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Original Contribution

Comparison between ultrasound guided technique and digital palpation technique for radial artery cannulation in adult patients: An updated meta-analysis of randomized controlled trials☆

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ABSTRACT

Study objective: Possible advantages and risks associated with ultrasound guided radial artery cannulation in comparison to digital palpation guided method in adult patients are not fully known. We have compared ultrasound guided radial artery cannulation with digital palpation technique in this meta-analysis.
Design: Meta-analysis of randomized controlled trials.
Setting: Trials conducted in operating room, emergency department, cardiac catheterization laboratory.
Patients: PubMed and Cochrane Central Register of Controlled Trials (CENTRAL) were searched (from 1946 to 20th November 2017) to identify prospective randomized controlled trials in adult patients.
Intervention: Two-dimensional ultrasound guided radial artery catheterization versus digital palpation guided radial artery cannulation.
Measurements: Overall cannulation success rate, first attempt success rate, time to cannulation and mean number of attempts to successful cannulation. Odds ratio (OR) and standardized mean difference (SMD) or mean difference (MD) with 95% confidence interval (CI) were calculated for categorical and continuous variables respectively.
Results: Data of 1895 patients from 10 studies have been included in this meta- analysis. Overall cannulation success rate was similar between ultrasound guided technique and digital palpation [OR (95% CI) 2.01 (1.00, 4.06); p = 0.05]. Ultrasound guided radial artery cannulation is associated with higher first attempt success rate of radial artery cannulation in comparison to digital palpation [OR (95% CI) 2.76 (186, 4.10); p < 0.001]. No difference was seen in time to cannulate [SMD (95% CI) -0.31 (−0.65, 0.04); p = 0.30] and mean number of attempt [MD (95% CI) -0.65 (−1.32, 0.02); p = 0.06] between USG guided technique with palpation technique.
Conclusion: Radial artery cannulation by ultrasound guidance may increase the first attempt success rate but not the overall cannulation success when compared to digital palpation technique. However, results of this meta-analysis should be interpreted with caution due presence of heterogeneity.

1. Introduction

Arterial cannulation is a commonly performed invasive procedure used in operating room, intensive care unit, emergency department and in cardiac catheterization laboratory. Arterial cannulation allows beat-to-beat blood pressure measurement, blood sampling for blood gas analysis and can be used for guiding fluid therapy in critically ill or surgical patients [1,2]. Radial artery, being easily accessible because of its superficial location, is one of the most preferred sites for arterial cannulation and has a low rate of procedural complications from arterial cannulation [3,4]. Classically radial artery cannulation is performed by digital palpation method. However, at times radial artery cannulation can be difficult or impossible leading to hematoma formation, bleeding or spasm of the artery. Radial arterial cannulation may be difficult at times particularly in some specific scenarios such hemodynamically unstable patients, altered vascular anatomy or in

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obese patients [2].

Ultrasonography (USG) is being increasing used for arterial cannulation; real time USG provides visualization of the artery, real time puncture of the artery and threading of the cannula. A number of randomized controlled trials [5–14] and meta-analyses [2,15] previously compared USG guided radial artery cannulation with digital palpation technique. Tang et al. in a meta-analysis of 7 randomized controlled trials reported that use of USG is associated with a significantly higher first attempt success rate and reduced mean time to success of radial artery cannulation [15]. Gu et al. also reported similar findings in their meta-analysis of 12 randomized controlled trials [2]. However, both the previous meta-analyses included studies conducted both in adults and children, which possibly introduced bias. Since the publication of the last meta-analysis, another two randomized controlled trials have also been published. Hence this meta-analysis of the randomized controlled trials have been designed in adult patients to know the clinical usefulness of USG guided technique in comparison to digital palpation guided technique of radial artery cannulation.

2. Methods

This meta-analysis follows the recommendations of *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) statement for conducting and reporting its results [16]. A protocol of this meta-analysis was not registered.

2.1. Eligibility criteria

Published randomized controlled trials comparing 2- dimensional USG guided short axis out-of-plane or long axis in-plane technique with a digital palpation guided technique of radial artery cannulation in adult patients has been included in this meta-analysis. Trials those reported first attempt success rate or over-all success rate of artery cannulation rate have been considered to be included in this meta-analysis. Studies where only USG Doppler was used and studies where only arterial puncture was done for sampling without cannulation have not been included in this meta-analysis.

2.2. Information sources

PubMed and The Cochrane Library databases were searched for potentially eligible trials from inception to 20th November 2017. We have not imposed any language restriction or date restriction in search strategy. References of the previously published meta-analyses were also searched for eligible trials.

2.3. Search strategy

Following keywords were used to search database: "*Ultrasound, ultrasonography, USG, Radial artery, radial arterial cannulation, arterial cannulation*". Details of PubMed search strategy have been provided in supplementary digital content.

2.4. Study selection

Two authors (SM and DKB) independently searched title and abstract of the potentially eligible articles. Finally, full text of the possible articles was retrieved and assessed for eligibility. Any disputes between the two authors were solved by discussion with the third author.

2.5. Data collection process

Two authors (SM & SB) independently retrieved required data from the eligible RCTs and all data were initially tabulated in a Microsoft Excel™ (Microsoft Corp., Redmond, WA) data sheet. Any disagreement was resolved with discussion with the third author (DKB).

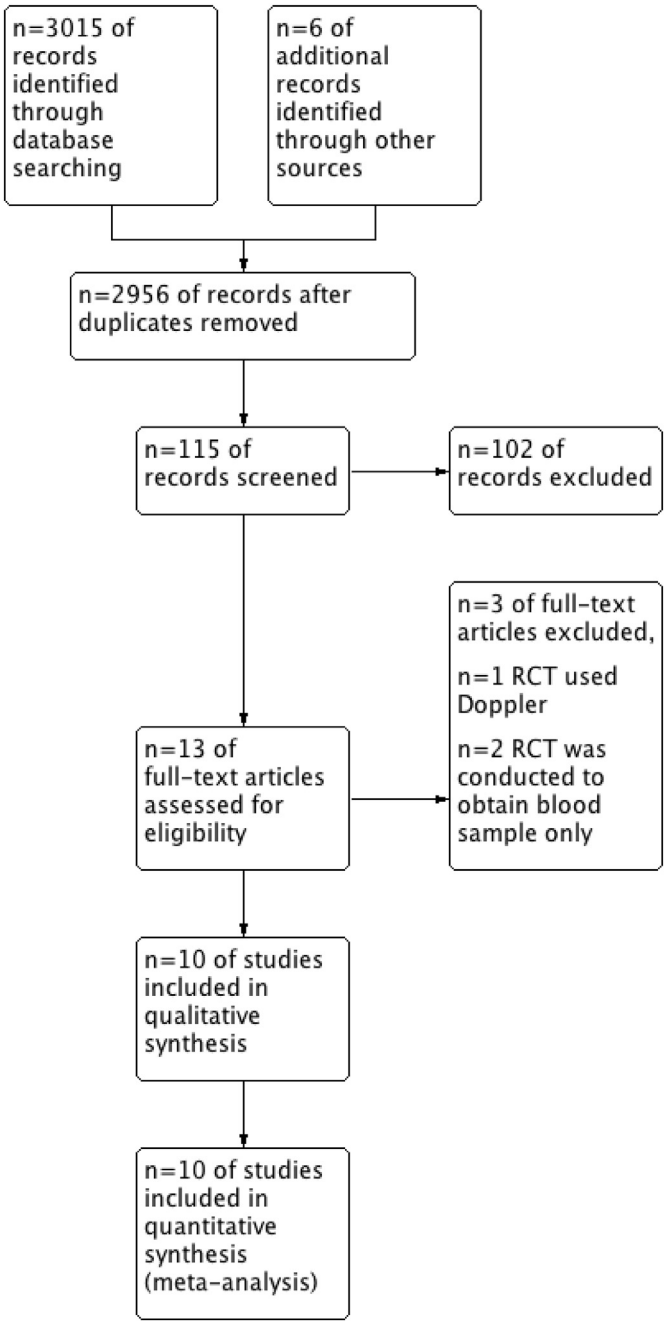

Fig. 1. Flow diagram showing stages of database searching and study selection as per PRISMA methodology.

2.6. Data items

Following data were retrieved from the full text for all studies: First author, year of publication, sample size, characteristics of included patients, details USG technique (short axis out-of- plane or long axis in-plane), details of digital palpation technique, clinical outcome (first attempt success rate, overall success rate, time to arterial cannulation, number of attempts and reported complications).

2.7. Risk of bias in individual studies

Two authors (SM & SB) independently assessed the methodological quality of the included studies. Following methodological questions were searched from the studies as per the Cochrane methodology: method of randomization, allocation concealment, blinding of the