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ORIGINAL RESEARCH

Barriers to the use of ultrasound guidance in central venous catheter placement by emergency physicians in Saudi Arabia: a cross-sectional study

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Abstract

The use of ultrasound-guided central venous catheter (USG-CVC) placement is still low among emergency physicians in many countries, including Saudi Arabia, because of several inherent perceived barriers. We assessed the barriers to the use of USG-CVC placement in clinical practice among Saudis currently in training, residents and board-certified physicians and evaluated the association of these barriers with the demographic characteristics of EPs. We conducted a cross-sectional survey among all emergency physicians (EPs) practicing in Saudi Arabia who completed a residency program in emergency medicine (EM) or were board-certified emergency physicians from October to December 2018. The survey material was sent via SurveyMonkey through the Saudi Commission for Health Specialties to target EPs. Two hundred thirty-four EPs completed the survey (response rate: 66.9%), and 177 (75.6%) were males. EPs from nongovernment institutions tended to agree significantly more than EPs from government institutions with the perception that USG-CVC placement is a time-consuming process (17.9% *vs.* 20.3%, respectively, $p = 0.022$). Residents were 3.8 times more likely to perceive loss of their skill in using Ultrasound (US) for CVC placement Odds ratio (OR) = 3.806, 95% Confidence interval (CI) = 0.218–0.686, $p < 0.001$), 2 times more likely to believe that USG-CVC placement was not proven in randomized controlled trials (OR = 2.061, 95% CI = 0.010–0.460, $p = 0.040$), and 5.5 times more likely to believe that USG-CVC placement was not a cost-effective procedure (OR = 5.490, 95% CI = 0.411–0.870, $p < 0.001$) than board-certified EPs. Many EPs, particularly those in training, believe there are several barriers to using USG-CVC placement, including loss of skill, a lack of support of the procedure in randomized controlled trials and cost-effectiveness. This is true, although there is existing evidence and a consensus regarding the superiority of USG-CVC placement over the landmark technique. In comparison to the more experienced and well-trained board-certified EPs, residents' confidence and skill in using USG-CVC placement may have been influenced by their training and experience.

Keywords

Barriers; Ultrasound-guided central venous catheter placement; Emergency physicians; Factors; Saudi Arabia

1. Introduction

Strong data from the past ten years show that ultrasound-guided central venous catheter (USG-CVC) placement is better than the landmark strategy [1]. The use of USG-CVC placement has been associated with an increase in physician confidence, an improvement in the overall success rate and efficiency and a reduction in complications from first attempts [2]. Consequently, the use of US guidance has been associated with higher satisfaction among patients with emergency department (ED) care [3].

Nevertheless, despite the obvious advantages and advancements in increasing US utility in the ED, different hospital settings have varying rates of USG-CVC placement use. In contrast to Saudi Arabia, where 21.8% of respondents indicated that they had never or only occasionally used US for CVC placement, a prospective study in northwest France found that just a small percentage of physicians (6%) had not adopted this technology into their practices [4]. According to published research, clinicians' reluctance to use USG-CVC placement is primarily due to a lack of training, with 62% of physicians in the WWAMI region (Washington, Wyoming,

Alaska, Montana, and Idaho) and 47% in Colorado seeing this as a major barrier to the technique's growth [5, 6]. Other barriers to adoption include a lack of support staff (41%) and challenges with image interpretation [3, 7]. According to a study by Leschyna *et al*. [8], 8.2% of their respondents said that there was not enough evidence to support continued US adoption.

To better understand existing clinical practices and identify the factors that impede the use of USG-CVC placement, we wanted to assess and compare the barriers to USG-CVC placement in clinical practice among Saudi Arabian residents in training and board-certified physicians. To the best of our knowledge, there has never been a study that compared residents in training and board-certified doctors in terms of barriers to performing USG-CVC placement in Saudi Arabia. Second, we also wanted to determine the association of these barriers with other demographic characteristics of EPs. This could provide an opportunity for policy-makers to mitigate these obstacles and make better use of USG-CVC placement.

2. Materials and methods

A cross-sectional survey was performed among all emergency physicians (EPs) currently practicing in Saudi Arabia. A physician was considered an EP if they had completed a residency program in emergency medicine (EM) or were licensed physicians classified by the Saudi Commission for Health Specialties (SCFHS) as emergency physicians or residents if they were currently undergoing training in emergency medicine. Data were gathered from October to December 2018. EPs with a range of professional years of experience were recruited to participate in this study from a variety of hospitals. An email invitation that included the consent form and the survey material was sent via SurveyMonkey through the Saudi Commission for Health Specialties to approximately 350 EPs. The sample size was calculated to be 184 using a 95% confidence level, 5% confidence interval, and power of 80. An evaluation by a group of board-certified, university-affiliated EPs with several years of clinical experience helped confirm the validity of the survey. To assess the dependability of the survey, a small-scale feasibility/pilot study was carried out.

The survey's questions were used to make direct evaluations of the frequency of USG-CVC placement. Additionally, the survey covered the respondents' demographic information (sex, nationality, place of residence, type of hospital, years in practice and number of clinical shifts), formal and informal training on USG-CVC placement, interest in further education, knowledge of CVCs, attitudes toward and comfort level with USG-CVC placement, *etc*. The respondents' level of agreement with the placement of USG-CVCs (1: strongly disagree to 5: strongly agree), their level of comfort inserting CVCs (0: extremely uncomfortable to 5: extremely comfortable), and their opinions and assessment of the use of medical technology and diagnostic ambiguity were all gauged using Likert scales (1: strongly agree to 9: strongly disagree). To determine correlations with USG-CVC placement, the respondents were divided into 5 groups based on the percentage of CVCs that they had placed under US guidance: 0–20%, 21–40%, 41–60%, 61–80%, and 81–100%. To measure the internal consistency of the questionnaire, cronbach's alpha was measured and result was 0.71.

The data collected from SurveyMonkey [9] were exported as a spreadsheet and analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0 software (IBM Corp., Armonk, NY, USA). The results are expressed as numbers and percentages for categorical variables and as the means and standard deviations for continuous variables. A chi-square (χ^2) test was used to compare proportions between two categorical groups. The Pearson correlation test was applied to determine the correlation between variables. Finally, univariate and multivariate regression analyses were performed to determine significant barriers to USG-CVC placement. All relevant variables were entered into a logistic regression model with USG-CVC placement as the dependent variable. A p value of <0.05 was considered statistically significant.

The Institutional Review Board (IRB) of King Fahad Medical City, Ministry of Health, Riyadh, Saudi Arabia, approved this study. This study adhered to the principles of the Declaration of Helsinki. Respondents were informed of the aim, purpose, and methodology of this study, and participation was voluntary. No incentives were given to the respondents to motivate them to participate in the survey.

3. Results

Of 350 emails sent, 234 EPs completed the survey (response rate: 66.9%), 177 (75.6%) were males and 57 (24.4%) were females, and the majority (n = 167, 71.4%) were Saudi nationals. The detailed sociodemographic characteristics of the respondents are presented in Table 1. The majority of the respondents agreed to have further formal and informal training on USG-CVC placement (Fig. 1).

Table 2 shows the identified barriers to the use of USG-CVC placement according to sex, nationality, institution type, educational/training level and years of practice. There was no statistically significant difference in sex or nationality regarding the response of EPs to the perceived barriers. On the other hand, EPs from nongovernmental institutions tended to agree significantly more than EPs from government institutions with the perception that USG-CVC placement is a time-consuming process (17.9% *vs.* 20.3%, respectively, $p = 0.022$). No significant differences were observed in other perceived barriers according to institution ($p > 0.05$). Respondents who were residents tended to agree significantly more with the perception that USG-CVC placement results in loss of their skill, that USG-CVC use is not proven by randomized controlled trials and that USG-CVC placement is not a cost-effective method ($p < 0.001$, $p = 0.003$ and $p < 0.001$, respectively) than board-certified EPs. Furthermore, respondents who had $\leq$5 years of training compared to Eps who had 6–10 years and $>$10 years of training agreed significantly more with the perception that USG-CVC placement results in the loss of their skill, that USG-CVC placement use is not proven by randomized controlled trials, and that USG-CVC placement is not a cost-effective method ($p = 0.004$, $p = 0.007$ and $p = 0.016$, respectively) than board-certified EPs.

More EPs with five years or less of experience used US $>$60% of the time during CVC placement compared to those

TABLE 1. Demographic characteristics of 234 surveyed EPs.

Characteristic	Description	n (%)
Gender		
	Male	177 (75.6)
	Female	57 (24.4)
Nationality		
	Saudi	167 (71.4)
	Non-Saudi	67 (28.6)
Institution Type		
	Government Ministry of Health	106 (45.3)
	Non-government	128 (54.7)
Education Level		
	Resident	91 (38.9)
	Board Certified	143 (61.1)
Practicing years		
	≤5 years	98 (41.9)
	6–10 years	72 (30.8)
	>10 years	64 (27.4)

EPs: Emergency Physicians.

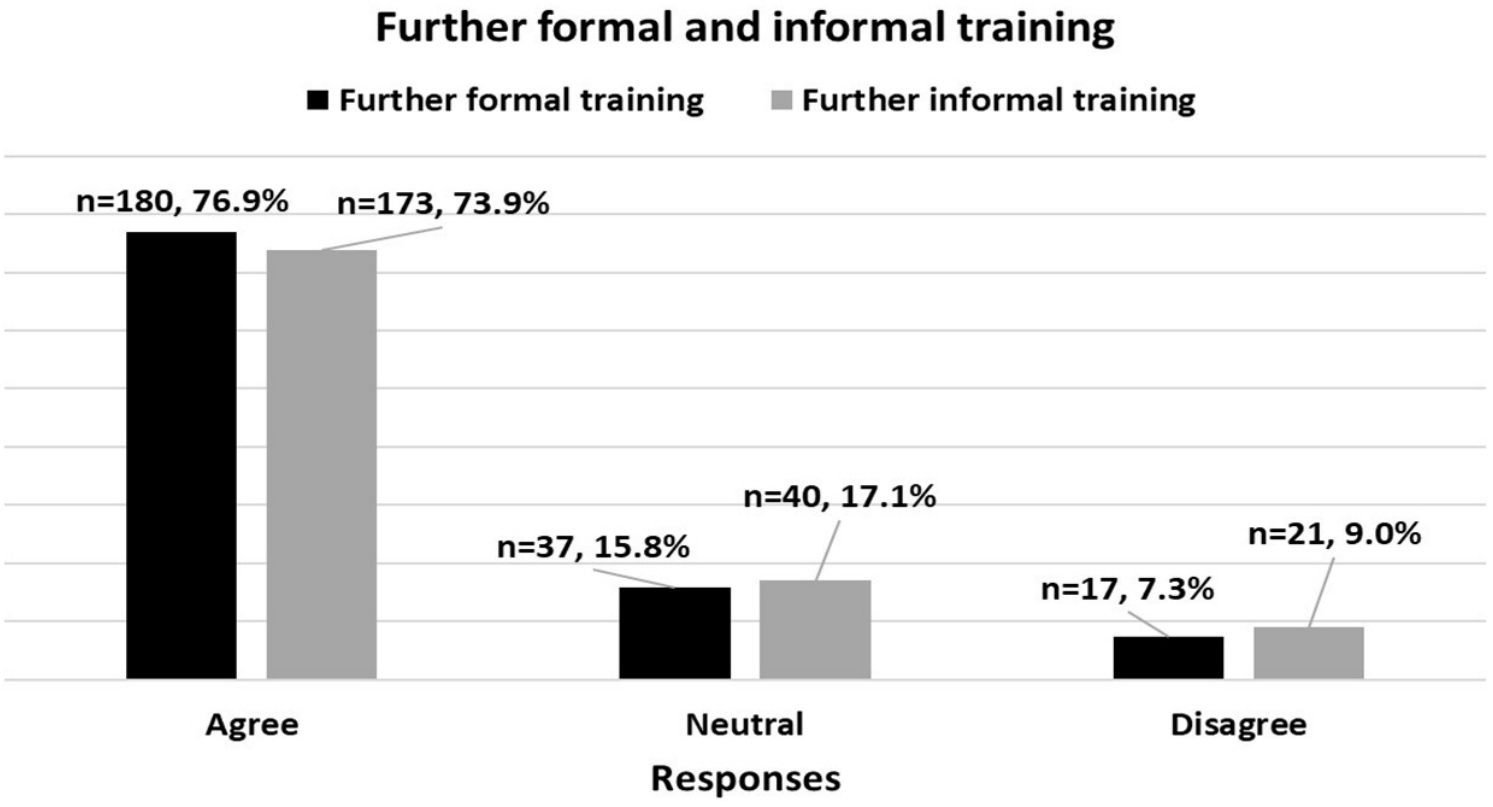

FIGURE 1. Percentage of respondents on questions regarding the need for further formal and informal training on US-CVC. USG-CVC: Ultrasound-Guided Central Venous Catheter.

TABLE 2. Proportion of responses to perceived barriers to use of USG-CVC according to gender, nationality, type of institution, educational/training level and years of practice among 234 surveyed Eps.

Perceived barriers	Groups	Agree	Neutral	Disagree	*p* values
A. According to gender					
Difficulty in usage of US	Male	8 (4.5%)	24 (13.6%)	145 (81.9%)	0.509
	Female	4 (7.0%)	5 (8.8%)	48 (84.2%)	
Time consuming	Male	34 (19.2%)	39 (22.0%)	104 (58.8%)	0.580
	Female	11 (19.3%)	9 (15.8%)	37 (64.9%)	
Results in mechanical complications	Male	0	13 (7.3%)	164 (92.7%)	0.153
	Female	1 (1.8%)	6 (10.5%)	50 (87.7%)	
Results in infection	Male	25 (14.1%)	69 (39.0%)	83 (46.9%)	0.026
	Female	17 (29.8%)	19 (33.3%)	21 (36.8%)	
Less convenient	Male	58 (32.8%)	41 (23.2%)	78 (44.1%)	0.066
	Female	10 (17.5%)	19 (33.3%)	28 (49.1%)	
Results in the loss of my skill	Male	31 (17.5%)	44 (24.9%)	102 (57.6%)	0.673
	Female	10 (17.5%)	11 (19.3%)	36 (63.2%)	
Not proven in randomized trials	Male	26 (14.7%)	56 (31.6%)	95 (53.7%)	0.698
	Female	9 (15.8%)	21 (36.8%)	27 (47.4%)	
Not cost-effective	Male	33 (18.6%)	42 (23.7%)	102 (57.6%)	0.917
	Female	11 (19.3%)	12 (21.1%)	34 (59.6%)	
B. According to nationality					
Difficulty in usage of US	Saudi	11 (6.6%)	21 (12.6%)	135 (80.8%)	0.269
	Non-Saudi	1 (1.5%)	8 (11.9%)	58 (86.6%)	
Time consuming	Saudi	38 (22.8)	31 (18.6%)	98 (58.7%)	0.079
	Non-Saudi	7 (10.4%)	17 (25.4%)	43 (64.2%)	
Results in mechanical complications	Saudi	1 (0.6%)	13 (7.8%)	153 (91.6%)	0.785
	Non-Saudi	0	6 (9.0%)	61 (91.0%)	
Results in infection	Saudi	33 (19.8%)	63 (67.7%)	71 (42.5%)	0.459
	Non-Saudi	9 (13.4%)	25 (37.3%)	33 (49.3%)	
Less convenient	Saudi	44 (26.3%)	42 (25.1%)	81 (48.5%)	0.240
	Non-Saudi	24 (35.8%)	18 (26.9%)	25 (37.3%)	
Results in the loss of my skill	Saudi	26 (14.6%)	43 (25.7%)	98 (58.7%)	0.283
	Non-Saudi	15 (22.4%)	12 (17.9%)	40 (59.7%)	
Not proven in randomized trials	Saudi	22 (13.2%)	56 (33.5%)	89 (53.3%)	0.482
	Non-Saudi	13 (19.4%)	21 (31.3%)	33 (49.3%)	
Not cost-effective	Saudi	28 (16.8%)	40 (24.0%)	99 (59.3%)	0.446
	Non-Saudi	16 (23.9%)	14 (20.9%)	37 (55.2%)	
C. According to institution					
Difficulty in usage of US	Gov't	5 (4.7%)	10 (9.4%)	91 (85.8%)	0.427
	Non-Gov't	7 (5.5%)	19 (14.8%)	102 (79.7%)	
Time consuming	Gov't	19 (17.9%)	14 (13.2%)	73 (68.9%)	0.022
	Non-Gov't	26 (20.3%)	34 (26.6%)	68 (53.1%)	
Results in mechanical complications	Gov't	1 (0.9%)	5 (4.7%)	100 (94.3%)	0.126
	Non-Gov't	0	14 (10.9%)	114 (89.1%)	
Results in infection	Gov't	20 (18.9%)	38 (35.8%)	48 (45.3%)	0.869
	Non-Gov't	22 (17.2%)	50 (39.1%)	56 (43.8%)	
Less convenient	Gov't	29 (27.4%)	30 (28.3%)	47 (44.3%)	0.681
	Non-Gov't	39 (30.5%)	30 (23.4%)	59 (46.1%)	
Results in the loss of my skill	Gov't	20 (18.9%)	21 (19.8%)	65 (61.3%)	0.471
	Non-Gov't	21 (16.4%)	34 (26.6%)	73 (57.0%)	

TABLE 2. Continued.

Perceived barriers	Groups	Agree	Neutral	Disagree	*p* values
Results in the loss of my skill	Gov't	20 (18.9%)	21 (19.8%)	65 (61.3%)	0.471
	Non-Gov't	21 (16.4%)	34 (26.6%)	73 (57.0%)	
Not proven in randomized trials	Gov't	17 (16.0%)	31 (29.2%)	58 (54.7%)	0.552
	Non-Gov't	18 (14.1%)	46 (35.9%)	64 (50.0%)	
Not cost-effective	Gov't	21 (19.8%)	17 (16.0%)	68 (64.2%)	0.065
	Non-Gov't	23 (18.0%)	37 (28.9%)	68 (53.1%)	
D. According to educational/training level					
Difficulty in usage of US	Resident	7 (7.7%)	10 (11.0%)	74 (81.3%)	0.338
	Board cert.	5 (3.5%)	19 (13.3%)	119 (83.2%)	
Time consuming	Resident	22 (24.2%)	13 (14.3%)	56 (61.5%)	0.093
	Board cert.	23 (16.1%)	35 (24.5%)	85 (59.4%)	
Results in mechanical complications	Resident	1 (1.1%)	7 (7.7%)	83 (91.2%)	0.448
	Board cert.	0	12 (8.4%)	131 (91.6%)	
Results in infection	Resident	21 (23.1%)	35 (38.5%)	35 (38.5%)	0.182
	Board cert.	21 (14.7%)	53 (37.1%)	69 (48.3%)	
Less convenient	Resident	29 (31.9%)	23 (25.3%)	39 (42.9%)	0.738
	Board cert.	39 (27.3%)	37 (25.9%)	67 (46.9%)	
Results in the loss of my skill	Resident	21 (23.1%)	32 (35.2%)	38 (41.8%)	<0.001
	Board cert.	20 (14.0%)	23 (16.1%)	100 (69.9%)	
Not proven in randomized trials	Resident	16 (17.6%)	40 (44.0%)	35 (38.5%)	0.003
	Board cert.	19 (13.3%)	37 (25.9%)	87 (60.8%)	
Not cost-effective	Resident	28 (30.8%)	29 (31.9%)	34 (37.4%)	<0.001
	Board cert.	16 (11.2%)	25 (17.5%)	102 (71.3%)	
E. According to years of practice					
Difficulty in usage of US	≤5 years	6 (6.1%)	11 (11.2%)	81 (82.7%)	0.830
	6–10 years	2 (2.8%)	9 (12.5%)	61 (84.7%)	
	>10 years	4 (6.3%)	9 (14.1%)	51 (79.7%)	
Time consuming	≤5 years	21 (21.4%)	19 (19.4%)	58 (59.2%)	0.443
	6–10 years	10 (13.9%)	13 (18.1%)	49 (68.1%)	
	>10 years	14 (21.9%)	16 (25.0%)	34 (53.1%)	
Results in mechanical complications	≤5 years	1 (1.0%)	9 (9.2%)	88 (89.8%)	0.202
	6–10 years	0	2 (2.8%)	70 (97.2%)	
	>10 years	0	8 (12.5%)	56 (87.5%)	
Results in infection	≤5 years	26 (26.5%)	35 (35.7%)	37 (37.8%)	0.065
	6–10 years	8 (11.1%)	28 (38.9%)	36 (50.0%)	
	>10 years	8 (12.5%)	25 (39.1%)	31 (48.4%)	
Less convenient	≤5 years	29 (29.6%)	24 (24.5%)	45 (45.9%)	0.075
	6–10 years	13 (18.1%)	22 (30.6%)	37 (51.4%)	
	>10 years	26 (40.6%)	14 (21.9%)	24 (37.5%)	
Results in the loss of my skill	≤5 years	18 (18.4%)	33 (33.7%)	47 (48.0%)	0.004
	6–10 years	10 (13.9%)	8 (11.1%)	54 (75.0%)	
	>10 years	13 (20.3%)	14 (21.9%)	37 (57.8%)	
Not proven in randomized trials	≤5 years	17 (17.3%)	42 (42.9%)	39 (39.8%)	0.007
	6–10 years	9 (12.5%)	14 (19.4%)	49 (68.1%)	
	>10 years	9 (14.1%)	21 (32.8%)	34 (53.1%)	
Not cost-effective	≤5 years	22 (22.4%)	28 (28.6%)	48 (49.0%)	0.016
	6–10 years	11 (15.3%)	8 (11.1%)	53 (73.6%)	
	>10 years	11 (17.2%)	18 (28.1%)	35 (54.7%)	

USG-CVC: Ultrasound-Guided Central Venous Catheter, Eps: Emergency Physicians.

with more than 5 years of clinical experience (79.8% *vs.* 57.9%, respectively, $p = 0.006$). Furthermore, EPs with more than five years of experience believed that more formal and informal training was needed, and they reported higher success rates at the first attempt than EPs with less than five years of clinical experience.

Regression analysis showed that residents were 3.8 times more likely to perceive loss of their skill in using USG-CVC placement (OR = 3.806, 95% CI = 0.218–0.686, $p < 0.001$), 2 times more likely to believe that USG-CVC was not proven in randomized controlled trials (OR = 2.061, 95% CI = 0.010–0.460, $p = 0.040$), and 5.5 times more likely to believe that USG-CVC placement was not a cost-effective procedure (OR = 5.490, 95% CI = 0.411–0.870, $p < 0.001$) than board-certified EPs.

4. Discussion

This study has shown the use of USG-CVC placement from the EP's point of view. We identified several factors and barriers to USG-CVC placement including the loss of skills among residents and those EP's who had five years or less of experience, EP's belief that the use of USG-CVC placement is not proven by randomized controlled trials and that it is not a cost-effective method. Furthermore, there exists a significant difference on the use of USG-CVC placement with regards to the type of institution, where EP's from non-government hospitals perceive that USG-CVC placement is a time consuming process [10–18]. Taking all of these findings, we discuss why EP's have this perceptions and ways to overcome these barriers.

Traditionally, CVC placement is performed using landmark techniques based on the knowledge of anatomic structures and palpation of arteries next to the veins. These landmark techniques cannot account for anatomic variations at the CVC insertion site. Numerous studies have investigated the use of USG-CVC placement and established its success, its advantages in the reduction of morbidity and difficulties brought on by the conventional landmark approach [1, 2, 19–21]. A recent article by Al-Aseri *et al*. [5] claimed that only a limited percentage of EPs in Saudi Arabia had introduced USG-CVC placement into clinical practice. Furthermore, Al-Aseri *et al*. [5] suggested that training, education, and institutional availability of permanent onsite US equipment may remove obstacles and barriers to the use of USGH-CVC placement. However, they were unable to completely explain and elaborate on the obstacles and underlying demographic factors that may be connected to the nonuse of USG-CVC placement. In this study, we discovered a number of barriers to USG-CVC placement as seen by EPs, including the difficulty in its use, the time-consuming factor, mechanical difficulties, infections, its inconvenience, the loss of the EP's abilities to use landmark techniques, the lack of support and verification of the technique in randomized controlled trials, and cost-effectiveness. Some of these identified barriers were reported by previous reports, including the feeling of less convenience/less comfort with their US skills and time-consuming factors [14, 22]. Most previous studies have implicated the lack of knowledge and training on the use of USG-CVC placement as a barrier to its use [5, 14, 23–26]. In contrast to previous studies, we further explored these barriers and determined their relationship to EPs' demographic characteristics.

This study further echoes our previous study that less than half of EP's perform USG-CVC placement [5]. In contrast to this study, here we identified the reasons why EP's do not use USG-CVC placement. To overcome these barriers (loss of skills, not proven by Randomized Controlled Trial (RCTs), not cost effective and time consuming). The problem with their perception of loss of skills can be attributed to lack of awareness affecting judgement whereas in some EPs are "overconfident" that is misperceived as competence [27, 28]. Cognitive biases can be addressed through education and motivational change to reduce reluctance and increase familiarity of the equipment [29]. Several Cochrane systematic reviews and meta-analyses has proven the safety and efficacy of USG-CVC placement with a success rate of 89% and risk ration of 1.11 [30]. For Eps who never use USG, institutional or hospital investments on training and equipment may significantly reduce these barriers. Although the question on which equipment to use is ideal since each machine and US probe has advantages and disadvantages related to factors including mobility, size, speed, image quality and ease of use. These all has to be considered by institutions to increase the use and decrease perceived barriers of CVC placement [18]. The issue cost-effectiveness can be addressed has been discussed by some authors [31, 32]. The purchase cost for each equipment may reach £7500, apart from that is the maintenance cost of around £1350 and the cost of training staff to use the equipment [31]. However, studies have shown that the use of USG-CVC may improve both clinical effectiveness and savings from resources of valuable time of doctors and the nursing staff than in hard cash [31]. Reducing the insertion failures, reducing average attempts to insertion and reducing the incidence of complications results in the increased use of USG-CVC placement. Machines and the operators of the equipment should be trained well t have sufficiently high throughput to ensure cost-effective use [31].

This study specifically drew attention to the shortcomings among ED residents who believed that employing USG-CVC placement would cause them to lose their ability to use landmark techniques. Furthermore, ED residents were persuaded not to employ USG-CVC placement because they believed its efficacy and cost-effectiveness must be demonstrated in randomized controlled trials. These factors have not been mentioned in any published work. Since we discovered that the more experienced and well-trained board-certified EPs were less likely to report these impediments, experience and training are a possible explanation. With the right training and experience, even EPs with limited training and experience should be able to use ultrasound as a supplement for central venous access (CVA) to both reduce the number of CVA attempts needed to cannulate a central vein and shorten the time needed to do so, beginning when the needle first touches the skin after the ultrasound machine has been set up and turned on [12]. The best strategies for removing such barriers were considered to be training and education [18].

Current research and clinical recommendations stress the importance of having the necessary cognitive skills, a compre-

hension of the workflow and manual dexterity to properly place a USG-CVC [33, 34]. The operator should be knowledgeable about the equipment's function, potential difficulties, and how to avoid them [19, 21, 22]. Many specialists in the field have argued in favor of teaching through simulation and a structured form of education and instruction [21, 22, 35, 36]. Additionally, to keep residents up to date on the most recent developments from peer-reviewed articles on the benefits and suggestions for USG-CVC placement, it is essential to provide early training on the use of USG-CVC placement, particularly among residents as early as during their training period. This training must be backed by continuing medical education.

This study had several limitations. This study was a survey, and the replies were self-reported; thus, they might not accurately represent the respondents' perceptions. The results could have also been biased, and some respondents might have had trouble understanding the questions.

5. Conclusions

Many EPs, particularly those who are in training, believe there are several barriers to using USG-CVC placement, including loss of skill, a lack of support of the procedure in randomized controlled trials and cost-effectiveness. This is true, although there is existing evidence and a consensus regarding the superiority of USG-CVC placement over the landmark technique. In comparison to the more experienced and well-trained board-certified EPs, residents' confidence and skill in using USG-CVC placement may have been influenced by their training and experience. Still the best approach to overcome these barriers are training and education to increase competence in the performance of USG-CVC placement.

AVAILABILITY OF DATA AND MATERIALS

The data used to support the findings of this study are available from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

ZAA—supervised the study, edited and critically reviewed the manuscript for important intellectual content, and approved the final version to be published. BAA, ASA, KNA, and MAM—edited and critically reviewed the manuscript for important intellectual content, and approved the final version to be published. RMA—collected and coordinated the data collection, interpreted the data, wrote, and edited the manuscript, critically reviewed the manuscript for important intellectual content, and approved of the final version to be published. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Institutional Review Board, Research Center, King Fahad Medical City, Riyadh City, Saudi Arabia. (study number IRB00010471). All participants signed consent forms.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] National Institute for Clinical Excellence. Guidance on the use of ultrasound locating devices for placing central venous catheters. 2002. Available at: https://www.nice.org.uk/guidance/ta49/resources/guidance-on-the-use-of-ultrasound-locating-devices-for-placing-central-venous-catheters-pdf-2294585518021 (Accessed: 21 September 2022).

[2] Reusz G, Csomos A. The role of ultrasound guidance for vascular access. Current Opinion in Anaesthesiology. 2015; 28: 710–716.

[3] Howard ZD, Noble VE, Marill KA, Sajed D, Rodrigues M, Bertuzzi B, *et al*. Bedside ultrasound maximizes patient satisfaction. The Journal of Emergency Medicine. 2014; 46: 46–53.

[4] Maizel J, Bastide M, Richecoeur J, Frenoy E, Lemaire C, Sauneuf B, *et al*. Practice of ultrasound-guided central venous catheter technique by the French intensivists: a survey from the BoReal study group. Annals of Intensive Care. 2016; 6: 76.

[5] Al Aseri ZA, Al Hussein RM, Malabarey MA, AlYahya BA, Al Moaiqel FA, Al Ansari MA, *et al*. Use of ultrasound guidance in central venous catheter placement by emergency physicians in Saudi Arabia. Saudi Medical Journal. 2020; 41: 698–702.

[6] Bellows B, Totten J, Shah S, Adedipe A. Perceived barriers in the use of point of care ultrasound in the WWAMI Region. Journal of Emergency Medicine & Critical Care. 2015; 1: 4.

[7] Backlund B, Hopkins E, Kendall J. Ultrasound guidance for central venous access by emergency physicians in colorado. Western Journal of Emergency Medicine. 2012; 13: 320–325.

[8] Leschyna M, Hatam E, Britton S, Myslik F, Thompson D, Sedran R, *et al*. Current state of point-of-care ultrasound usage in canadian emergency departments. Cureus. 2019; 11: e4246.

[9] Howard ZD, Noble VE, Marill KA, Sajed D, Rodrigues M, Bertuzzi B, *et al*. Bedside ultrasound maximizes patient satisfaction. The Journal of Emergency Medicine. 2014; 46: 46–53.

[10] Hind D, Calvert N, McWilliams R, Davidson A, Paisley S, Beverley C, *et al*. Ultrasonic locating devices for central venous cannulation: meta-analysis. BMJ. 2003; 327: 361.

[11] Hrics P, Wilber S, Blanda MP, Gallo U. Ultrasound-assisted internal jugular vein catheterization in the ED. The American Journal of Emergency Medicine. 1998; 16: 401–403.

[12] Miller AH, Roth BA, Mills TJ, Woody JR, Longmoor CE, Foster B. Ultrasound guidance versus the landmark technique for the placement of central venous catheters in the emergency department. Academic Emergency Medicine. 2002; 9: 800–805.

[13] Milling TJ, Rose J, Briggs WM, Birkhahn R, Gaeta TJ, Bove JJ, *et al*. Randomized, controlled clinical trial of point-of-care limited ultrasonography assistance of central venous cannulation: the third sonography outcomes assessment program (SOAP-3) trial. Critical Care Medicine. 2005; 33: 1764–1769.

[14] Leung J, Duffy M, Finckh A. Real-time ultrasonographically-guided internal jugular vein catheterization in the emergency department increases success rates and reduces complications: a randomized, prospective study. Annals of Emergency Medicine. 2006; 48: 540–547.

[15] Adhikari S, Theodoro D, Raio C, Nelson M, Lyon M, Leech S, *et al*. Central venous catheterization: are we using ultrasound guidance? Journal of Ultrasound in Medicine. 2015; 34: 2065–2070.

[16] Flynn CJ, Weppler A, Theodoro D, Haney E, Ken Milne W. Emergency medicine ultrasonography in rural communities. Canadian Journal of Rural Medicine. 2012; 17: 99–104.

[17] Zaver F, Boniface K, Wachira B, Wanjiku G, Shokoohi H. International scope of emergency ultrasound: barriers in applying ultrasound to guide central line placement by providers in Nairobi, Kenya. Emergency Medicine International. 2018; 2018: 1–5.

[18] Buchanan MS, Backlund B, Liao MM, Sun J, Cydulka RK, Smith-Coggins R, *et al*. Use of ultrasound guidance for central venous catheter placement: survey from the american board of emergency medicine longitudinal study of emergency physicians. Academic Emergency Medicine. 2014; 21: 416–421.

[19] Leibowitz A, Oren-Grinberg A, Matyal R. Ultrasound guidance for central venous access: current evidence and clinical recommendations. Journal of Intensive Care Medicine. 2020; 35: 303–321.

[20] Javeri Y, Jagathkar G, Dixit S, Chaudhary D, Zirpe KG, Mehta Y, *et al*. Indian society of critical care medicine position statement for central venous catheterization and management 2020. Indian Journal of Critical Care Medicine. 2020; 24: S6–S30.

[21] Crenshaw NA, Briones P, Gonzalez JM, Ortega J. A review of central venous access using ultrasound guidance technology. Advanced Emergency Nursing Journal. 2020; 42: 119–127.

[22] Ablordeppey EA, Drewry AM, Theodoro DL, Tian L, Fuller BM, Griffey RT. Current practices in central venous catheter position confirmation by point of care ultrasound: a survey of early adopters. Shock. 2019; 51: 613–618.

[23] LeMaster CH, Hoffart N, Chafe T, Benzer T, Schuur JD. Implementing the central venous catheter infection prevention bundle in the emergency department: experiences among early adopters. Annals of Emergency Medicine. 2014; 63: 340–350.e1.

[24] Khait L, Malik AN, Petrovich MP, Ajani AA, Favot MJ. Ultrasound-guided central venous catheters. Emergent Vascular Access. 2021; 146: 111–132.

[25] Pinelli F, Franco A. Ultrasound-guided central and peripheral vein cannulation. Textbook of Echocardiography for Intensivists and Emergency Physicians. 2019; 9: 483–488.

[26] Gjesteby LA, Pare JR, Brattain LJ. Ultrasound for the emergency department and prehospital care. Engineering and Medicine in Extreme Environments. 2022; 48: 209–234.

[27] Brenner LA, Koehler DJ, Rottenstreich y. Remarks on support theory: recent advances and future directions. Heuristics and Biases. 2002; 13: 489–509.

[28] Duffy FD, Holmboe ES. Self-assessment in lifelong learning and improving performance in practice: physician know thyself. JAMA. 2006; 296: 1137–1139.

[29] Pronovost PJ. Enhancing physicians' use of clinical guidelines. JAMA. 2013; 310: 2501–2502.

[30] Brass P, Hellmich M, Kolodziej L, Schick G, Smith AF. Ultrasound guidance versus anatomical landmarks for subclavian or femoral vein catheterization. The Cochrane Database of Systematic Reviews. 2015; 1: CD011447.

[31] Calvert N, Hind D, McWilliams R, Davidson A, Beverley CA, Thomas SM. Ultrasound for central venous cannulation: economic evaluation of cost-effectiveness. Anaesthesia. 2004; 59: 1116–1120.

[32] Sibbitt WL, Band PA, Kettwich LG, Chavez-Chiang NR, DeLea SL, Bankhurst AD. A randomized controlled trial evaluating the cost-effectiveness of sonographic guidance for intra-articular injection of the osteoarthritic knee. Journal of Clinical Rheumatology. 2011; 17: 409–415.

[33] Saugel B, Scheeren TWL, Teboul J. Ultrasound-guided central venous catheter placement: a structured review and recommendations for clinical practice. Critical Care. 2017; 21: 225.

[34] Safety Committee of Japanese Society of Anesthesiologists. Practical guide for safe central venous catheterization and management 2017. Journal of Anesthesia. 2020; 34: 167–186.

[35] Peltan ID, Shiga T, Gordon JA, Currier PF. Simulation improves procedural protocol adherence during central venous catheter placement: a randomized controlled trial. Simulation in Healthcare. 2015; 10: 270–276.

[36] Hameeteman M, Bode AS, Peppelenbosch AG, van der Sande FM, Tordoir JH. Ultrasound-guided central venous catheter placement by surgical trainees: a safe procedure? The Journal of Vascular Access. 2010; 11: 288–292.

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