Novelty Journals

ISSN 2394-7330

International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (82-95), Month: September - December 2020, Available at: www.noveltyjournals.com

Peripheral versus Central Venous Catheter Complications and Pressure among Critically Ill Patients

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Abstract: **In critically ill patients, venous pressure can be monitoring by inserting a central venous catheter and peripheral venous catheter. Venous pressure monitoring from a central venous catheter is called central venous pressure, obtained from peripheral venous pressure. So, a peripheral venous catheter can be used as a quickly invasive technique to minimize many complications arising from applying the central venous catheters. The aim of this review was describing all published reports of peripheral and central venous catheters regarding venous pressure and complications. Data source: A systematic search of Medline, Science Direct, CINHAL, PubMed, Medscape, and Ovid. Grey literature also searched as Google Scholar and Cochrane databases was performed from inception through January 2013 for reports of adults who received peripheral and central venous catheters regarding venous pressure and complications. We included primary studies or case reports of many literature emphasized on simplicity of peripheral venous pressure, and as an alternative to central venous pressure among critically ill patients. Results: There were three hundred and three articles with 11,332 patients that met all inclusion criteria. We eliminated 20 articles due to duplication either within the same database or across databases. The abstract was screened for the relevancy of the search and 78 were excluded. The articles were narrowed to 22 when assessing full-text articles for eligibility. We included in our search published and non-published articles only quantitative methods are screens. Conclusion: Published data on peripheral venous catheter and central venous catheter are very important among critically ill patients, both catheters are used in intensive care units to monitor fluids and therapy; central venous pressure is measured employing central venous catheters. Further study is warranted to clarify the safety of using peripheral venous catheter as alternative to central venous catheter.**

Keywords: **Central Venous Catheter, Peripheral Venous Catheter, Venous pressure, Venous Catheter complications, Critically ill patients.**

1. INTRODUCTION

The current literatures review provides an overview of the sources that the researchers presented while examining a topic.[1,2] It describes what knowledge and ideas have been discussed on a topic. [3,4] Literature review provides clear understanding about identifying the problem, gathering data of related concept, referring to the appropriate intervention to be applied, making comparison, minimizing limitation and challenges. In this chapter, the researcher covers different aspects include, central venous catheter, peripheral venous catheter and Boolean, other key words including venous pressure, complications, and critically ill patients.

ISSN 2394-7330

International Journal of Novel Research in Healthcare and Nursing
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2. SEARCH STRATEGY

This review is based on relevant publications from journals, articles, and books; published from 2013 to 2019. The review used seventh different databases (CINHAL, PubMed, Google Scholar, ProQuest, Cochrane Library, Science Direct and Medline) to find all relevant studies. The key terms used were central venous catheter, peripheral venous catheter, venous pressure, complications, and critically ill patients.

3. RESULTS OF THE SEARCH

The total number of the identified studies was 303 articles. The electronic search strategy yielded citations and two additional records were identified through the WHO and International Association for the Study of Pain (IASP). A total of 76 records were screened after removal of duplicates, of which 54 full text articles were further excluded comprised of review studies, qualitative studies, mixed methods, reports with no outcomes or methodology, articles which are neither a research study nor the target age group of less than 18 years old. A total of 22 studies were identified as potentially relevant. Fig.1. illustrates the PRISMA flow diagram to show the selection process of the included studies. [5]

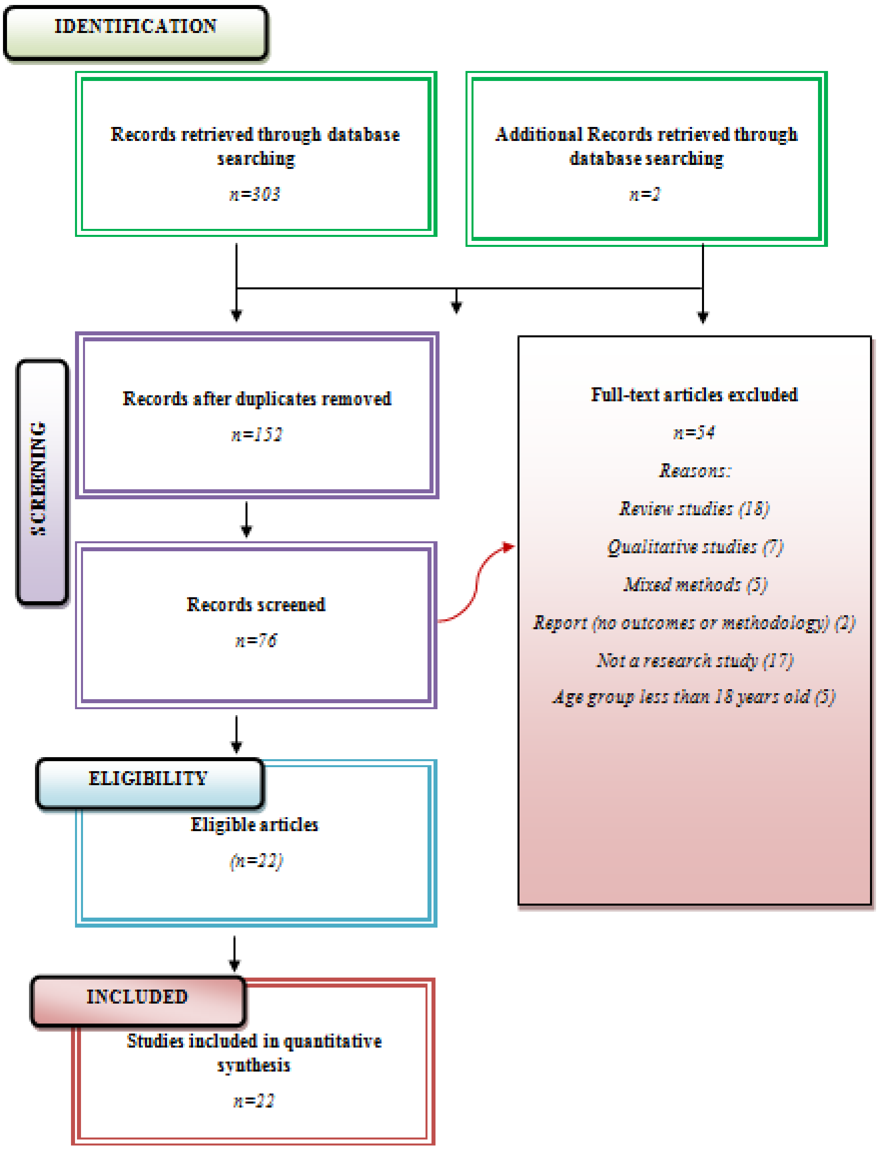

Fig. 1: PRISMA of the Study

ISSN 2394-7330
International Journal of Novel Research in Healthcare and Nursing
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3.1. Critically ill patient:

Critically ill patients with often life-threatening complications were admitted to intensive care unit (ICU) to facilitate advanced medical and nursing care. The physiological and thermodynamic conditions of critically ill patients in ICU necessitates prompt decisions of intensivist for early support. [6,7]

Critically ill patients in ICU are often manifested by hemodynamic instability. Patients should be closely monitored for hypovolemic conditions, cardiac dysfunction, variations in vasomotor function, and failure of any organ function. [8]

Treatment of underlying disease depends on the prevention of physiological deterioration through the use of advanced monitoring techniques. In spite of advancement in monitoring techniques, the screening and diagnosis of critically ill patients, requirement for ventilation and other ICU supports still pose a considerable challenge. [9]

The requirements for invasive procedures largely depend on the severity of the complications of critically ill patients. It has been well documented that critically ill patients were managed successfully through invasive procedures like central and peripheral venous catheter. [10,11]

Central venous line is one of the time-tested invasive approach for management of critically ill patients in ICU. [12] Moreover, monitoring of Central venous pressure (CVP) through the CVC has been an integral part of measurement in assessing preload. [6] Although CVC is an established procedure, it has certain limitations, as initiation, insertion and placement of line and monitoring of pressure is cumbersome. However, simpler, and minimally invasive procedures have been designed to assess the fluid volume status in critically ill patients. [6]

Peripheral venous catheterization (PVC) is the other viable alternative for monitoring peripheral venous pressure (PVP). This method has been reported to be more prudent and suitable with easy accessibility. This alternative, minimally invasive and cost-effective procedure is especially appealing. Owing to its reliability, PVP recording can be successfully employed to ascertain patient’s fluid status in hospital settings which lacks advanced monitoring system. [6,13,14]

3.2. Peripheral venous catheter

There are many patients requiring hospitals health care to receive intravenous therapy as fluids, blood transfusions, nutrition, and other drugs like contrast media through PVC. PVC is the most used catheter because it provides access to the vascular system in a faster, less invasive, and less complex way. Establishment of peripheral line or peripheral IV cannulation, involves insertion of a thin plastic tube into a peripheral vein of critically ill patients. The devices are also known as venous lines, peripheral IV, cannulas, or catheters. [15,16,17,18,19]

It is the most widely used procedure globally for intravenous access, with an estimated I billion lines used in hospital in-patients annually. It is usually inserted into the lower part of the arm, hand and occasionally the lower limbs of patients. [19,20]

Peripheral cannula defined as one that its length is less than or equal to 3 inches (7.5cm), it selected for short term therapy of 3–5 days and for or short infusions in the outpatient/day unit setting and it is commonly inserted peripheral catheters in which approximately 1.8 billion used globally in a single year. and 25 million in Australia. [21,22]

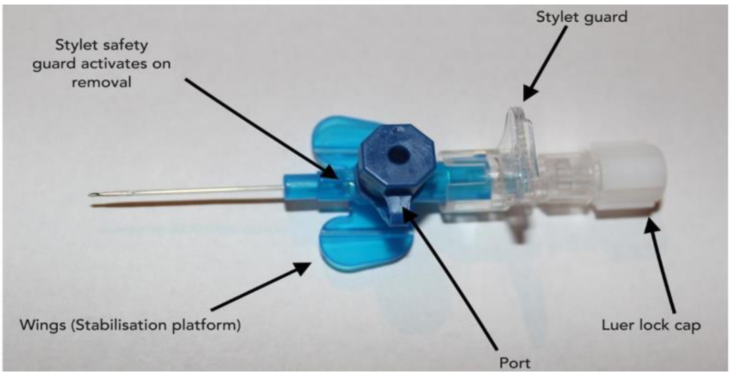

Figure 2: Open ported safety cannula. [23]

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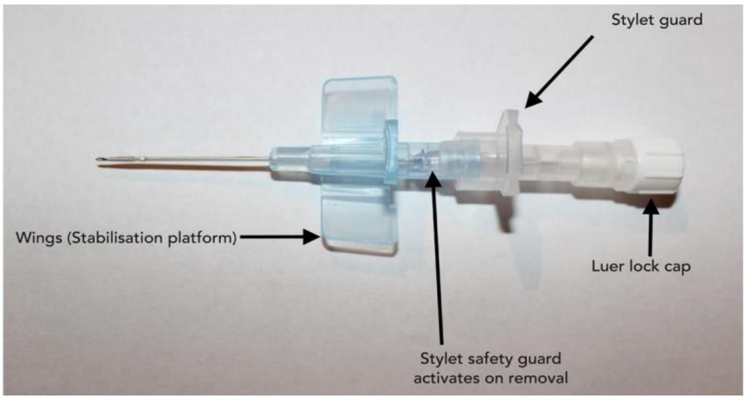

Figure 3: Open non-ported safety cannula. [23]

Needle is inserted across the skin and into the vein maintaining an angle of less than 45 degree. Needle insertion is advanced slowly till the appearance of blood flow into the anterior cannula chamber. If blood flow is not observed, it is likely that needle bevel is not inserted into the vein. In such situation line may be flattened and inserted further by 1 to 2 mm until the appearance of flash of blood in the catheter, followed by releasing of tourniquet. The IV set is then screwed, and cannula is secured to the skin with proper dressing. The flow through the administration set should be confirmed using a saline flush or IV fluids. The insertion site should be properly screened for any swelling or edema.[19]

In some critical cases when peripheral access becomes difficult or attempt for peripheral line placement have failed, an ultrasound-guided technique may be necessary. Previous studies reported that PVC is used widely among patients but for short period via insertion in the veins of the hand or arm. The upper extremities are the preferred insertion site for PVC's due to minimal risk of dislodgement and thrombosis. [19, 24]

Catheter insertion in areas of flexion should be avoided, except in an emergency. Albeit PVC may be inserted in any accessible vein, upper extremity veins are usually preferred for patient comfort and minimal contamination risk. Forearm, hand dorsum and wrist are the most preferred sites of PVC insertion with minimal risk of phlebitis, while antecubital fossa is the least preferred site, and especially in elderly patients. [19,25,26] The selection of insertion sites for peripheral venous access, requirement for single or multiple venous punctures largely depends on the patient characteristics and technical skill of the nurses. In most cases, in the absence of suitable alternatives, lower limbs are selected for peripheral venous puncture. [27]

Venous access may often become difficult in some patients such as children, obese, elderly, pregnant women, dark-sinned patients, and patients undergoing chemotherapy. [24, 28] Identification for PVC site also becomes difficult in patients with local infection, burns, compromised skin, past or potential mastectomy, and presence of arteriovenous fistula or venous thrombosis in the limbs. [19]

Selection of PVC size in adults remains controversial in most of the earlier studies. , Insertion of large-bore catheters (18 gauge) were connected to higher risk of thrombosis, and smaller-bore catheters (22 gauge or lower) were associated with higher rates of dislodgment and occlusion/infiltration. Based on clinical results catheter size of 20 gauge is usually recommended for adults. [15]

Peripheral cannula was specifically designed with flexible tube for safe insertion into a blood vessel. They are fitted with a proximal connector to permit infusion of liquids or injectables. There are varied cannula sizes ranging from 14g to 24g, with different colors for each size. For example, 14-16g are used for administration of fluids in critical patients with hemorrhage, 18-20g are used for radio-opaque contrast medium, and 22g is used for administration of intermittent medicines.[29]

Although peripheral venous catheters causes' higher morbidity, the risk for PVC related infections are extremely rare. The higher morbidity rate might be due to its frequent use for vascular access.[30] Another challenge is the selection of preferred veins. Straight, distal, and non-branched veins are usually preferred. After engorgement with tourniquet the vein should be spongy and non-pulsatile. Hard veins indicate thrombosed conditions and pulsatile flow is an indicator of artery.[19]

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In UK, the most common type of peripheral cannula in use are open cannula. [31] The needle or stylet tip is outside the cannula end facilitating easy penetration of the vein. However, the chances of blood leakage are more in an open cannula as there is no blood-control mechanism. Therefore, in an open cannula vein occlusion is required during insertion to minimize the risk of blood spillage during cannulation. [31]

Open ported (Figure 2) and open non-ported safety cannula (Figure 3), as well as winged and non-winged cannula are available. Wings are fitted as stabilization platforms preventing the to and fro movement in the vein after securing the device.[23] The wings thereby reduce the complications of phlebitis, infiltration, and blood leakage. The port of the device permits administration of intravenous drugs without any interruption in the infusion. [31]

Ported cannula is widely used in northern Europe but has some limitations. [31] For instance, administration of intravenous medication is difficult as milliliter indicator on the syringe is difficult to visualize, and turbulent flush cannot be achieved.

The use of intravascular catheters is often associated with risk of infection, which may be attributed to duration of cannulation, site of insertion, skin preparation during insertion and dressing procedures. [32]

There are many factors that cause difficult cannulation, age group and health conditions of patients, experiences of the health care providers, cannula size and selection of insertion site. The insertion of peripheral intravenous catheter is largely influenced by some or all these factors. [33]

Complications are considered the main reason for removing peripheral venous catheters, so researcher realize that nursing team should communicate with doctors to avoid the peripheral venous catheters complications; nursing team must understand how to deal carefully with the catheters. [33] The PVC insertion site should be closely monitored for any possible complications, so that prompt measures can be taken for any eventuality by the attending nurse. [30]

Nurses have a big responsibility towards critically ill patients, so they must take care of their patients; they must have acquired practical skills to avoid the complications resulted from the insertion of catheters. PVC is frequently used among patients and it is considered as a low risk to patients. [34,35]

Peripheral venous catheter complications are divided into local and systematic complications. [24]. **Local complications** include infiltration of fluid into tissues, extravasation, hemorrhage, blood leakage at puncture site, laceration, drug-induced irritation, hematoma-induced irritation, occlusion followed by cessation of fluid infusion, catheter dislodgement, vein trauma and spasm.[24] On other hand, **Systematic complications** include gas embolism through intravenous site, pulmonary edema, accidental embolism of catheter fragment, Infection at insertion site, hypersensitivity reaction, and improper placement of PVC. [24]

The cause of peripheral intravenous catheter failure has been described in several studies. Catheter failure can be divided into two types. The first one is the failure during insertion and is influenced by the inserting clinician. The second is failure after insertion, such as infiltration, occlusion, dislodgment and phlebitis or thrombophlebitis. There are other factors that cause PVC failure, some of these factors related to patient type while others pertain to the device type. Most of these factors are interlinked such as size of the catheter depends on the geometry of the vein and flow dynamics. [15, 36, 37]

A series of studies has been conducted for operation of peripheral vascular catheters by the nursing professional in adult patients. In one of the studies of the internal medicine at San Vicente De Paul Hospital, 82 adult patients were involved. The study focused on nursing practices for the management of the peripheral venous catheter, the associated complications due to poor management, and effective measures to help nursing staff in rectifying the lacking. The study revealed high percentage of nursing professionals had sound knowledge of the application of biosecurity, antisepsis, salinization and care related to the management of the PVC. The study showed that effective management contributed to the decrement in incidence of phlebitis and other associated complications. [30]

A randomized control trial showed that the PVC can remain on the site up to 96 hours if no complications arise after 72 hours of insertion. The Infusion Nurses Society, 2016 guidelines stated that in adult patients' catheter should be changed only when clinically indicated [38]. This reduces unnecessary pain of the patients from frequent re-sites insertion, and equipment causes and nurses time [39]. Thus, nursing practice guidelines suggested only clinically indicated replacements of PVCs. [40]

In another randomized control trial conducted on 2016, PVC were inserted in an experimental group without complications for a maximum of 10 days. [41] The study found that variety complications such as obstruction, phlebitis, leakage, seepage, and accidental removal has resulted. [15]

Finally, from these studies it became clear that there are several ways to reduce complications of PVC. These studies examined the associated complications and described on the effective management for reducing the risks of PVC. These studies revealed that replacement of PVC sites at 72 hours or as clinically indicated, are safe to avoid complications of PVC such as phlebitis and infections.

Peripheral venous pressure (PVP) measurement is considered as a non-invasive and cost-effective procedure and is used to assess preload among critically ill patients. PVP is used to record patient's fluid condition in intensive care units. The procedure is employed an alternative to CVP if the conditions of patients as well as application of the instruments are not suitable for direct CVP measurement. [6]

Stoneking et al., (2014) found that PVP is a relatively good prognosticator of CVP. PVP is usually placed in the proximal upper extremity or can be placed in the neck. Special precaution should be taken on patient position, and movement be avoided as far as possible during the measurement. Concomitant use of PVP and SVV yields better results in measuring CVP, and as alternative to CVC placement. [42]

The catheter site for PVP is maintained at mid-thorax height during the procedure. During flushing and calibration, the transducer sets are maintained at mid-thorax level. During proximal arm occlusion pressure changes in the PVP wave form must be observed. [43] Peripheral blood stem cell collection using peripheral venous catheter is considered as safe alternative to CVC, with minimal adverse event. [44] The CVP remain as most acceptable procedure for fluid resuscitation in critically ill patients. [45]

The patient's positions change may lead to flexion of the elbow and might result in an incorrect value in PVP. [46] There is a possibility of changes in PVP value with different hand positions such as adduction or abduction, as the flow through the vein might get impeded reflecting as a false increase in PVP. [47] Care should be taken to minimize external compression of blood pressure cuff or overstretching in the catheterized arm to prevent occlusion in peripheral vein and thereby increase in PVP. [14]

The CVP and PVP values might have had a definite correlation. However, when the mean values in a group of patients in whom different factors might have influenced CVP and PVP were compared, the correlation might have failed to manifest. [47] Ravindran et al., (2017) in their study found that PVP monitoring do not have any impact on pneumothorax or injury of large central vessels. As per literature, PVP is the reliable marker for CVP and venous congestion, with lesser risk of complication and without the need for central catheterization in critically ill patients. [14] In literature, there are contradicting findings of the relationship between CVP and PVP. [48]

Yet there is a tendency in many authors to advice PVP as an alternative and accurate method that estimates CVP with less complication risk. They recommend using PVP as a volume status marker in these patients to decrease hemorrhagic or other complications related to central catheterization. [48]

3.3. Central venous catheters (CVC)

Central venous catheter is one of the important devices for administration of fluids, medicines, and intravenous nutrition. Compared to peripheral catheters, the length of CVCs is longer and facilitates deep insertion into the major veins of the body. It also provides better. However, infections of bloodstream are more likely with CVCs, sometimes with fatal consequences. [49] CVC is very reliable for the care of hospitalized and critically ill patients, as it provides clinical operations with medication infusion, blood sampling, and hemoglobin measurement. [50] Researcher suggests that the selection of the best CV-catheterization plays a vital role in avoiding complications, because the choice is warranted by the rate of complications.

Medical staff and nurses are responsible for the insertion of CVC without any complications. [51] In the light of earlier report by Hignell (2016) and Chen , et al., (2014), there are lot of indications for use CVC, these are to administer intravenous fluids, blood products, medication, and nutritional support, Also, CVC is frequently used to obtain venous blood samples, administration of large volumes of intravenous therapy faster, monitoring of CVP, better access to

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transvenous pacemaker or pulmonary artery catheters, access to venous circulation and hemodialysis access for critically ill patients. [52,53]

All studies mentioned previously implicate the importance of central venous catheters in providing fluids and drugs to critically ill patients in ICU. Moreover, it is used to monitor hemodynamic, and to administer hypertonic solutions.

Central venous catheters are classified into **Short-term** or **Non-tunneled** *C*VCs, and **Long-term** or **Tunneled** CVCs. **Short-Term or Non-tunneled** CVC includes a percutaneous CVC and is inserted by puncture of skin directly in the intended location without passing through subcutaneous tissue. The catheter site is typically inserted into subclavian vein or the internal jugular vein. Non-tunneled CVCs are considered as the easiest CVC to be placed, and is used in emergency situations and can be inserted for a short (2–4 weeks) to medium duration (1–3 months). [26,54,55]

Long-Term CVC or **Tunneled catheters** are further subdivided into two groups: partially implanted and totally implanted. [26, 55] **Partially-implanted CVCs** has an exterior part for drawing blood sample or to connect the infusion lines, a tunneled subcutaneous part fitted with a Dacron cuff, and an intravenous part with the tip aligned at the border of superior vena cava and the right atrium. [55] The Dacron cuff is restorative in function and maintains stability securing CVC. Cuff also prevents entry of extraneous microbes along the CVC. [55]

Totally implanted catheters such as implanted ports, that stays insitu for months to years, are implanted surgically into a vessel, body cavity, or organ. [26, 52, 55] Implanted ports cost is high, and they needed surgical implantation and can be used for a long time. [54]

Totally implanted catheters consist of a reservoir that is placed in a pocket in the subcutaneous tissue of chest wall. From the clavicle it is connected to the catheter. This type of CVC has several advantages as no parts are visible outside the body without affecting the patient's body image. The only limitation of this type of CVC is that for port access a skin puncture is required with a Huber needle or gripper system. The device is not suitable for patients requiring frequent port accesses as repeated access may be painful or discomfort often necessitating application of topical anesthetics.[55] Moreover, it is also not suitable for patients requiring high volume of infusion. However, modification of reservoir chamber in the improved version permits higher flow rate. [54]

Tunneled CVC whose proximal end is inserted subcutaneously through tunneling and the remaining part remain external to the body. [26] The Tunneled catheters causes less complications compared to the Non-tunneled catheters. [54]

Another type of long-term CVC known as **Peripherally Inserted Central Catheter** (PICC), commonly used by physician or nurse by inserting it into peripheral vein. The catheter is inserted into the cephalic, basilic or brachial veins of extremities. [26,52,54]

There are many factors affecting CVC, these are patient age, the prolonged duration in hospital, and the selection of CVC types. CVCs are also responsible for localized and systemic infection The infections due to CVCs may be catheter related and central line related, and accordingly blood stream infections are known as catheter related bloodstream infections (CRBSI) and central line associated bloodstream infections (CLABSI). [56] **Central line associated bloodstream infection** (CLABSI) is one of the major concern of bloodstream related infections in ICUs. [56] This is more common in patients with prolonged hospitalization, lack of frequent observation by attending nurses and accidental contamination during insertion of catheters. [57]

Catheter-related bloodstream infection is the infection arising from Although attributed to nosocomial infections, CRBSI is one of the major causes of fatality. Such infections lead to prolonged hospital stay with increased morbidity. [58] CVC pose a a greater risk of device-related infections in ICU patients compared to other medical device or procedures, leading to poor outcomes. It is estimated that the risk for CRBSI is 64 times higher with CVCs than with PVC. [58] The factors associated with such higher rate of CRBSI are catheterization duration, number of lumens, access to site femoral, extensive manipulation of the CVC, parenteral nutrition, and bacterial multiplication at the insertion site. [59]

Although, CVCs play a vital role in treating critically ill patients in ICU but may cause serious complications if proper precautions are not taken. CVC may lead to a lot of complications. [60]

Kashif, Hashmi, Jadhav & Khaja, (2016) reported a case of a missing guide wire detected in ultrasound in a patient at ICU. The guide probably left during placement of peripherally inserted central catheter (PICC). Although such complications are rare but may lead to significant mortality and morbidity. Such complications may be overcome by ultrasound guidance placement of PICC. [61]

Central venous catheters' complications may be mechanical, embolic, and infectious. Noticeable complications are those that emerge after introducing a CVC and consist of mechanical and malposition and thromboembolic. Mechanical complications include arterial puncture, hematoma, pneumothorax, intra-arterial placement of catheter, hemorrhage, pneumothorax, hemothorax, thoracic duct injury, arrhythmia, and cardiac tamponade. Correct configuration of CVC tip may be established by chest x-ray or ultrasonography. [62,63,64]

Thromboembolic complication such as air embolism and wire embolism occur when air enters into the venous system and migrates to the right ventricle and/or pulmonary circulation. Catheter embolism results from pinch-off syndrome, damage during catheter exchange, separation of the catheter from an implanted port body, and fracture of a distal portion of a venous catheter. [26]

Delayed complications may be due to mechanical cause, infectious cause and thrombotic, all of which may be caused by improper implantation of CVC. [64] Sometime faulty positioning of the CVC tip into the right atrium leads to arrhythmias and atrial perforation. [65] Mechanical complication are venous stenosis, cardiac tamponade, erosion or perforation of vessel and line fracture and embolism. Infection complication are colonization of catheter and catheter associated blood stream infection.

Another study of Kenya at Kenyatta National Hospital (KNH) CCUs revealed that nursing care related factors may predispose critically ill patients to CLABS. Some of the nurse care related factors described in the study were poor hygienic practices, manipulation of infusion line. failur of prompt removal of CVCs, lack of sufficient knowledge and experiences on CVC maintenance and intravenous administration system components. [66]

Several authors have recognized that there are many recommendations for the effective management of infections pertaining to central venous catheters. Some of the recommendations are personal hygiene, maintenance of barrier, use of chlorhexidine skin antisepsis, minimal catheter site selection, use of antibiotic-impregnated catheters, use of catheters with less lumens, periodic evaluation of line and prompt removal of unnecessary catheters. [14]

Central venous pressure is used to measure of pressure in the vena cava during estimation of preload and right atrial pressure. CVP is commonly used to assess hemodynamic status in an intensive care unit. The CVP may be measured using a central venous catheter advanced via the internal jugular vein and placed in the superior vena cava near the right atrium. [67] CVP is intricately linked to the optimal measurement and physiological interpretation of intravascular volume, heart performance and vascular resistance. [68] CVP is located through the crucial intersection of the force generating returning blood to the heart and the force created by cardiac function. [67]

Central venous pressure between 8 to 12 mmHg is considered normal and may be altered by volume status. [67] A high CVP is considered as an indicator of a primary pump problem whereas; a low CVP represents also a primary pump problem, The study added that in order to provide useful clinical information, it should be understood the factors that determine CVP magnitude, mechanisms that produce the components of the CVP wave form and changes in CVP with respiratory efforts. [69]

The central venous pressure is altered by changes in the transmural pressure and vessel distensibility. CVP is influenced by pericardial changes, intrathoracic pressure, intra-abdominal pressure, vascular resistance and compliance, blood volume, and cardiac pump function. [68] Although, CVP is widely used to assess preload, it has several complications starting from establishment of line till monitoring of the pressures. Dan &Varghese stated that to assess the fluid volume status in critically ill patients' efforts should be given to make devise simpler for easy manipulation and assessment. It also stated that PVP monitoring is a viable alternative to CVP monitoring in critically ill patients. [6]

In addition to, the CVP is widely used for guiding and management fluid therapy in critically ill patients. Both CICCs and PICCs are used in monitoring CVP. [70] The CVP monitoring in critical care settings was extensively studied by Hill. The study focused on assessing the fluid status of patients in critical care units. It also described in detail about CVP

ISSN 2394-7330

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monitoring, complications associated with CVP monitoring and the nursing responsibilities in relation to their activities. The results revealed that CVP monitoring requires thorough understanding of relevant anatomy and physiology of patients in critical care settings. Nurses should be familiar with accurate measurements, interpretation and recording CVP. Nurses should have sufficient expertise in assessment of patients for better clinical outcomes. [71]

Central venous pressure should be monitored taking sufficient precautions preferably using electronic pressure transducer and a cardiac monitor so that sufficient CVP waveform is generated for accurate evaluation. All the aseptic measures should be taken when using CVCs to prevent complications. Nurses involved in CVP monitoring should be well versed with the techniques and associated complications and should follow the guidelines of local and national authorities. [71] Several conditions like congestive heart failure syndrome, constrictive pericardial disease, tension pneumothorax, and CVP elevation occurs frequently in critical care units, which should be monitored by experience nurses on duty. [72,73]

According to the Starling and Guyton model on cardiac function, the interactivity of cardiac function and returning blood to the heart can determine CVP. Organ failure in critical patients results from obstruction of the venous return and microcirculatory blood flow, and due to lung edema and splanchnic congestion. The cause of elevated-CVP should be established, and appropriate treatments should be initiated for patients in critical care settings. This is because failure to monitor may lead to prolonged treatment in ICU. [74]

There is study explored by Rhodes et al (2017), the low reading of CVP means decreasing of circulating volume, these decreasing can be the result of hemorrhage, Infections as sepsis, decreased cardiac output, hyperglycemia, diabetes insipidus, hyperthermia and hypothermia, bradycardia, chemical paralyzing agents, and bisoprolol. [75] Values of CVP are very vital for providing information about the cardio circulatory status of the patient. CVP is widely used to administration fluid resuscitation and has several advantages as well as limitations. Better understanding of the limitations may yield desirable outcomes rather than to avoid CVP completely.[76]

The research revealed that there are three different techniques of CVP measurement; these techniques are (CVP monitor, CVP nadir, and CVP calculated). CVP monitor displays the measurable unit and is used for accurate estimation of CVP. CVP monitor is an alternative to CVP measured. [77] CVP can be measured in two ways electronically and manually, manual CVP measurement contains the use of a manometer instead of pressure transducer or cardiac monitor. The manometer comprised of an ordinary IV infusion interspersed by a vertical infusion line integrated to a drip stand, which runs alongside a tape measure in centimeters. The CVP is measured by leveling the base or 'zero' mark, near the three-way tap, to the phlebo-static axis. This is leveled using a spirit level and secured to the drip stand. The three-way tap should then be turned off to the patient. [71]

The manometer is filled with saline to a level just above what the CVP is calibrated. Saline IV bag acts as a normal IV infusion to the catheter patent. The three-way tap should be opened to the patient. The fluid level inside the manometer gradually fall until it equals the pressure in the central veins, due to gravity. This is the CVP numerical value, which is a single figure rather than a continuous waveform. Whereas in electronic CVP measurement readings are produced by using a pressure transducer and are displayed in a cardiac monitor as a continuous waveform along with the numerical CVP value. [71]

Central venous pressure can be influenced by numerous conditions including technical and physiologic factors. **Technical factor** as patient position, inappropriate CVC placement and inconsistent measurement technique, **Physiologic factor** include changes in intrathoracic pressure and central venous blood volume, right ventricular compliance, vascular tone &cardiac output. [71,78]

The factors that affect the measurement are systemic vasodilation and hypovolemia. These factors may lead to a reduced venous return in the vena cava and reduced right atrial pressure and a lower CVP. The resultant consequences are right ventricular failure, tricuspid and pulmonary valve disease, and pulmonary hypertension. [79] Although there are a lot of factors influencing the accurate CVP readings, positive pressure in the thorax resulting from mechanical ventilation often enhances intrathoracic pressure. This in turn cause decrement in venous return resulting in decreased preload, affecting the CVP measurement. [71]

In the review of Hill and Cole it was stated that there are a lot of complications associated with CVP monitoring during insertion. Some of which are increases the risk of infection, open caps on the lumens, open valve ports etc. These faults result in blood loss, which may lead to hemorrhage, especially in patients who have coagulation problems and clotting disorders. Other faults are catheter occlusion, air embolus, catheter displacement etc. [71]

4. CONCLUSION

The major findings of this review are the comparison between peripheral and central venous catheter in relation to venous pressure and associated complications. The review suggests that both PVC and CVCs are very important among critically ill patients. Moreover, they are used in intensive care units to monitor fluids and therapy. CVC is also used in measuring CVP, but complications are the undesirable outcome of both PVC and CVCs. For this reason, most central venous catheters are removed because of the occurrence of many serious complications. These complications including thrombosis, infections which can lead to pain, discomfort, increase hospital costs, and longer hospital stays. For this reason, the scope of the review is to highlight the main aspects in peripheral and central venous catheter including the association between peripheral and central venous pressure. It may be concluded that Peripheral Venous Pressure can be used as interchangeable methods.

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