European Journal of Radiology 72 (2009) 494–498

Contents lists available at ScienceDirect

European Journal of Radiology

journal homepage: www.elsevier.com/locate/ejrad

Central venous infusion port inserted via high versus low jugular venous approaches: Retrospective comparison of outcome and complications

Hong Suk Park[a,b,*], Young Il Kim[a], Sang Hyun Lee[a], Jung Im Kim[a], Hyobin Seo[a], Sang Min Lee[a], Youkyung Lee[a], Min Kyung Lim[a], Young Suk Park[c]

[a] Research Institute and Hospital, National Cancer Center, 809 Madu 1-dong, Ilsan-gu, Goyang-si, Gyeonggi-do 411-764, Republic of Korea
[b] Department of Radiology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea
[c] Division of Hematology-Oncology, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

ARTICLE INFO

Article history:
Received 30 June 2008
Received in revised form 2 September 2008
Accepted 11 September 2008

Keywords:
Catheterization
Central venous access
Jugular vein

ABSTRACT

Purpose: To retrospectively compare immediate and long-term outcome of central venous infusion port inserted via right high versus low jugular vein approaches.
Materials and methods: The study included 163 patients (125 women patients, 38 men patients; age range, 18–79 years; mean age, 53 years); 142 patients underwent port insertion with low jugular vein approach and 21 patients with high jugular vein approach. The causes of high jugular vein puncture were metastatic lymphadenopathy ($n = 7$), operation scar ($n = 6$), radiation scar ($n = 5$), failure of low jugular vein puncture ($n = 2$), and abnormal course of right subclavian artery ($n = 1$). Medical records and radiologic studies were reviewed retrospectively to determine and compare the outcome and the occurrence of complication related to port.
Results: The procedure-related complications were all minor ($n = 14$, 8.6%) in both groups; hematoma ($n = 4$, 2.8% in low jugular puncture group and $n = 1$, 4.8% in high jugular puncture group, $p = 0.6295$), air embolism ($n = 2$, 1.4% in low jugular puncture group and $n = 0$ in high jugular puncture group, $p = 0.5842$) and minor bleeding ($n = 5$, 3.5% in low jugular vein puncture group and $n = 2$, 9.5% in high jugular vein puncture group, $p = 0.2054$). The average length of follow-up was 431 days for low jugular vein puncture group and 284 days for high jugular vein puncture group. The difference between two groups was significant ($p = 0.0349$).
The reasons for catheter removal were patients' death (59 in low jugular puncture group and 14 in high jugular puncture group, $p = 0.0465$), suspected infection (11 in low jugular vein puncture group and 2 in high jugular vein puncture group, $p = 0.8242$), catheter occlusion (four in low jugular vein puncture group and one in high jugular vein puncture group, $p = 0.6583$). The catheter tip migrated upward an average of 1.86 cm (range, −0.5 to 5.0 cm) in low jugular vein puncture group and 1.56 cm (range, 0–3.6 cm) in high jugular vein puncture group and there was no significant difference ($p = 0.4232$).
Conclusions: Right high jugular vein approach can be a feasible alternative to right low jugular vein approach.

1. Introduction

The placement of implantable subtcutaneous central venous infusion port has become important in the care of cancer patients receiving intravenous chemotherapy [1,2]. It has been well established that venous access under guidance with ultrasound is safe and effective in the placement of infusion port [3–5]. Reports of long-term complications in subclavian venous access, such as thrombosis and stenosis, have led to use the right internal jugular vein for primary access [6,7]. Puncture of right internal jugular vein just above or 2 cm above the clavicle has been reported to be safe and effective in the avoidance of carotid artery puncture and catheter kinking [6,8–11]; therefore, that region is recommended as the puncture site of choice. However, because sometimes that region cannot be accessed due to metastatic lymphadenopathy, scar after surgery or radiation, or vascular abnormality, we should inevitably puncture the so-called "high jugular vein" region.

The purpose of this study was to retrospectively review and compare the outcome and complications of central venous infusion port inserted via right high versus low jugular vein approaches under ultrasound guidance.

* Corresponding author at: Department of Radiology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea.
Tel.: +82 2 3410 1736.
E-mail address: hpark@dreamwiz.com (H.S. Park).

0720-048X/$ – see front matter © 2008 Published by Elsevier Ireland Ltd.
doi:10.1016/j.ejrad.2008.09.015

2. Materials and methods

Among 458 adult patients who had the placement of implantable subcutaneous central venous infusion port via right internal jugular vein from April 2002 to December 2003 in our center, 163 patients (125 women patients, 38 men patients; age range, 18–79 years; mean age, 53 years) whom could be followed up to the time of catheter removal or to the end of the study period were enrolled in the study. One hundred twenty-two patients underwent placement of venous infusion port on outpatient basis. The patients' underlying malignancies were lung cancer ($n = 51$), breast cancer ($n = 43$), ovarian malignancy ($n = 30$), GI tract malignancy ($n = 13$), musculoskeletal malignancy ($n = 9$), lymphoma ($n = 8$), urologic malignancy ($n = 3$), head and neck malignancy ($n = 2$), and others ($n = 4$).

Prior to the procedure, correction of platelet counts to 50,000 mm^{-3} or greater was required. Prophylactic antibiotics were not administered and conscious sedation was not obtained. Written informed consent was obtained from each patient or the patient's family.

All venous access ports were placed in the interventional radiology suite by one of three staff interventional radiologists (H.S.P., Y.I.K., S.H.L) under both ultrasonographic and fluoroscopic guidance as follows: the patient was placed in supine position with the head turned away to left. The right internal jugular vein 1–2 cm above the clavicle was imaged with 10 MHz linear transducer to verify its accessibility. When there was mass lesion, scar tissue, or vascular abnormality in that region, we used right high internal jugular vein, 3 cm or higher as an access route. The right upper chest and lower neck was prepared with povidone iodine solution and draped in the usual sterile method. The 2.5 cm length horizontal incision was made 5 cm caudal to the middle one-third of the right clavicle and the pocket was formed by blunt dissection with kelly forceps under local anesthesia. The skin over the targeted point of right internal jugular vein was infiltrated with local anesthetic and a small incision was made and dissected. Under ultrasound guidance, the vein was punctured with 18 guage needle (if bleeding or hematoma occurred after the failure of puncture of the right low internal jugular vein, we changed the access route to right high jugular vein). After blood has gushed out freely, 0.038 in. guide wire was inserted into needle. Under fluoroscopy, guide wire was positioned 2–3 cm below the junction of right atrium and superior vena cava. The appropriate length of catheter was measured with guide wire and catheter was cut. The catheter was inserted into subcutaneous pocket and brought out of the venous access site using blunt metallic tunneling tool. The port was attached to the catheter and the catheter was pulled out of the puncture site so that port was situated into subcutaneous pocket. Peel-away sheath and fascial dilator were inserted over the guide wire into jugular vein, and after removing fascial dilator and guide wire, catheter was quickly inserted into the venous system. Pinching the sheath with the fingertips between dilator removal and catheter insertion was necessary to avoid air embolism. After catheter position was fluoroscopically checked, the sheath was split and peeled out. The port was not fixed to the underlying fascia. Using the disposable skin stapler or non-absorbable sutures, skin was sutured. Using non-coring (Huber) needle, the function of port was checked with transcatheter contrast media injection and the final position of the catheter was confirmed. The system was flushed with heparinized saline. After the procedure, the patient was kept in supine position for 4 h and checked for hematoma and other immediate complication. If the procedure was done on an outpatient basis, he or she was discharged on that day. All patients started chemotherapy on day 0–7 after the procedure. The catheter care and dressing change was performed by nurses in the outpatient chemotherapy unit or hospital ward. We recommend to flush the port catheter with heparinized saline after each use or monthly if it was not used. Problems related to catheter must be notified to us.

Table 1
Baseline characteristics of low and high jugular vein puncture group.

Characteristics	Low jugular vein	High jugular vein	*p*-Value
Mean age (year)[a]	52.2 (18–79)	59.9 (44–75)	0.0065
Sex (male/female) [b]	30/112	5/16	0.7799

[a] Student *t*-test.
[b] Mantel–Haenzel Chi-square test.

There were 142 patients in low jugular vein approach group and 21 in high jugular vein approach group and demographic characteristics of both groups are presented in Table 1. The patients were divided into two groups, not according to measurement of puncture height. The patients who were inserted with the standard method with low jugular vein approach were classified into low jugular vein puncture group, and those in whom there were the following problems and therefore low jugular approach was impossible were classified into the high jugular puncture group. The causes of high jugular vein puncture were metastatic lymphadenopathy ($n = 7$), operation scar ($n = 6$), radiation scar ($n = 5$), failure of low jugular vein puncture ($n = 2$), and abnormal course of right subclavian artery ($n = 1$).

Port systems implanted included 111 Vortex VTX (Horizon Medical Products, Atlanta, GA), 22 M.R.I. Port (Bard Access Systems, Salt Lake City, UT), 21 Port-A-Cath (Sims Deltec, St. Paul, MN), and 9 Vital Port (Cook, Bloomington, IN).

Medical records including laboratory data related with infection were reviewed for the presence of complications of infusion port and documented in accordance with the Society of Interventional Radiology reporting standards [12]. Follow-up chest radiographs or CT scans were evaluated for the detection of the migration of catheter and other complication. The puncture height of right internal jugular vein was measured from clavicle on follow-up upright chest radiograph and catheter migration was measured as the difference between the location of catheter tip on immediate supine radiograph and follow-up upright chest radiograph by a consensus of two radiologist (H.S.P., Y.I.K.).

Comparisons between two groups were performed with Student *t*-test, paired *t*-test and Mantel–Haenszel Chi-square test. Unconditional multiple logistic regression was used to identify the statistical association between total catheter days and related factors such as age, sex, the height of puncture, vertical displacement, infection and death. Standard Poisson regression analysis was applied to calculate expected infection, death and catheter occlusion rates and to identify the difference of the rates between low and high jugular vein approach group.

Since this study was retrospective, institutional review board approval was not required, in accordance with institutional review board policy.

3. Results

The average puncture height of right internal jugular vein measured from clavicle was 1.8 cm (range, 0.3–5.5 cm); 1.5 cm (range, 0.3–2.8 cm) for low jugular vein puncture group and 3.6 cm (range, 3.1–5.5 cm) for high jugular vein puncture group.

The average number of needle passes for successful cannulation of the vein made to obtain access was 1.22 (range, 1–4); 1.21 for low jugular vein puncture group and 1.29 for high jugular vein puncture group. There was no significant difference between two groups (Student *t*-test, $p = 0.6515$). The individual learning curve of interventional radiologists performing the procedure exited, leading