MISPLACEMENTS OF CENTRAL VENOUS CATHETERS: INTERNAL JUGULAR VERSUS SUBCLAVIAN ACCESS IN CRITICAL CARE PATIENTS

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Aim; In central venous catheterization (CVC), misplacement is not a rare complication since this is a blinded procedure. The aim of this study was to compare the misplacement risks of the access of internal jugular vein with that of subclavian vein catheterizations.

Methods;The records of a total of 1092 patients in whom central venous catheters were placed between 2002 and 2006 in Anesthesiology Intensive Care Unit and the location of the tips was confirmed radiologically were retrospectively evaluated. Neck and infraclavicular region were cleaned by antiseptic solution after routine monitorization. CVC were easily inserted with Seldinger's technique after blood aspiration through internal jugular vein or subclavian vein.

Results; In adult patients, six internal jugular catheter misplacements were seen (0.80%); among them five were kinking and one was intrapleural location of the catheter tip. Six subclavian misplacements (2.02 %) were detected, five of them were located in contralateral subclavian vein, and one was located in ipsilateral internal jugular vein. In children, two subclavian misplacements were seen as crossing to contraleteral subclavian vein, and there were no internal jugular misplacement. There was no statistically difference for misplacement between the access sites (in adult p= 0.110, in children p=0.501).

Conclusion; We have concluded that experience of operator should be taken into account for choice of catheterization site.

Key words: Central venous catheter, misplacement, intensive care unit

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INTRODUCTION

Central venous catheterization (CVC) has become more and more common for the past two decades in emergency rooms and intensive care units (ICU). CVC is used for administration of drugs, blood and its products, for central venous pressure (CVP) monitorization, total parenteral nutrition, and dialysis in renal failure. Internal jugular or subclavian veins are frequently used for this purpose (1).

Although CVC has vital importance for the management of conditions listed above, it has also some complications due to its misplacement. The aim of this study was to compare the risk of malposition between the catheterizations of internal jugular vein and subclavian vein.

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MATERIALS AND METHODS

In this study, totally 1092 cases (1047 adult, 45 children), who were performed CVC through either subclavian or internal jugular access and confirmed radiologically in the ICU of the University Hospital between January 2002 and January 2006 were retrospectively evaluated. The written informed consent of the patients or their relatives and approval of internal review boards were obtained.

Data collected included age, sex, site of catheterization (juguler and subclavian region), type of catheter (juguler and subclavian) and catheter misplacement.

Neck and infraclavicular region were cleaned by antiseptic solution after routine monitorization. When the patient was in the supine position, a point at the junction of the medial one third and lateral two thirds

Table 1. Placements of the catheters according to sex and age

Access line	Correct placement Σ (F / M)	Misplacement Σ (F / M)	Misplacement rate (%) Σ (F / M)	p
Internal jugular vein (adult)	744 (201/543)	6 (1/5)	0.80 (0.49/0.91)	0.110
Subclavian vein (adult)	291 (130/161)	6(3/3)	2.02 (2.25/1.82)	
Internal jugular vein (child)	19 (9/10)	0	0	0.501
Subclavian vein (child)	24 (13/11)	2 (1/1)	7.69 (7.14/8.33)	

Σ: total, M: male, F: female

of the clavicle in the right infraclavicular area was used as a puncture point for subclavian approach. During subclavian vein catheterizations, the ipsilateral internal jugular vein was manually compressed in the supraclavicular area. Central venous catheters were easily inserted with Seldinger's technique after blood aspiration through internal jugular vein or subclavian vein. Endocavitary electrocardiography was used if universal adapter is convenient or able to be found. Chest radiography was taken to confirm the placements of catheters, and rule out pneumothorax. Catheters were fixed after blood aspiration. Misplaced catheters were removed and replaced with new ones.

Fisher's Exact Chi-square test was used for statistical analysis. $P<0.05$ was considered statistically significant.

RESULTS

In adults, 6 of 750 catheters placed through internal jugular vein were misplaced (1 female, 5 male). Six of 297 catheters placed through subclavian site were misplaced (3 female, 3 male). In children, while all 19 catheters were correctly placed through internal jugular vein, there were 2 misplacements (1 female, 1 male) in subclavian site (Table 1). In adults, 5 of 6 misplacements detected by radiography were seen as kinking of the tip of the catheter (Figure 1). One catheter had been placed into the intrapleural region, leading to hydrothorax (Figure 2). Five of 6 misplacements of subclavian site were seen in contralateral subclavian vein (Figure 3), while one was seen in ipsilateral internal jugular vein (Figure 4). In children, during subclavian access 2 misplacements were seen in the contralateral subclavian vein (Figure 5). Ages, sex, and the type of catheters used in the cases with catheter misplacements were displayed in Table 2. There was no statistically significant difference for misplacements both in adults ($p=0.11$), and in children ($p=0.50$) between the access sites. There was no significant difference between adult and children for misplacements ($p=1.00$). Likewise, there was no difference for gender in the rate of misplacement in both adults and children.

DISCUSSION

CVC possess complications such as arterial punction, bleeding, misplacement, pneumothorax, haematom, vessel and nerve injury, infection, thrombosis, and kinking of the catheter (2,3). The most common cause of early catheter malfunction is incorrect placement of the catheter tip. This is usually detected by chest radiography (4).

It should be noticed that the tip of catheter is inserted to the just above the junction of the superior vena cava and the right atrium. On the other hand, it is accepted as correct insertion if the tip of catheter is 2 cm proximal to the pericardial line (5).

Correct placement of the central venous catheter is an essential prerequisite for accurate monitoring of CVP and long-term use of catheter. However, misplacement is not a rare complication since the tip of catheter can not be directly visualized during CVC procedures. In a metaanalysis of Ruesch et al (6), the rates of misplacement were reported to be 5.3 % in the internal juguler vein site and 9.3 % in the subclavian vein site. In two large case series, malposition rates for subclavian route were 4.2% (7), and 6 % (8). Lovino et al (9) found the rate of misplacement to be 1.8 % both in the internal jugular vein site and subclavian vein site. Janik et al (10) reported 7.3% misplacement rate in children under the age of 5 years. In our study, the rates of misplacement were

Table 2. Catheter misplacements

Case	Access line	age	sex	Types of the misplacement catheters
1	right IJV	36	M	Certofix trio V 720
2	right IJV	26	M	Seldiflex 7F-3L
3	right IJV	26	M	Seldiflex 7F-3L
4	right IJV	70	F	Seldiflex 7F-3L
5	right IJV	22	M	Seldiflex 7F-3L
6	right IJV	103	M	Seldiflex 7F-3L
7	right SCV	35	M	Certofix trio V 730
8	right SCV	23	F	Seldiflex 7F-3L
9	right SCV	24	M	Certofix trio V 730
10	right SCV	28	M	Seldiflex 7F-3L
11	right SCV	49	F	Certofix trio V 720
12	right SCV	68	F	Balton dialysis catheter 12 F 20 cm double lumen
13	right SCV	2	F	Certofix paed S 413 4F
14	right SCV	12	M	Balton triple cannula 5F/13 cm

IJV: Internal jugular vein, SCV: Subclavian vein, M:male, F: female

0,80% in the internal jugular site, 2.02% in the subclavian site in adults, and 0% and 7.69%, respectively, in children. In our study, the rates of misplacement in subclavian site is lower than the previous studies since we used manual internal juguler vein occlusion and endocavitary electrocardiography technique in some patients (256 cases). We think that the lower rate of misplacements in the internal jugular site compared to that of the subclavian site found in our study may be due to our experience with the internal jugular vein access.

Although, subclavian access is associated with fewer infectious complications, mechanical complications are common and can have serious results. Because the risk for infection increases with the duration of catheter use, subclavian access is probably the best choice if the catheter is expected to stay for 5 days. Failure of the first attempt at subclavian catheter insertion dramatically increases the risk for mechanical complications (7,11). In our cases, access choice was based on these principles. There was fewer catheter misplacements with internal jugular approach compared with the subclavian approach. Commonly, the misplacement is into the ipsilateral internal jugular vein. However, the tip of catheter may be rarely placed to the brachiocephalic, azygos, superior intercostals vein, and contralateral subclavian vein (4).

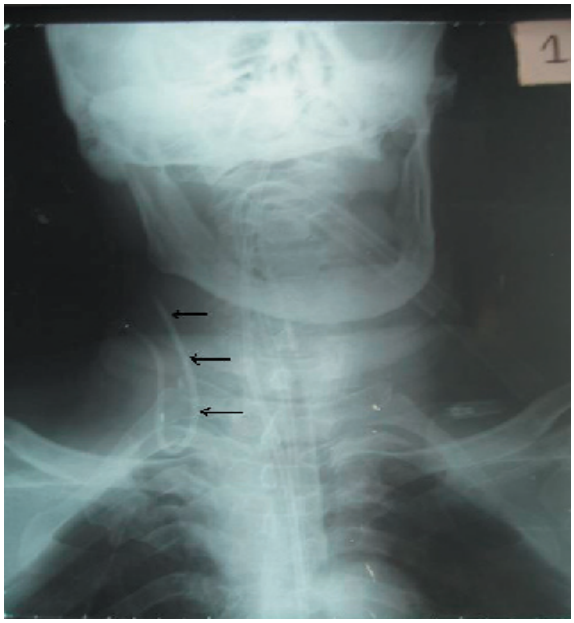

Figure 1. Kinking of the tip of catheter

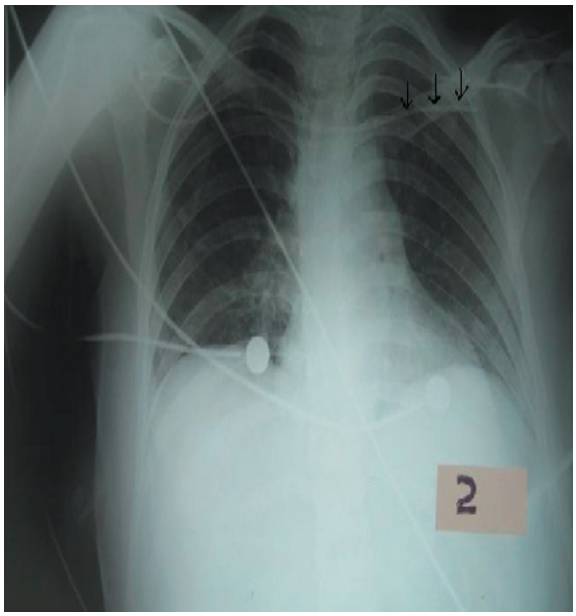

Figure 2. Intrapleural misplacement

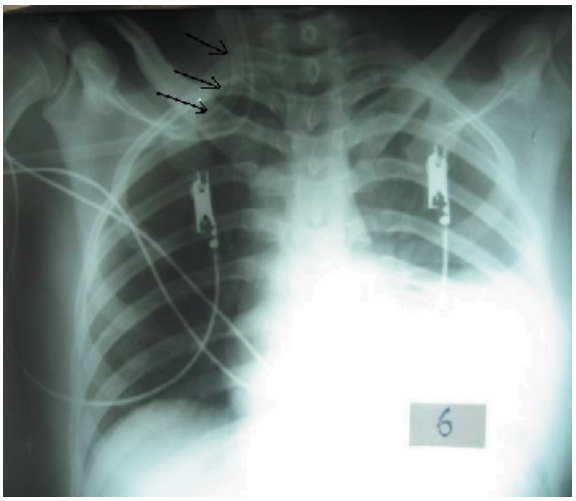

Figure 3. Misplacement into contralateral subclavian vein

In our study, in seven of the cases attempted for subclavian approach misplacement was toward the contralateral subclavian vein, and one toward ipsilateral internal jugular vein. This was attributed to manual occlusion of the ipsilateral internal jugular vein during subclavian catheterization.

Misplacements may also cause the formation of coagulum, catheter erosion, chemical and bacterial thrombophlebitis as well as default measurement of CVP. Application of CVC may sometimes result in failure, though in the hands of experienced. Increased attempt number also increases the risk of complication (2). Furthermore, CVC misplacement may be lethal (5,12).

Endocavitary electrocardiography, ultrasonography (USG), and internal jugular vein occlusion tests can be used for convenient placement of catheter (13-15).

Subclavian and jugular sites are safe accesses when they are controlled with bedside chest radiography, but the necessity of radiography is controversial. Guth (16) has claimed that the radiological control is not needed for catheterizations if complication is not suspected, while Whicky at al (1), and Gladwin at al (17) have suggested routine control of chest radiography. Radioscopy may also be used for this purpose (16). Intensivist must be alerted. Control radiographies and other methods should be used if there is any suspicion.

It was reported that, the risk of misplacement of subclavian and internal jugular catheters was significantly decreased when performed with the guidance of Doppler USG (14). Likewise, endocavitary electrocardiographic system could be used for correct insertion of catheter (13). In our study, endocavitary electrocardiographic system was used in 256 cases, and catheter misplacement was only encountered in one case. In the rest of the cases catheters were being inserted in blind manner.

Chest radiography still remains the gold standard and the most commonly used diagnostic tool to detect misplacement of the catheter or pneumothorax (18). In our clinic, routine confirming of chest radiography has been taken after central venous catheterization, especially, in the children and in the cases in which the first attempt failed. In addition, the insertion site was changed if the first attempt failed.

As a result of this study, we have concluded that the experience of the operator should be taken into account for choice of catheterization site because there was no significant difference for misplacements in both access sites.

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