.21884
17. Silberzweig JE, Sacks D, Khorsandi AS et al (2003) Society of Interventional Radiology Technology Assessment Committee: reporting standards for central venous access. J Vasc Interv Radiol 14:S443–S452