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Research Article

Doppler Auditory Assistance - Arterial Cannulation Made Easy

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Abstract: ***Background*****-** Intra-arterial cannulation for invasive blood pressure monitoring is required in patients with shock. However in these patients it is difficult to pass the cannula because of difficulty in palpation of artery. Few tools like ultrasound guidance and Doppler auscultatory assistance are available to locate the artery in such difficult cases. However use of ultrasound requires practical as well as operator knowledge. Hand held fetal Doppler auscultatory assistance device is an easily available tool that can be effectively used for arterial cannulation in patients with shock. ***Method*****:** This is a prospective study conducted in 100 patients who were admitted to Intensive care unit with shock. Here intra-arterial cannulation was done with the help of hand held Doppler ausculatory assistance device by an inexperienced operator. We observed the ease of cannulation indicated by number of attempts, number of cannulas used, failure to cannulate and post cannulation complications in difficult conditions like shock, by inexperienced operators. ***Result*** **-** In 72 patients cannula was placed in first attempt, 12 patients required 2-3 attempts. In 10 patients though artery was located cannulation was unsuccessful and different site was cannulated. These 10 patients required more than 2 cannula as they were damaged during the procedure. In 6 patients neither artery was located satisfactorily nor were we able to cannulate the artery. ***Conclusion*** **-** A simple hand held Doppler ascultatory assist device can be used to cannulate the artery in difficult cases even by inexperienced operator where palpation of artery is difficult.

Keywords: Intra-arterial cannulation, Doppler auscultatory assistance, shock.

INTRODUCTION

The first successful arterial cannulation was described by Peterson *et al*. in 1949. Arterial cannula insertion has evolved from insertion of a metal needle to the polyethylene catheter. The method of insertion has developed and modified from simple percutaneous needle insertion, arterial cut down to the catheter over needle technique.(Peterson LH, Dripps RD, Risman GC.1949)(Barr PO 1961) (Seldinger SI1953).Continuous haemodynamic monitoring is one of the main goals of intensive care management as it determines cardiac status and organ perfusion. Blood pressure is one of the main haemodynamic parameters monitored in intensive care units (ICU). It can be monitored both invasively and non-invasively. Both techniques have got their own advantages and disadvantages. However invasive blood pressure (IBP) monitoring is the gold standard of blood pressure measurement because of its accuracy and continuous beat to beat measurement.(Chatterjee A, *et al*., 2010),(McGhee BH, Bridges EJ.2002). Traditionally anaesthesiologists or intensivists are used to pass the arterial cannula by palpating the pulsatile artery at different sites. (Schindler_E *et al*., 2005). But in cases of shock the arteries may not be well palpable enough to pass the intra-arterial catheter. This may lead to confusion or difficulty in identifying the course of artery and hence difficulty in cannulation; thus causing many unwanted complications ranging from multiple punctures to irreversible ischemic changes of the limb. (Brown AE, Sweeney DB, Lumley J.1969) (Soderstrom CA.1982) (Downs JB.1973) (Scheer BV.2002) (Varga_EQ *et al*., 2013). There are a few tools which can help Anaesthesiologist or Intensivist in locating the artery in such difficult scenarios. Doppler auscultatory assistance is one of these methods which can help in locating the artery. In this article we have evaluated the use of hand held fetal heart monitor Doppler assistance as an easy and economic mode for intra arterial cannulation in shock patients.

MATERIALS AND METHODS

After ethical committee permission, the study was conducted prospectively in 100 patients of either sex with shock. The patients were admitted to the ICU with shock and required continuous invasive blood pressure monitoring.

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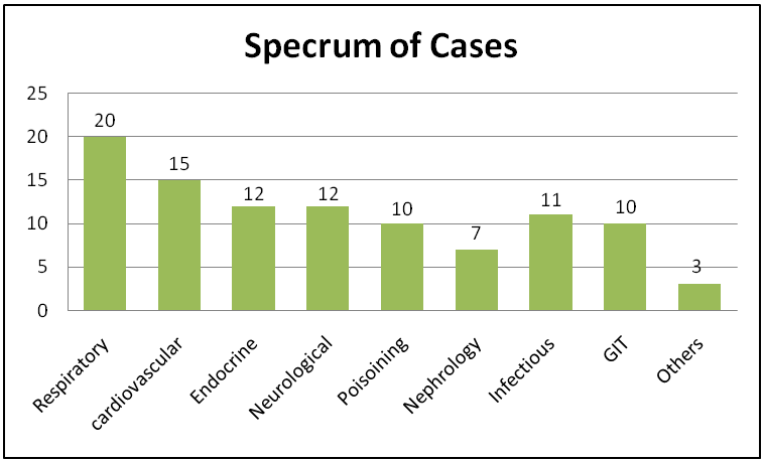


Inclusion Criteria
Patients with shock for various causes.

(Hemorrhagic, septic, anaphylactic etc.)Patients on ionotropic and vasopressor support.

Exclusion Criteria
Patients not in shock

1. Arterial Cannulation for other than haemodynamic monitoring (Frequent ABG, Angio etc)
2. Patients with gangrenous changes
3. Pediatric patients (Due to unavailability of paediatric cannula).
4. Any other contraindication for arterial Cannulation.

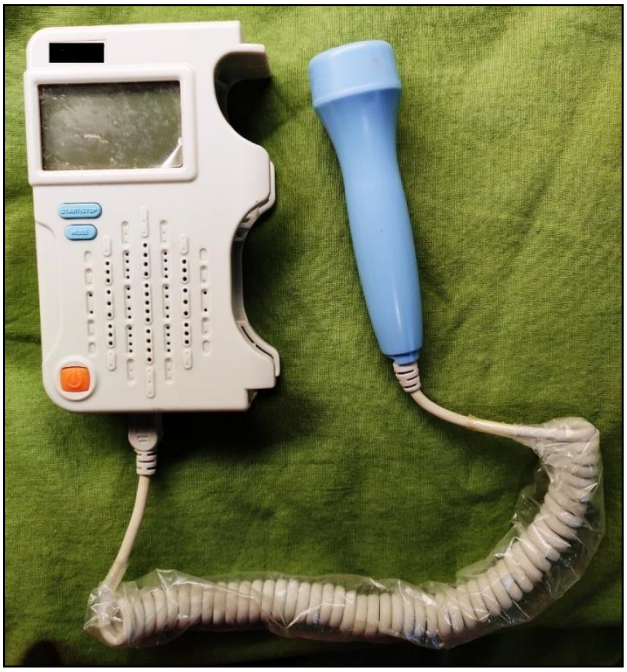
Presence of pulsatile blood gush after removing the stylet of the arterial cannula was considered as the end point of the study.

Shock was defined by evidence of hypotension or hypoperfusion requiring ionotropic or vasopressor support and continuous blood pressure monitoring. The operator was either an anaesthesiology resident or critical care resident. None of the operators had prior experience of placing the arterial cannula with the help of Doppler auscultation assistance. Before initiation of the procedure a brief demonstration of the instrument regarding its usage was given. The radial artery of non dominant hand was selected for placement of the cannula. Collateral circulation of the hand was noted. The technique of cannulation remained the same. The patient's hand was restricted for movements by adhesive tape and wedge was placed below the wrist joint. Location of the artery was done with the help of Doppler auscultatory assistance where maximum sound of Doppler flow was heard. Skin was pricked approximately 0.5 cm distal to the Doppler probe. The placement of cannula was confirmed by characteristic auditory change in the Doppler flow sound and pulsatile gush of blood in the arterial cannula after removal of stylet which was considered as the end point.

In this study we monitored for first attempt success, total number of attempts, extra cannula used when first one was damaged during the procedure, extravasations of blood under the skin, hematoma formation and help required in case of failure. Numbers of attempts were counted if the tip of the cannula removed from the skin or new prick was made. If the operator was taking more than 10 min for cannulation then help was seeked from experienced operator.

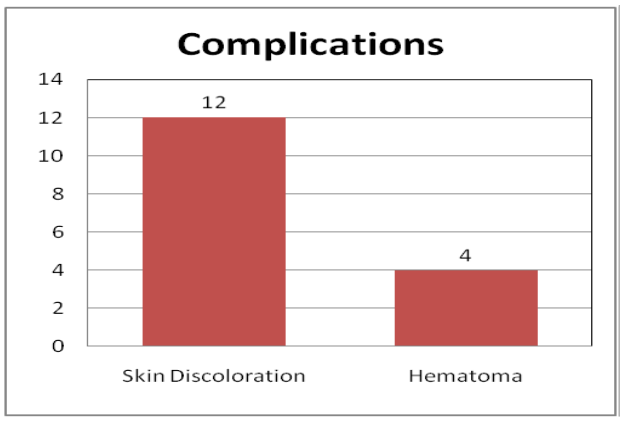
Adverse effects were monitored for 24 hours after arterial cannulation. Patients were monitored for skin discoloration, hematoma formation, thrombus and ischemic changes.

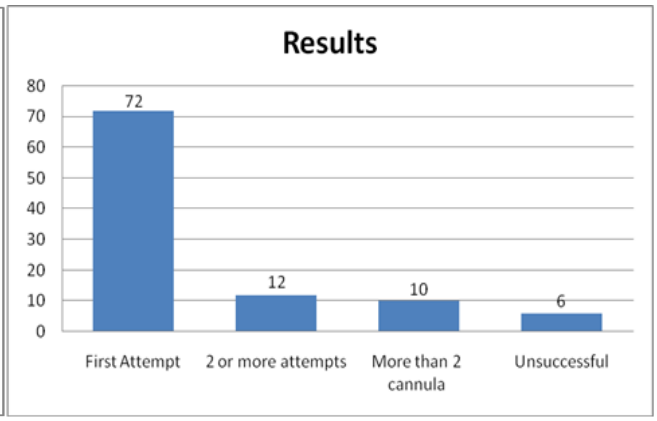
We have used Doppler transducer with 2.5 MHz ½ inch probe.



OBSERVATION AND RESULTS

Out of 100 patients, 68 were male and 32 were female with mean age of 49.51(± 16.37). In 72 patients cannula was passed in first attempt.12 patients required 2-3 attempts. In 10 patients though artery was located cannulation was unsuccessful and a different site was cannulated. These 10 patients required more than 2cannulas as they were damaged during the procedure. In 6 patients neither artery was located satisfactorily nor were we able to cannulate the artery. These patients were cannulated with USG guidance. In patients where either multiple attempts were made or there was failure to cannulate, 12 patients developed skin discoloration , 4 patients developed hematoma.





DISCUSSION

IBP is the gold standard for measurement of blood pressure and is indicated in conditions like shock, ionotropic support titration, frequent blood sampling, major surgeries and for diagnostic and interventional procedures (Seidlerová *et al*., BMC Cardiovascular Disorders.2019). However arterial cannulation in shock patients can be in challenging. Traditional way of passing arterial cannula has limitations as there may not be palpable pulse. In these conditions the operator may take multiple attempts to pass cannula, causing multiple punctures, hematoma formation and in the worst cases ischemic damages to the limb.(Weiss BM, Gattiker R.1986) (Quist J, Peterfreund RA, Perlmutter GS.1996). In a conscious patient the repeated pricking can be very painful and agonizing.

Use of ultrasound(USG) and doppler sound assistance are helpful in locating the artery in such difficult cases. Though ultrasound can help in accurate localization of artery,its use requires expertise and training(Hausmann D, Schulte am Esch J, Fischdick G.1981) (Hack WW,Vos A,OkkenA.1990). Moreover ultrasound machine is costly, bulky and difficult to shift from one place to another when a machine dedicated to the ICU is not available.In an intervention review study by Marie and comparative study by Ueda concluded that USG is better in first attempt cannulation. However

use of USG guided arterial cannulation requires sound knowledge about the machine, selection of USG probe and identification of diastolic diameter of the artery. While performing USG guided arterial cannulation operator holds the USG probe in one hand, artery cannula in the other hand and watches the screen to insert the cannula. This definitely requires lot of hand, eye orientation and co-ordination. As per the guidelines issued by ultrasound society at least 25 USG guided artery line procedures are required to make the operator competent. (Chinyanga HM, Smith JM.1979) (Morray JP, Brandford HG, Barnes LF, Oh SM, Furman EB. 1984) (K, Sese A.1988) (Fukutome T, Kojiro M, Tanigawa Aouad-Maroun.2016) (Ueda_K, Puangsuvan_S, Hove_MA, Bayman EO.2013).

Foetal heart monitoring Doppler probe can help in tracking the arteries without much expertise. In our study 72 patients could be cannulated in first attempt. This showes the utility of this technique to identify arteries in shock patients. The operators in our study were demonstrated the use of this technique and performed arterial cannulations for the first time using this method. This shows that not much training is required to use the doppler machine. In patients where multiple attempts were required and there was failure to cannulate using this technique we observed that the patients were obese, had edema of the hand or systolic blood pressure less than 60mmHg. These underlying conditions made the tracking of artery by auditory assisstance of doppler difficult. These conditions are problaly cases where doppler assisstance may not help. But as per our study in majority of the cases it was helpful and could be used without much training. The other advantages of hand held foaetal doppler machine are its easy availability, low cost compared to USG, small size making it easy to carry from one place to another.

The postive points of our study are the size of study group (100 patients) and that we also monitored the patients for complications following cannulation.

Limitation of the Study

Blinding of the study is not possible.

CONCLUSION

A simple hand held Doppler ascultatory assist device can be used to cannulate the artery in difficult case scenario where conventional palpatory method of arterial cannulations is difficult to perform. The use the Doppler probe can also help in minimizing the complications associated with the procedure. It can be used to cannulate artery where USG machines are not easily available or operator knowledge is limited.

Conflict of interest – None

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