Original Article

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Ultrasonic Guided Insertion of Central Venous Catheter in Infants and Children

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***Background/Purpose**: ultrasound is licensed for application of regional blocks and insertion of vascular access. We aimed to compare ultrasonic guided (USG) and anatomical landmark technique (ALT) for insertion of central venous catheter (CVC) as regard success rate and rate of complications in infants and children.*

***Materials & Methods**: eighty childen (age ranged from 1-5 y) were classified into 2 groups, anatomical landmark technique was used to insert CVC in group I and ultrasonic guided technique was used in group II. Number of trials, duration of the procedure, and rate of complications were recorded.*

***Results**: There was a significant increase in success rate of insertion in group II as compared to group I (p = 0.001). Number of trials showed significant decrease in group II as compared to group I (p<0.0001). Incidence of arterial puncture was significantly decreased in group II (p = 0.028). Duration of the procedure was 21.3 ± 0.05 min in group I, and 12.5 ± 0.3 min in group II, (p<0.0001).*

***Conclusion**: Insertion of central venous catheter in children should be guided with ultrasonography to avoid complications and failure of the procedure.*

***Index Word**: CV line insertion, ultrasonography.*

INTRODUCTION

Insertion of central venous catheter is an essential procedure in anesthesia and ICU.

It is used for haemodynmic monitoring and administration of nutrition, drugs and fluids. In 2002, the National Institute for Clinical Excellence (NICE) stated that central venous line insertion should be guided with ultrasound locating devices [1].

Insertion of CVC is associated with many complications including arterial puncture, haematoma formation, pneumothorax, hemothorax, malpositioning, failure of insertion, loss of guide wire, chylothorax and chylopericardium [2]. We must respect the guidelines for insertion of CVC to avoid those complications as far as possible [3,4].

In this study, we aimed to compare ultrasonic guided (USG) and anatomical landmark technique (ALT) for insertion of CVC as regard success rate and rate of complications in infants and children

PATIENTS AND METHODS

The study was designed recruiting 80 infants and children prepared for major elective surgery: GIT surgery, orthopedic, urology and plastic surgery (age ranged from 1-5 y). They were classified into 2 groups: **group I** (40 infants and children): ALT was used to insert CVC, and group II (40 infants and

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children): USG technique was used.

Approval by the hospital ethical committee was granted and the parents were provided with an information sheet containing the details of the study and a written informed consent was obtained.

The randomization was performed using sealed envelopes indicating the group of the assignment at the time of pre-assessment. An anesthesiologist read the number contained in the envelope and made group assignments.

All the central catheters were inserted in the right internal jugular vein after induction of anesthesia. In group I (ALT), CVCs were inserted at the apex of a triangle consisting of the clavicle and the 2 heads of sternocleidomastoid muscle. In group II (USG), 6-13 MHz linear probe (sonoscope) (Sonosite M-turbo®; Bothell, WA), was used to insert the catheter. The skin was sterilized by antiseptic solution and the probe was cleaned also with antiseptic solution, then a sterile glove filled with a sterile gel was used to cover the probe. The head was slightly tilted to the left side then the probe was put perpendicular to the vessels at the apex of the triangle in vertical line along the vein, then the needle was introduced to penetrate the vein, which is easily compressed and non pulsatile . Lastly, Seldinger's technique [5] was used to insert the catheter.

All the operators should have experience more than 5 years in insertion of CVCs. We recorded number of trials, duration of the procedure (the time between sterilization of the neck and the end of procedure) and rate of complications (arterial puncture, hematoma formation, pneumothorax, hemothorax and failure of insertion of the catheter). Failure of insertion was considered after 5 failed trials.

Statistical analysis:

Statistical analysis was done using SPSS ® ver. 11 (Chicago, Il, USA). Where applicable, data were presented as mean ± SD. Student's t-test was used to compare means of continuous variables. Fisher's exact test was used to compare categorical variables. A P value of < 0.05 was considered statistically significance.

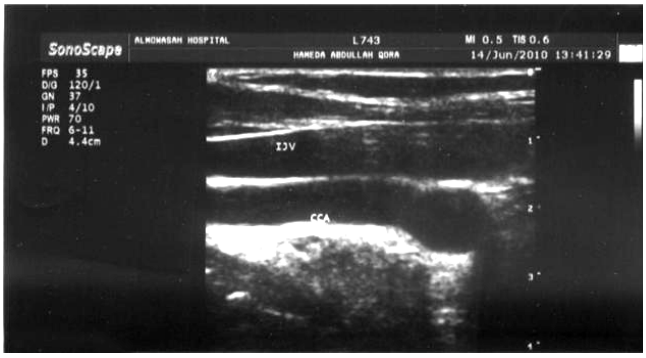

Fig. 1: Longitudinal section showed internal jugular vein and common carotid artery

Fig. 2:Transverse section showed internal jugular vein and common carotid artery

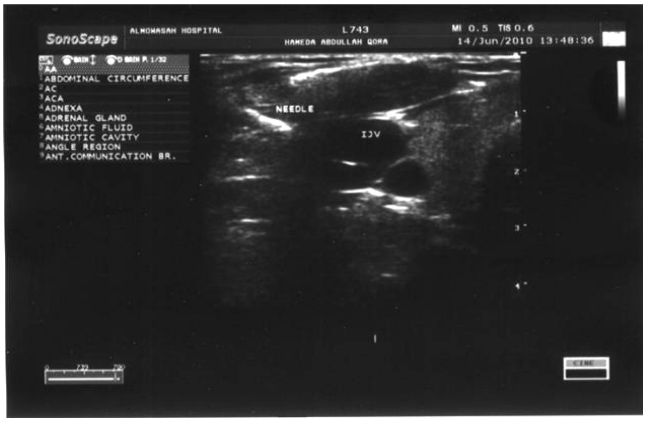

Fig. 3: The needle passes towards the internal jugular vein

Fig. 4: The needle inside the right internal jugular vein

Table 1: Demographic data for patients in both groups, values are presented as mean ±SD

	ALT (I)	USG (II)
Age (y)	3.1 ± 0.05	3.3 ± 0.2
Sex	23 ♂	22♂
	17♀	18♀
Wt (kg)	14.5 ± 0.2	14.4 ± 0.5

Table 2: Results of CVCs insertion in both groups

	ALT (I)	USG (II)
Success rate	30	40
Success from 1st trial	18	34
Number of trials (mean)	2.13 ± 1.613	1.15 ± 0.36
Failure rate	10	0
Duration of procedure (min)	21.3 ± 0.05	12.5 ± 0.3

Table 3: Comparison of complications in both groups

	G I (ALT)	G II (USG)
Hematoma formation	6	1
Arterial. puncture	8	1
Pneumothorax	1	0
Hemothorax	1	0

RESULTS

Success rate: Insertion was successful in 30 children in group I (ALT), while it was successful in all cases of group II (USG). This increase in success rate was statistically significant (p=0.001).

Number of trials: in group I (ALT): 6 patients needed 5 trials, 4 patients needed 3 trials, 2 patients needed 2 trials and the procedure succeeded from 1st trial in 18 children. The mean of number of trials in this group was 2.13 ± 1.6. In group II (USG), 6 patients needed 2 trials, and in 34 patients, the procedure was successful from the first trial. The mean of number of trial was 1.15 ± 0.36. Number of trials showed significant decrease in group II as compared to group I (p = 0.0003).

Arterial puncture: occurred in 8 patients in group I (ALT) and only in one case in group II (USG), showing a significant decrease in group II as compared to group I(p = 0.028).

Hematoma formation was insignificantly increased in group I (6 patients) over group II (only 1 case), p = 0.11. Hemothorax and pneumothorax occurred only in one patient in group I (ALT). No other complications occurred in both groups.

Duration of the procedure: the mean duration was 21.3 ± 0.05 (min) in group I (ALT) and 12.5 ± 0.3 (min) in group II (USG), (p<0.0001)

DISCUSSION

Success rate of CVC in right internal jugular vein (RTIJV) by ALT is about 90% in adults, but it falls to 77% in infants and younger children [6]. Success rate rises up to 100% by USG technique [7]. This is in agreement with the results in this study.

As regard number of attempts, there was a significant decrease in USG group as compared to ALT group. It is in agreement with previous studies [8,9].

Also there was a significant decrease in duration of the procedure in USG group as compared to ALT group.

As regard arterial puncture and hematoma formation, there was a significant decrease in USG group as compared to ALT group. Also, pneumothorax and hemothorax haven't occurred in USG group as compared to ALT group, that showed a single case of pneumothorax and another one of hemothorax.

So, all complications were reduced due to ultrasonic

guidance. This is in agreement with all previous studies [8,9]. Decrease of complications may be due to decrease number of attempts.

CONCLUSION

Insertion of central venous catheter in children should be guided with ultrasonography to avoid complications and failure of the procedure .

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