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Original Article / Özgün Araştırma

Assessment of the Ability of Anaesthetists to Locate the Internal Jugular Vein by the Anatomic Landmark Technique with Ultrasonography: Right or Left, Does it Make any Difference?

Anestezistlerin Anatomik Landmark Yöntemi İle İnternal Juguler Veni Bulabilme Becerisinin Ultrasonografi İle Değerlendirilmesi: Sağ ve Sol Fark Eder mi?

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Abstract / Özet

Objective: To assess senior and junior anaesthetists' ability to locate the right and left jugular vein (IJV) using the anatomic landmark technique.

Methods: A total of 45 anaesthetists were included in this study. Initially, a questionnaire assessing the experiences of the anaesthetists was completed. The anaesthetists were grouped into two groups, junior and senior. The anaesthetists, who were blind to the screen, were asked to point to the internal jugular vein bilaterally on the neck of a healthy volunteer using an ultrasound probe with the midpoint as an 'imaginary needle'. The success rates for locating the right and left IJV in both junior and senior groups were assessed separately.

Results: The success rate for locating the right IJV was 88% (n=26, 23/26) in the senior and 68.4% (n=19, 13/19) in the junior group (p<0.001). The success rate for locating the left IJV was 69% (18/26) in the senior and 78% (15/19) in the junior group (p<0.001), while the difference in success rates for locating the right and left IJV in the senior group was found to be statistically significant (p<0.001).

Conclusion: Both use of the anatomic landmark technique and experience increased the success rate. Especially in the less preferred left IJV catheterization, use of the anatomic landmark technique independent of the experience factor could increase the success rate.

Key Words: Internal jugular vein, landmark technique, anesthesia training, ultrasound

Amaç: Tecrübeli ve tecrübesiz anestezistlerin sağ ve sol İnternal juguler veni (İJV) anatomik landmark tekniği uygulanarak bulabilme becerilerinin karşılaştırılmak.

Yöntemler: Bu çalışmaya toplam 45 anestezist dahil edildi. Başlangıçta kullanıcıların daha önceki deneyimlerini sorgulayan bir anket uygulandı. Anestezistler tecrübeli ve tecrübesiz olarak iki gruba ayrıldı. Anestezistlerden ultrason probunun orta noktasını hayali bir iğne olarak kullanıp, ekrana kör olarak sağlıklı bir gönüllünün boynunda internal juguler veni çift taraflı göstermeleri istendi. Her iki grupta sağ ve sol internal juguler veni bulabilme başarıları incelendi.

Bulgular: Sağ internal juguler veni bulabilme başarısı tecrübeli grupta %88 (n=26, 23/26) iken, tecrübesiz grupta ise %68,4 (n=19, 13/19) idi (p<0,001). Sol İJV'yi bulabilme başarısı tecrübeli grupta %69 (18/26) iken tecrübesiz grupta %78 (15/19) idi (p<0,001). Buna karşılık tecrübeli grupta sağ İJV'yi bulabilme başarısı sol İJV'yi bulabilme başarısından daha iyiydi (p<0,001).

Sonuç: Hem anatomik landmark tekniği hem de tecrübe başarı yüzdesini artırmaktadır. Özellikle daha az tercih edilen İJV kanülasyonunda tecrübeden bağımsız olarak anatomik landmark tekniğini kullanmak başarı yüzdesini artırabilir.

Anahtar Kelimeler: İnternal juguler ven, landmark tekniği, anestezi eğitimi, ultrason

Introduction

Central venous catheterization is a frequently used procedure in anaesthetists' practice (1). Despite frequent usage of internal jugular vein cannulation (IJV) among anaesthetists, complications during central venous catheterization are still seen in approximately 2-15% of cases (2). According to a study by Bailey et al. (3), when central venous cannulation is required the first choice is the right IJV (94.3%), followed by the left IJV (3.25%) and the right subclavian vein (1.6%).

The anatomic landmark technique has been used in IJV cannulation for years (4). Some studies have recently shown that ultrasonography (USG) may be a safer method compared to the anatomic landmark technique, and therefore it may be preferred to the landmark technique for internal jugular catheterization (5).

However, although the NICE guidelines published in 2002 recommended two-dimensional ultrasound guidance for catheterization, they also emphasized the landmark technique as an important skill for the anaesthetist and recommended its usage in cases where ultrasonography is not available (6). Nevertheless, some studies claim that performing catheterization with USG guidance decreases the ability of anaesthetists to use the landmark technique, which can cause complications when ultrasonography is not available (7).

As left IJV cannulation is less frequently performed, we hypothesized that application of the landmark technique to locate the left IJV might be less successful. Therefore, we designed a simulation model for locating IJV with ultrasound. In this observational design, the

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Table 1. The participant questionnaire

1.	Approximately how many landmark-technique RIGHT IJV cannulations have you performed up to the present? A. 0-9 B. 10-19 C. 20-49 D. 50-99 E. 100-199 F. 200-499 G. ≥500
2.	Approximately how many landmark-technique LEFT IJV cannulations have you performed up to the present? A. 0-9 B. 10-19 C. 20-49 D. 50-99 E. 100-199 F. 200-499 G. ≥500
3.	Do you routinely use ultrasound in RIGHT IJV cannulation? A. No B. Yes, in real-time C. Yes, before the procedure, to identify anatomy
4.	Do you routinely use ultrasound in LEFT IJV cannulation? A. No B. Yes, in real-time C. Yes, before the procedure, to identify anatomy
5.	If your answer to questions 3 and 4 is 'No' which one of these options is true for you? A. No need for ultrasound B. Lack of experience C. Not practical due to extended procedure duration

ability of anaesthetists working in our clinic to locate the left versus right internal jugular veins by the anatomic landmark technique in healthy volunteers with ultrasound was compared.

Methods

The study was approved by Ethical Committee of Mersin University Faculty of Medicine (05.01.2012 / 2012-01). All participants and healthy volunteers gave written informed consent before taking part in the study. A questionnaire containing all participants' previous experiences, number of catheterizations performed by anatomic landmark technique, usage of USG and, in cases where they did not use it, the reasons why, was completed (Table 1). The healthy volunteer's right and left IJV was recorded using ultrasound and confirmed as anatomically normal (the vein lying anterolateral to the carotid artery at the level of the cricoid cartilage). The same volunteer was used throughout the duration of the study.

After the procedure was explained to the participant and volunteer, the healthy volunteer was placed in a supine position. Participants were asked to place a healthy volunteer in a position for right and left internal jugular vein catheterization by anatomic landmark technique. Head turning, putting a pillow under the head, and performing a manoeuvre like the Trendelenburg were left to the participant's choice. A 13-6 MHz, 38-mm linear array ultrasound probe (M-Turbo, Sonosite®; Sonosite Ltd, Bothell, WA, USA) was used with a depth setting of 2.7 cm and the midpoint clearly marked and closed with a standard adhesive dressing. This probe was used as an 'imaginary needle' during the study.

Table 2. Previous experience with right and left internal jugular venous cannulation with the landmark technique and frequency of USG use. Values are given as numbers (and proportions)

	Senior (58%) (n=26)	Junior (42%) (n=19)
1. Number of landmark techniques for right ijv cannulation		
0-9		2 (11%)
10-19		5 (26%)
20-49		5 (26%)
50-99		7 (37%)
100-199	3 (12%)	
200-499	5 (19%)	
≥500	18(69%)	
2. Number of landmark techniques for left ijv cannulation		
0-9	5 (19%)	16 (84%)
10-19	15 (58%)	2 (11%)
20-49	5 (19%)	1 (5%)
50-99	1 (4%)	
100-199		
200-499		
≥500		
3. Routine USG use		
Not at all	21 (81%)	17 (90%)
To identify anatomy	1 (4%)	2 (11%)
Real time	4 (15%)	0
4. Reason for not using USG		
No need	3 (12%)	2 (11%)
Lack of experience	13 (50%)	13 (68%)
Not practical	5 (19%)	2 (11%)

Participants were asked to apply a minimum amount of pressure to the skin in order to avoid vein collapse, and to point the probe in the intended direction of puncture. Once the anaesthetist decided where to place the probe, the image on the screen was frozen and recorded under a unique identifier number in jpeg format. Until the images were recorded, both the volunteer and anaesthetist were blind to the screen. An experienced independent researcher, who was blind to the participants' identities, later reviewed the images. If the vertical midline trajectory of the imaginary needle intersected any part of the lumen of the internal jugular vein, it was evaluated as a pass and if the trajectory missed the IJV or intersected the artery it was graded as a fail (Figure 1, 2).

Anaesthetists were later grouped by their responses to the questionnaire, considering the number of catheterization they performed, into either an experienced (senior) or inexperienced (junior) group. During the fellowship period in our clinic, the average number of cannulations performed was 90-100 IJV. On that basis, the senior group was defined as 100 or more and the junior group as 99 or less internal jugular vein cannulations performed.

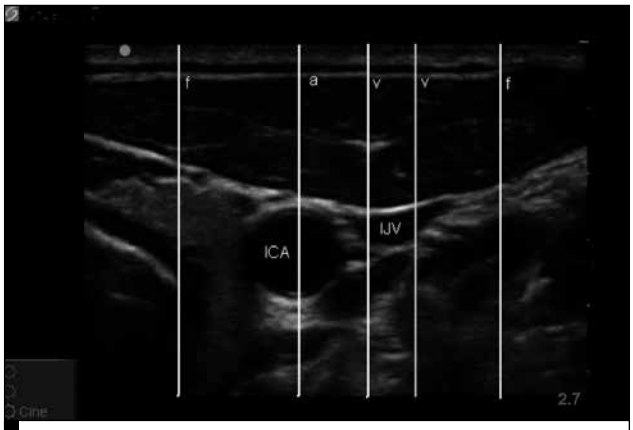

Figure 1. Ultrasound image showing normal right internal jugular vein anatomy in healthy volunteer. Line positions reflect: f=Fail, a=Fail, v=Pass, ICA, Internal Carotid Artery, IJV, Internal Jugular Vein

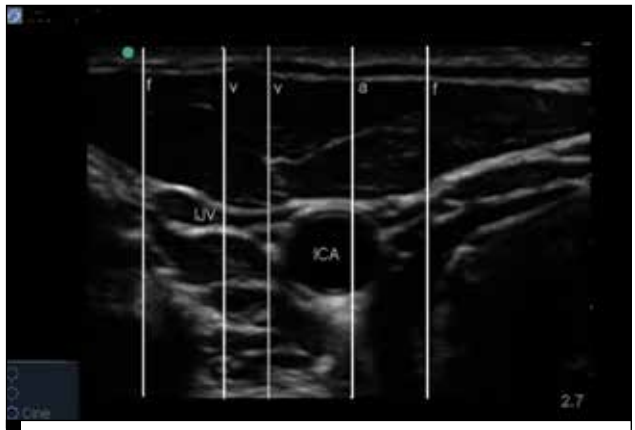

Figure 2. Ultrasound image showing normal left internal jugular vein anatomy in healthy volunteer. Line positions reflect: f=Fail, a=Fail, v=Pass, ICA Internal Carotid Artery, IJV, Internal Jugular Vein

Table 3. The ability of the anaesthetists to identify the vein correctly (achieve a 'pass'). Values are proportions

'Pass' on study attempt	Senior (n=26)	Junior (n=19)	p
Right IJV	88%	68%	0.001
Left IJV	69%	78%	0.001
p	0.001	NS	

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences version 17.0 (SPSS Inc, Chicago, IL, USA). Fisher Exact test, Chi-squared test and McNemar tests were used for statistical analysis. A p value less than 0.05 was considered significant.

Results

All 45 invited anaesthetists agreed to participate in the study. Fifty-eight percent of all participants (n= 26) were senior, and 42% (n=19) were classified as junior anaesthetists.

The results of a questionnaire completed before the procedure showed that while just one participant from the senior group had performed 50-99 left IJV cannulations, most other participants in the same group had performed only 10-19. In the junior group, the average number of left IJV cannulations performed was 0-9. In the senior group, while 4 participants (15%) stated that they used 'real-time' ultrasound guidance during right and left IJV cannulation, just one participant used ultrasound to identify anatomy. When asked about their use of ultrasound in right and left IJV cannulation, just 2 participants in the junior group stated they used ultrasound to identify anatomy (p=0.143). When participants from both groups were asked why they do not use ultrasound for cannulation, the main reasons cited were lack of experience (n=26), no need for it (n=7) and extended duration of the procedure (n=5) (p=0.694) (Table 2).

The success rate for locating the right IJV was 88% (n=26, 23/26) in the senior and 68.4% (n=19, 13/19) in the junior group (p<0.001). The success rate for locating the left IJV was 69% (18/26) in the senior and 78% (15/19) in the junior group, and this difference was found to be significant (p<0.001). Whereas the difference in success rates for locating the right and left IJV in the senior group was found to be statistically significant (p<0.001), in the junior group no difference was observed (Table 3).

Discussion

In our hospital, anaesthetists perform approximately 1200 central catheterizations annually for haemodialysis, total parenteral nutrition, fluid management and other reasons. This procedure is usually performed by the Seldinger technique using anatomic landmarks. Since 2010, bedside ultrasound has been available in our operating theatres and intensive care units.

A survey conducted on 2000 senior anaesthetists in 2008 in the United Kingdom showed that while just 27% of them performed ultrasound guided catheterization, 73% used traditional methods for the same procedure (8). When they were asked for a reason, most answered they find the anatomic landmark technique sufficient. In a survey of cardiac anaesthetists, the rate of real time ultrasound guidance was just 15%, despite the availability of ultrasound devices in the clinic being 40% (3).

In our study as well, just 15% of participants preferred USG guided catheterization and as the main reason for this they cited lack of experience. Therefore, we think that the anatomic landmark technique is still an irreplaceable skill for anaesthetists.

The reported success rate of catheterization by the anatomic landmark technique is fairly high, 85-99% (5). In our simulation model, senior anaesthetists were able to locate the right IJV successfully in 88% of attempts, which is in accordance with the literature. However, junior anaesthetists' success rate for locating IJV was lower compared with seniors (68%), which was expected.

The ability to locate the left IJV in the senior group was lower compared to the right side. Generally, when there is a need for cannulation, the right IJV is preferred for various reasons and, among anaesthetists, right IJV cannulation is performed more often than left IJV cannulation (9). It is known that complications associated with placement of cannulae are related to operator experience and number of attempts to locate the vein (10). Our questionnaire results showed that while the average number of right IJV cannulations performed by seniors was above 500, the average procedure num-

ber for the left IJV was fewer than 50, except for one participant. This explains the higher success rate with right IJV cannulation by the anatomic landmark technique compared to the left side in the senior group.

During the procedure it was noticed that senior anaesthetists directly pointed the imaginary needle to the intended puncture point without repeating anatomic landmark identification. As a result, right IJV localisation was successful in 88% of attempts and the left in 69%. The higher success rate with the right IJV can be explained by the more frequent performance of right over left IJV cannulation. On the other hand, not using anatomic landmarks and relying just on their experience could be a reason for the lower success rate locating the left IJV.

Participants in the junior group generally first identified the right IJV by identifying landmark points, and then repeated the same procedure on the left side. It is thought that holding to anatomic landmarks increased the success rate of left IJV location in the junior group.

Identifying the internal jugular vein on the first attempt does not necessarily mean successful cannulation without complication. Therefore, this simulation model cannot exactly mimic clinical practice. However, we found that this simulation model was more appropriate, as in our working group some participants had never before performed internal jugular vein catheterization alone.

Conclusion

The results of this simulation study showed that both use of the landmark technique and operator experience increased the success rate. However, especially with the less preferred left IJV cannulation, we think that use of the anatomic landmark technique could increase the success rate independent of experience.

Conflict of Interest
No conflict of interest was declared by the authors.

Peer-review: Externally peer-reviewed.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Mersin University School of Medicine (05.01.2012, 2012-01).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Author Contributions
Concept - J.E.; Design - D.Ö., J.E.; Supervision - T.A., H.G.; Funding - M.Ö.; Materials - M.Ö.; Data Collection and/or Processing - J.E., D.Ö., M.Ö.; Analysis and/or Interpretation - D.Ö.; Literature Review - J.E., M.Ö.; Writer - J.E.; Critical Review - H.G.

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Yazarlar herhangi bir çıkar çatışması bildirmemişlerdir.

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Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.

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