SONOGRAPHIC EVALUATION OF INTRAVASCULAR VOLUME IN SIMULATED CLASS 1 HAEMORRHAGIC SHOCK: A COMPARISON OF SUBCLAVIAN VEIN COLLAPSIBILITY INDEX AND INFERIOR VENA CAVA COLLAPSIBILITY INDEX

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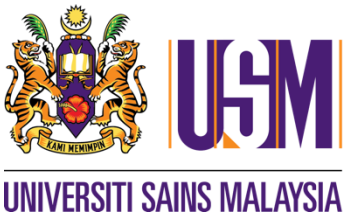
DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN MEDICINE



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LISTS OF SYMBOLS, ABBREVIATIONS OR NOMENCLATURE

BMI – Body Mass Index

CVP – Central venous pressure

GEDVI – Global End-Diastolic Volume Index

Hospital USM - Hospital Universiti Sains Malaysia.

ICU – Intensive care unit

IJV – Internal jugular vein

IVC – Inferior vena cava

IVCe – Inferior vena cava diameter on expiration

IVCi – Inferior vena cava diameter on inspiration

IVC-CI – Inferior vena cava diameter collapsibility index

MAP – Mean arterial pressure

PR – Pulse rate

PPV – Pulse pressure variation

SBP – Systolic blood pressure

SCV – Subclavian vein

SCVe – Subclavian vein diameter on expiration

SCVi – Subclavian vein diameter on inspiration

SCV-CI – Subclavian vein diameter collapsibility index

SI – Shock index

SVC – Superior vena cava

SVV – Stroke volume variation

USM – Universiti Sains Malaysia

ABSTRAK

Pengenalan

Pengesanan awal mengenai kehilangan darah memainkan peranan yang penting dalam rawatan pesakit kes trauma. Indeks keruntuhan saluran darah Subclavian (Subclavian vein collapsibility index, SCV-CI) dengan menggunakan ultrasound telah dilaporkan dapat menolong dalam mengesan jumlah cecair dalam saluran darah badan pesakit di unit rawatan rapi. Objektif penyelidikan ini adalah untuk mengenal pasti sekiranya SCV-CI dapat digunakan sebagai salah satu cara untuk mengenal pasti tahap awal kehilangan darah dalam kes trauma, beserta dengan indeks keruntuhan Inferior Vena Cava (IVC-CI).

Kaedah Kajian

Kajian prospektif ini telah dijalankan pada Mac 2019 hingga Mac 2020. Seramai 117 orang penderma darah telah mengambil bahagian dalam penyelidikan tersebutdan ukuran saiz saluran darah Subclavian (SCV) serta Inferior Vena Cava (IVC) telah direkodkan. Pengambilan ciri-ciri denyutan jantung, tekanan darah serta demographic penderma darah telah dicatatkan sebelum dan selepas proses menderma darah.

Keputusan

Data daripada seramai 116 orang penderma darah telah dianalisa dan didapati bahawa terdapat perbezaan min yang signifikan untuk diameter saluran darah Subclavian semasa menarik nafas (SCVi), SCV-CI, diameter inferior vena cava semasa menarik nafas (IVCi) serta IVC-CI untuk sebelum dan selepas pendermaan darah. Tiada perbezaan min yang signifikan untuk diameter saluran darah Subclavian semasa hembusan nafas (SCVe), diameter inferior vena cava semasa hembusan nafas (IVCe), denyutan nadi (PR), tekanan darah sistolik (SBP), tekanan darah min arteri (MAP),

dengan Shock Index (SI). Untuk SCV-CI dengan IVC-CI selepas pendermaan darah, didapati bahawa keputusan dua index ini ada korelasi positif yang signifikan, dengan kekuatan yang lemah ($r<0.29$). Tiada korelasi yang signifikan untuk keputusan yang lain.

Kesimpulan

Ukuran SCV-CI menggunakan ultrasound mungkin boleh membantu dalam pengesanan awal dalam kes trauma yang kehilangan darah sekurang-kurangnya 480cc. Tetapi lebih banyak kajian yang lebih besar perlu dijalankan untuk mengenal pasti keputusan tersebut.

Kata Kekunci

Sistem Kardiovaskular ; Ultrasound; Haemorrhage; Trauma

ABSTRACT

Introduction

Early detection of haemorrhagic shock can be helpful in management of trauma cases. Subclavian vein collapsibility index (SCV-CI) has been reported to be helpful in determining intravascular volume status in intensive care units. The objective of this study is to determine if SCV-CI can be used as a possible adjunct to Inferior Vena Cava Collapsibility Index (IVC-CI) in detecting early stages of haemorrhagic shock.

Methods

This is a prospective study which was carried out from March 2019 until March 2020. A total of 117 blood donors were recruited and ultrasonography readings of the SCV and IVC diameter before and after blood donation were recorded, along with the clinical vital signs.

Results

116 patient's data were analysed. There was significant mean difference between SCVi, SCV-CI, IVCi and IVC-CI when compared between pre and post blood donation results. There was no statistically significant difference for mean IVCe, SCVe, pulse rate, SBP, MAP and SI. There was significant positive correlation between SCV-CI and IVC-CI for the post test result, with weak strength ($r<0.29$). There was no significant correlation between SCV-CI and the clinical indices (i.e. PR, SBP, MAP and SI) pre and post blood donation.

Conclusion

Ultrasonographic measurement of SCV-CI may be a useful non-invasive tool in early detection of blood loss of at least 480cc in adult patients, however larger studies are required to validate the result.

Keywords

Cardiovascular system; Ultrasound; Haemorrhage; Trauma.

CHAPTER 1.0 INTRODUCTION

Trauma-associated haemorrhagic shock is one of the leading causes of mortality globally, which place a significant burden on the healthcare system worldwide [1]. It is known to be remarkably challenging in determining the amount of blood loss in the acute setting, especially in the early stages of haemorrhagic shock[2,3]. Haemodynamic vital signs, especially blood pressure and heart rates, are known to be unreliable indicator of blood loss in the early stages[4]. Laboratory parameters such as high urea level, haemoconcentration and metabolic acidosis are also neither sensitive nor specific[5] in the detection of early stages of blood loss. Invasively placed devices such as central venous or pulmonary catheters are also used in the assessment of intravascular volume. However there are multiple potential disadvantages to these monitoring options including infection, thrombosis, data interpretation error and iatrogenic injury[6].

Ultrasonography has been widely used in adult emergency medicine clinical practice as a rapid and objective way of assessing intravascular volume[7]. Studies have shown that calculation of the inferior vena cava collapsibility index (IVC-CI) appears to be a reliable indicator of both intravascular volume and clinical response to fluid resuscitation[8,9]. However IVC-CI is not without its own set of disadvantages[10].

Studies in ICU settings have shown that superior vena cava (SVC) diameter variation detected by transoesophageal echography can serve as an accurate index of fluid responsiveness[11], however this procedure is not readily accessible in most emergency departments and transthoracic ultrasound is unable to display the main intrathoracic vein. However, the subclavian vein (SCV), which is just adjacent to the pleura and upstream of the SCV, can be easily visualised with a linear probe [6,10,12]. Hence this makes the SCV of particular interest for the assessment of intrathoracic volume status.

In this study, we set out to prospectively examine the SCV collapsibility index (SCV-CI) as a potential adjunct to IVC-CI.

CHAPTER 2.0 STUDY PROTOCOL

2.1 INTRODUCTION

Trauma is one of the leading causes of mortality and morbidity in Malaysia[13], with the main attributor would be haemorrhagic shock. It is known to be extremely challenging in determining the amount of blood loss in acute settings, as there is no available tool to assess the ongoing blood loss[9]. Vital signs, especially blood pressure and heart rates are known to be unreliable indicator of blood loss in the early stages[4]. Laboratory parameters including high urea level, haemoconcentration level and metabolic acidosis are neither sensitive nor specific[5].

Traditional paradigm of intravascular volume assessment relies on invasive devices placed with central venous accesses. There are multiple disadvantages to these monitoring used, for example infection, data interpretation error, thrombosis and iatrogenic injury[6]. More recently, a number of less invasive techniques have been introduced, but they lack standardisation and reliability[14].

Ultrasonography has been used in adult population as a tool for assessing intravascular status in a rapid, objective way and has become an integral part of adult emergency medicine in clinical practice[7]. Studies have shown that the measurements of IVC diameter and calculations of the IVC-CI appear to be a reliable indicator of both intravascular volume status and clinical response to fluid resuscitation[8,9]. However, the IVC CI is not without its own set of disadvantages[10].

Vieilard Baron et al. have shown that SCV diameter variations detected by transoesophageal echocardiography can serve as an accurate index of fluid responsiveness[11]. Transthoracic ultrasound is not able to display the main intrathoracic vein; however, the SCV can be visualised in most ICU patients using a linear probe.

Due to its accessibility and ease of utilisation, this approach may be of interest to physicians using ultrasound in the ICU for the placement of catheters or for echocardiography[6,10,12]. Interestingly, the intrathoracic location of the SCV, adjacent to the pleura and upstream of SVC, makes it of particular interest for the assessment of intrathoracic volume status in mechanically ventilated patients.

In this study, we set out to prospectively examine the SCV-CI as a potential adjunct to IVC-CI.

2.2 PROBLEM STATEMENT

It is known that sonographic measurement of central veins (i.e. inferior vena cava) is helpful in determining the fluid status and fluid responsiveness in patients[15].

However, its uses can be limited as visualisation of the inferior vena cava can be impaired by patient factors commonly encountered including abdominal distention, bowel gas overlying the vena cava, tissue oedema, complex abdominal sounds, and morbid obesity. In addition, the required sonography skills and natural variation in IVC positioning during respiration combine to limit more widespread use of IVC-CI as an effective non-invasive means of intravascular volume status assessment[10].

There is a paucity of literature examining the usage of other central vein in determining fluid status and responsiveness, especially in early stages of haemorrhagic shock.

2.3 STUDY JUSTIFICATION AND BENEFIT OF THIS STUDY

This study is conducted to show the use of bedside ultrasound in detecting early phase of hypovolaemia by measuring the diameter and variability of SCV and also comparing it to the variability of IVC diameter.

There is limited literature on the SCV, as compared to IVC which is currently widely practiced in emergency departments and intensive care unit internationally. There is also other more "peripheral" central vein being studied, however the SCV is relatively protected by the overlying tissue from unintended external compression, as compared to femoral vein or IJV, hence giving a more reliable reading less affected by the compression from the operator.

SCV measurement may be of clinical utility in commonly encountered scenarios where IVC sonography is impractical (i.e. patients presenting with complex abdominal wound, patients with obesity, significant body wall oedema), giving clinicians an alternative adjunct in assessing patient's intravascular volume status.

2.4 RESEARCH QUESTION(S)

1. Can the collapsibility index of SCV detect a reduction in blood volume in adult blood donor?
2. Would the collapsibility index of SCV be able to correlate with the collapsibility index of IVC?
3. Can the collapsibility index of SCV correlate with clinical indices such as PR, MAP, SBP, and SI?

2.5 OBJECTIVE

2.5.1 GENERAL OBJECTIVE

1. To study SCV diameter changes in simulated class 1 haemorrhagic shock volunteer.

2.5.2 SPECIFIC OBJECTIVE

1. To compare the mean of the collapsibility index of the SCV diameter pre and post blood loss.
2. To determine the correlation between the collapsibility index of the SCV to the collapsibility index of the IVC in simulated class I haemorrhagic shock volunteer.
3. To correlate the collapsibility index of SCV with clinical indices, i.e. PR, MAP, SBP and SI.

2.6 LITERATURE REVIEW

An initial study in 2013 compared SCV collapsibility index and IVC collapsibility index in 34 patients in surgical intensive unit, out of which 22 were mechanically ventilated. It was also noted that the mean time to acquisition of venous measurement was shorter for the SCV mean measurement[10]. This study initiates the suggestion which SCV collapsibility could be a feasible adjunct to IVC collapsibility in intravascular volume status assessment.

In 2015, a study in Japan compared the collapsibility of the IJV, SCV and IVC as predictor of fluid responsiveness for 29 patients on non-invasive ventilation[16]. The response was determined by using the calculation of stroke volume by the Vigileo

monitor. It was found that SCV is a moderate predictor for fluid responsiveness in such patient's group.

In the same year, another study in China by Zhu et al compared the measurements of SCV diameter to CVP in the assessment of intravascular volume in patients undergoing gastrointestinal surgery[6]. The specification of the surgery was not mentioned. 40 patients and 40 healthy volunteers underwent SCV sonography measurements, this study reveals that the SCV diameter is persistently lower in patients who are undergoing the surgery, and subsequently following fluid resuscitation, the SCV diameter for both inspiratory and expiratory phase have increased significantly. The diameter readings for the SCV pre and post fluid resuscitation also correlates with the CVP. This study suggests that the sonographic measurement of SCV could be an addition to the ultrasonographic evaluation of hypovolaemia.

Recently, a study looked at the respiratory ventilation in SCV diameter correlating with fluid responsiveness in mechanically ventilated patients, as compared to the PiCCO which measure the cardiac output[12]. This study suggests that evaluation for SCV parameter in the ICU are reliable indicators to assess fluid responsiveness in sedated and mechanically ventilated critically ill patients.

However, the literatures were not able to demonstrate the practicality of the sonographic measurements of the SCV on patients with blood loss, for example in trauma patients, especially in the early stages of haemorrhagic shock.

Haemorrhagic shock can be classified into 4 classes, with the earliest class being class 1, which is defined as blood loss of less than 750 ml or 15% of total blood volume. This type of patient would be the most challenging to diagnose as their clinical parameters would still be normal despite loss of blood. For our study, blood donors will be

recruited as simulated class 1 haemorrhagic shock patient as the usual amount of blood donated is around 400-500ml, which fits into the criteria of class 1 haemorrhagic shock.

2.7 METHODOLOGY

2.7.1 STUDY DESIGN

This is a prospective cross-sectional study of 1-year period from March 2019 until March 2020.

2.7.2 STUDY AREA

Blood bank Hospital Universiti Sains Malaysia.

2.7.3 STUDY POPULATION

All the whole blood donor who come for blood donation at blood bank Hospital Universiti Sains Malaysia.

2.7.4 SUBJECT CRITERIA

Inclusion

- Criteria met as a blood donor.
- Participant consented for ultrasonography.
- Age 18-55 years old.
- Healthy with no previous medical illness.
- Weight > 45kg.

Exclusion

- Patient requiring hydration immediately during or post donation.
- Previous surgery/delivery/received blood transfusion within 6 months.

2.7.5 SAMPLE SIZE ESTIMATION

1. For 1st objective:

   No sample size derived

2. For 2nd objective:

   We are planning a study of subjects in which we will regress their values of yvar against xvar. Prior data indicate that the standard deviation of xvar is 0.3 and the standard deviation of regression error will be 0.5. If the true slope of the line obtained by regressing yvar against xvar is 0.61, we will need to study 61 subjects to be able to reject the null hypothesis that this slop equals zero with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05.

   Sample size = 61

   Drop out 10% = 6

   Total sample = 61 + 6 = 67

   (Using result from Kent et al, 2013[10])

3. For 3rd objective:

- For PR:
    - Statistical test: Correlation, Bivariate normal model
    - Type of analysis: A Priori Power analysis
    - Parameters: Correlation parameter: 0.543, α error prob: 0.05, Power 0.8
    - Sample size = 69
    - Drop out 10% = 7
    - Total Sample: 69 + 7 =76
- For MAP:
    - Statistical test: Correlation, Bivariate normal model

- Type of analysis: A Priori Power analysis
- Parameter: Correlation parameter: -0.269, α error prob: 0.05, Power 0.8
- Sample size = 106
- Drop out 10% = 11
- Total sample = 106 + 11 = 117

  (Both using result from Zhu et al, 2015[6])

- For SBP and SI, no sample size is derived as no previous study was done on these two parameters correlating with SCV.

2.7.6 SAMPLING METHOD AND SUBJECT RECRUITMENT

Sampling method would be of convenient sampling as all blood donor who fulfil the inclusion criteria and consented will be included in this study.

The sonographer performing data collection is female, hence a male chaperone from the blood bank unit staff will be present during the process of ultrasound image acquisition for data collection for a male subject.

A female chaperone can also be requested to be present from the blood bank unit staff if required by the female subject.

2.7.7 VULNERABILITY OF THE SUBJECT/PARTICIPANT

The subject will first have to be a voluntary blood donor before he/she is recruited as a study subject. In no instance that the subject will be recruited before they decided voluntarily that they will be undergoing blood donation.

By agreeing to be a blood donor, the patient's blood will only then be drawn as per the blood bank unit blood donation protocol.

The amount of blood donated will be according to their weight as per the blood bank unit blood donation protocol.

A class 1 haemorrhagic shock is defined as less than 750ml (for a 70 kg man) or less than 15% of the blood loss, which is consistent with the amount of blood drawn from a blood donor at one time.

The study will not be influencing the decision on the amount of blood drawn for a simulated class I haemorrhagic shock

Should any complication arise during the procedure, the sonographer, who is also an Emergency Medicine Master Student, will be attending the subject accordingly. Should the need arise, the subject will also be sent to the Emergency Department in Hospital Universiti Sains Malaysia for resuscitation and stabilisation.

2.7.8 OPERATIONAL DEFINITION

1. SCV diameter on expiration (SCVe):

   The intraluminal diameter of SCV visualised on M-mode assessment during expiration.

2. SCV diameter on inspiration (SCVi):

   The intraluminal diameter of SCV visualised on M-mode assessment during inspiration.

3. SCV diameter collapsibility index (SCV-CI):

   SCV-CI = [(SCVe-SCVi)/SCVe] x 100%

4. IVC diameter on expiration (IVCe):

   The intraluminal diameter of IVC visualised on M-mode assessment during expiration.

5. IVC diameter on inspiration (IVCi):

   The intraluminal diameter of IVC visualised on M-mode assessment during inspiration.

6. IVC diameter collapsibility index (IVC-CI):

   IVC-CI = [(IVCe-IVCi)/IVCe] x 100%

7. Mean arterial pressure (MAP) (mmHg)

   MAP = 1/3 Systolic blood pressure (SBP) (mmHg) + 2/3 Diastolic blood pressure (DBP) (mmHg)

8. Shock Index (SI):

   SI = Pulse Rate (PR) (beat per minute)/ SBP (mmHg)

2.7.9 RESEARCH TOOL

1. Automated Dinamap machine:

   Blood pressure, pulse rate and pulse oximetry oxygen saturation of the subjects will be recorded using a Dinamap Machine.

2. Weighing scale with height measurement:

   The height and body weight will be measured using the weighing scale with height measurement which is available in the blood bank unit of Hospital Universiti Sains Malaysia.

3. Ultrasound machine:

   The SCV diameter will be measured using a Mindray Z5 ultrasound machine.

2.7.10 RESEARCH METHODS

A prospective study will be conducted on normal healthy blood donors who attend the blood bank in the university hospital for whole blood donation.

The blood donor will be identified by a staff in the blood bank unit and all necessary tests prior to whole blood donation will be done as per blood bank criteria. Once the eligibility of the donor for blood donation is confirmed, the donors are included into the study and written consents are then obtained. Inclusion criteria are similar to the blood donors in the university hospital which includes adult donor age 18 to 55 years old, weighing more than 45 kg, no known medical illness, able to understand and to give informed consent. Exclusion criteria for the study includes patients requiring rehydration immediately during or post blood donation, previous surgery or delivery within 6 months, a recipient of blood transfusion within the past 6 months, pregnancy, breast feeding or donor with high risk behaviour such as having multiple sex partners, sharing needles or sex workers.

A single researcher who is familiar with ultrasound will be performing each ultrasound examination. The researcher would be trained in the principle of ultrasound, with hands on demonstration and measurement validation by the Director of Emergency Ultrasound Unit in the Emergency Department, Hospital Universiti Sains Malaysia. The results will then be correlated using Spearman's rank correlation coefficient for the validation of the researcher's result. Subsequently, the researcher will be performing ultrasound measurement of the SCV and IVC on the blood donor who consented in participating in this study.

The ultrasound measurement is carried out once the donor is supine on the blood donation bed. The right SCV diameter will then be checked using a high frequency

linear array probe and the M-mode. The probe will then be placed beneath the proximal part of the middle part of the clavicle perpendicular to the long axis of SCV, to obtain the best cross-sectional view of the SCV. After the target vein is localised, the diameter change will be recorded over time using the M-mode to identify and measure the minimum and maximum venous dimensions over the respiratory cycle.

For the IVC measurement, a curvilinear probe with a bandwidth of 5-2MHz with B-mode scan will be placed longitudinally over the subxiphoid area and adjusted until the junction where the IVC meets the right atrium inlet. The IVC diameter is measured 2cm from the junction of the right atrium inlet. Once the area is localised, the diameter change will be recorded over time using the M0mode to identify and measure the minimum and maximum venous dimension over the respiratory cycle.

The SCV diameter will be measured using the linear probe at the band width of 12-4MHZ. The same mode of ultrasound will be used for training, hands on demonstration and validation by the researcher and a sonographer. No technical adjustment was done to the ultrasound machine and the patient's position to get the pre-donation and post-donation SCV and IVC measurements, in attempt to exclude the confounding factors.

The measurements will be taking before the blood donation and repeated just after the blood donation. It will take approximately a total of 15 minutes to complete the whole ultrasound procedure for pre-blood donation and post-blood donation.

To avoid variability of the result from operator experience, all sonographic measurements will be done by the same operator.

2.7.11 OUTCOMES

Normal SCV diameter and IVC diameter for normal Kelantan population. Difference in SCV collapsibility post blood donation.

2.8 DATA COLLECTION METHOD

2.8.1 DATA ENTRY

Data to be complied and analysed using SPSS Statistics 24 which is licensed to the School of Medical Science, Universiti Sains Malaysia.

2.8.2 VARIABLES

Demographic, pulse rate, blood pressure, mean arterial pressure, SpO2 monitoring, height, weight, amount of blood donated, SCV diameter pre and post blood donation, IVC diameter pre and post blood donation.

2.8.3 STATISTICAL ANALYSIS

The aim of this study is to evaluate the changes in SCV-CI in blood donors in correlation with the mild hypovolaemia or hypovolaemic chock class 1. Paired T-test will be used for the expected outcome. Correlations of the SCV-CI to PR, MAP, SBP, SI and IVC-CI will be done using Pearson's correlation (depending on the scatterplot of the data).

2.8.4 DUMMY TABLES

Variables	Mean (SD)	N (%)
Gender:		
Male		
Female		
Age (years)		
Weight(kg)		
Height (m)		
BMI (kg/m^2)		
Pulse rate (bpm)		
Blood pressure (mmHg)		
Spo2 (%)		

Table 1: Gender, age, weight, height, BMI distribution, and vital sign (mean).

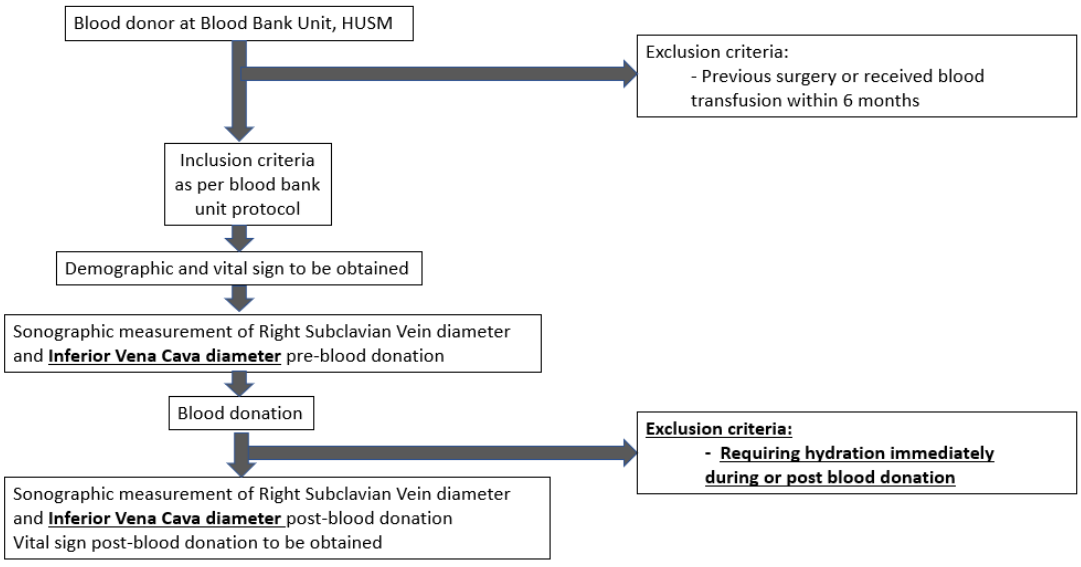
Variables	Pre-Mean (SD)	Post-Mean (SD)	Mean difference (SD) (95% CI)	t-statistic (df)	P value
SCVi					
SCVe					
SCV-CI					
IVCe					
IVCi					
IVC-CI					
PR					
SBP					
MAP					
SI					

Table 2: Comparison for Pre and Post Mean of SCVi, SCVe, SCV-CI, IVCi, IVCe, IVC-CI, PR, SBP, MAP and SI.

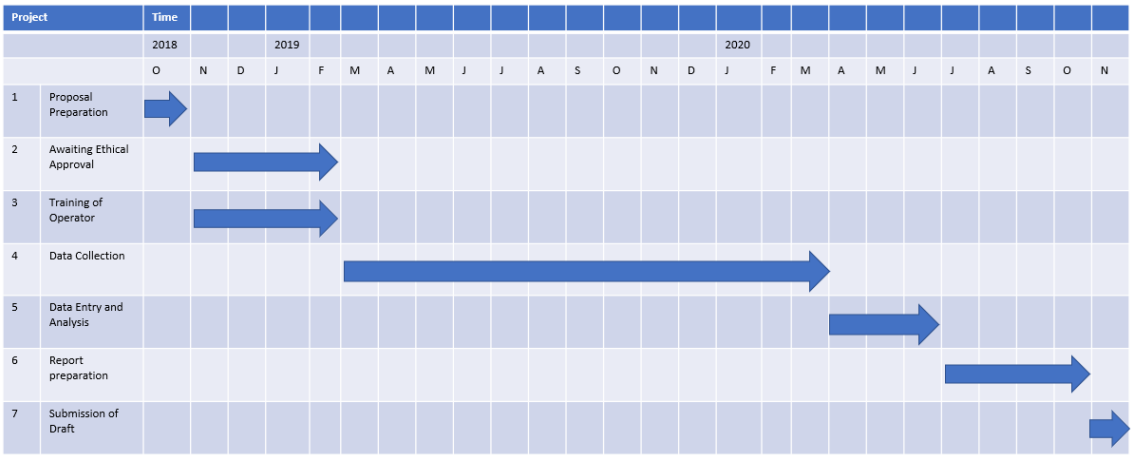
Variable	R	P
SCV-CI and IVC-CI		
SCV-CI and PR		
SCV-CI and SBP		
SCV-CI and MAP		
SCV-CI and SI		
IVC-CI and PR		
IVC-CI and SBP		
IVC-CI and MAP		
IVC-CI and SI		

Table 3: Correlation of SCV-CI, IVC-CI, PR, MAP, SBP and SI using Pearson's correlation.

2.9 STUDY FLOW CHART



2.10 GANTT CHART & MILESTONE



No	Milestones	Date	Semester
1.	Draft research proposal to supervisor	July 2018	
2.	Present research proposal to department	August 2018	Semester 1 2018/2019
3.	Submit proposal to ethics committee	October 2018	
4.	Anticipated date for ethics approval	Feb 2019	
5	Training of Operator	Feb 2019	Semester 2 2018/2019
5.	Data collection commencement	March 2019	
6.	Data collection complete	March 2020	

7.	Data entry & analysis commencement	April 2020	Semester 2 2019/2020
8.	Data entry & analysis complete	June 2020	
9.	Review findings with supervisor	July 2020	
10.	Dissertation report write up	August 2020	Semester 1 2020/2021
11.	Review draft final report with supervisor & corrections	October 2020	
12.	Submit final report	November 2020	

2.11 ETHICS OF STUDY

The quality and integrity of the research will be ensured. Informed consent will be obtained. The study will be conducted in compliance with ethical principles outlined in the Declaration of Helsinki and Malaysian Good Clinical Practice Guideline. Approval to conduct the study will be obtained from the institutional ethic committee; Human Research Ethics Committee USM (HREC/ JePEM) and the hospital management. The participants will take part voluntarily. Any harm towards the participants will be avoided.

This study will benefit the community by being able to determine if ACV is a reliable tool in detecting early blood loss, especially in trauma patients, hence enabling early initiation of suitable resuscitation, improving morbidity and mortality in trauma cases.

A token of appreciation will be given to all responders.

2.12 PRIVACY AND CONFIDENTIALITY

All forms are anonymous and will be entered into the SPSS software. Only the research team members can access the data. The data will be presented as a grouped data and will not identify the responders individually. The confidentiality and anonymity of the research respondents will be respected.

2.13 CONFLICT OF INTEREST

The investigators declared that they have no conflict of interest.

2.14 PUBLICATION POLICY

No personal information will be disclosed and subjects will not be identified when the findings of the study is published.

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