.

RATE OF COLONIZATION OF INTERNAL JUGULAR AND FEMORAL CENTRAL VENOUS CATHETERS IN MEDICAL INTENSIVE CARE UNIT AND MEDICAL HIGH DEPENDENCY UNIT

A dissertation submitted in partial fulfillment of the MD Branch - 1 (General Medicine) Examination of the Tamil Nadu Dr. M.G.R Medical University, Chennai to be held in April 2015

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DECLARATION

This is to state that the dissertation entitled "Rate of colonization of internal jugular and femoral central venous catheters in Medical Intensive Care Unit and Medical High Dependency Unit" is my original work, submitted in partial fulfillment of the M.D Branch 1 (General Medicine) Degree Examination to be conducted by the Tamil Nadu Dr. M.G.R Medical University, Chennai, Tamil Nadu in April, 2015.

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C E R T I F I C A T E

This is to certify that the dissertation entitled "Rate of colonization of internal jugular and femoral central venous catheters in Medical Intensive Care Unit and Medical High Dependency Unit" is the bonafide original work of Dr. Sohini Das, submitted in partial fulfillment of the M.D Branch 1 (General Medicine) Degree Examination to be conducted by the Tamil Nadu Dr. M.G.R Medical University, Chennai, Tamil Nadu in April, 2015.

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TITLE OF THE ABSTRACT

Rate of colonization of internal jugular and femoral central venous Catheters in Medical Intensive Care Unit and Medical High Dependency Unit

DEPARTMENT

General Medicine

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M.D. General Medicine

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OBJECTIVES

To assess the colonization rate and catheter related bloodstream infection rate of internal jugular and femoral central venous catheters in Medical Intensive Care Unit and Medical High Dependency Unit.

METHODS

Single blinded randomized controlled trial where the site of central venous catheter insertion was determined by randomization. There were 2 arms with equal allocation – internal jugular and femoral

Inclusion criteria

All patients in Medical Intensive Care Unit / Medical High Dependency Unit who require insertion of a central venous catheter

Exclusion criteria

A) Deep vein thrombosis

B) Cardiac arrest in the last 24 hours

D) Patients who do not give consent

E) Pregnant women

F) Immunocompromised patients

G) Severe coagulopathy

H) Skin lesion

I) Profound volume overload

Primary Outcome:

Colonization rate of central venous catheter tip in the jugular and femoral group

Secondary outcome:

Catheter Related Bloodstream Infection rate in patients with jugular and femoral central venous catheters

RESULTS

The colonization rate in the internal jugular and the femoral group was 20.5% and 23.9% respectively. This difference was not statistically significant. More patients need to be included in the study to draw clinical implications.

There were 3 catheter related bloodstream infections among the patients included in the study. All 3 infections were in the femoral group. There is a trend towards higher number of catheter related bloodstream infections in the femoral group in spite of similar colonization rates.

Keywords: catheter related bloodstream infections, catheter related bloodstream infection rate, colonization rate

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INTRODUCTION

Central Venous Catheter (CVC) is a catheter placed into a large vein to obtain an intravenous access. Its use has become indispensable in the management of critically ill patients. Central venous catheters are used for hemodynamic monitoring, measurement of Central Venous Pressure, hemodialysis / plasmapheresis and in the setting of difficult peripheral venous access in critically ill patients. Despite its benefits, central venous catheters have drawbacks as well. Catheter insertion may result in mechanical complications like arterial puncture, hematoma formation, pneumothorax and hemothorax. Late complications include bloodstream infection and local infection due to the catheter.

Earlier studies have shown that jugular and subclavian venous catheters have a lower rate of infectious complications as compared to femoral central venous catheters. However, over the years, the overall rate of catheter related bloodstream infections has declined. This is secondary to better compliance with sterile barrier precaution measures, better handling of the catheter and education of healthcare workers regarding aseptic precautions when handling catheters.

Recent studies have failed to demonstrate superiority of one insertion site over the other with respect to infectious complications. The insertion of femoral catheters does not subject the patient to the risks of pneumothorax and hemothorax and can be performed by relatively inexperienced operators. In patients who require prolonged mechanical

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ventilation, secretions from tracheostomy is a potential source of infection for patients with jugular venous catheters.

The purpose of this study is to determine the rate of infectious complications in the internal jugular and the femoral site in critically ill patients.

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AIMS

To assess the rate of infectious complications in femoral and internal jugular central venous catheters in the Medical Intensive Care Unit and Medical High Dependency Unit.

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OBJECTIVES

To assess the colonization rate and catheter related bloodstream infection rate of internal jugular and femoral central venous catheters in Medical Intensive Care Unit and Medical High Dependency Unit.

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REVIEW OF LITERATURE

Central venous catheters, or central lines, are thin long flexible tubes that are inserted into one of the great veins and lie in proximity to the heart.

Central venous catheters can be inserted through a proximal central vein commonly the internal jugular, subclavian or femoral vein, or through a peripheral vein. The catheter is threaded through the vein till the tip reaches a large vein near the heart. The tip of the central venous catheter resides in the right atrium, superior vena cava or the inferior vena cava.

Central venous catheters are used to rapidly give medications and blood products, and for intravenous hydration. They are used to measure central venous pressure. Central venous catheters may have up to five lumens.

HISTORY

The first central venous catheter insertion was done by Werner Frossman in 1929. His initial thoughts were ridiculed and opposed by his colleagues. He inserted a ureteric catheter into his own antecubital vein and threaded the catheter up to 65 cm to reach the right atrium. With the catheter in situ, he walked to the X-ray room and demonstrated the accurate position of the tip of the catheter in the right atrium. He thereby convinced his

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colleagues of the safety of the procedure. He received Nobel Prize in Medicine in the year 1956 for his immense contribution in this field. (1)

Sven-Ivar Seldinger, in the year 1953 published his pioneering technique of introducing catheters into body cavities. This technique had the advantage of use of thinner bore needles, less vessel wall damage and less risk of extravasations. This technique is still the benchmark in terms of placement of the central venous lines. The use of this technique provides greater safety in internal jugular and subclavian vein cannulation. (2) It is also used in various non-vascular interventions like tumour biopsy, embolization, percutaneous cholangiogram and percutaneous nephrostomy. (3)

Central venous catheters can be associated with thrombosis, infectious complications and mechanical complications. An ideal central venous catheter should have ease of insertion, low thrombogenecity and a low rate of infectious complications.

INDICATIONS:

Indications for insertion of CVCs include the following:

1) Administration of high dose of vasopressors and irritant drugs (eg. Chemotherapeutic agents, antibiotics, antifungals) which may cause phlebitis if administered through a peripheral vein

2) Rapid administration of medications and fluids in critically ill patients

3) Lack of peripheral venous access in a critically ill patient

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4) Total parenteral nutrition

5) To measure central venous pressure

6) To monitor venous oxyhemoglobin saturation

Central venous catheters also provide a channel for drawing blood samples without repeated peripheral venipunctures.

CONTRAINDICATIONS:

Contraindications for insertion of CVCs include the following:

1) Deranged bleeding parameters

2) Thrombocytopenia

3) Vessel thrombosis or stenosis

4) Infection overlying the insertion site

The decision of insertion of a central venous catheter has to be made for each individual patient by the physician keeping in mind the potential risks involved, the expected duration of the catheter, as well hemodynamic stability and coagulation parameters of the patient.

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The preferred site of insertion of a central venous catheter depends on various factors including the experience of the operator and the availability of an ultrasound for insertion of catheter. Patient related factors including risk of bleeding and pneumothorax and the urgency of placement of the central venous catheter also play a role in determining the site of insertion of the central venous catheter.

TYPES OF CENTRAL VENOUS CATHETERS:

1) Tunneled versus non tunneled central venous catheters

Tunneled central venous catheters are catheters in which the site of skin insertion is away from the site of entry into the vein. The catheter is tunneled through a short distance forming a subcutaneous tract to reach the vein. Tunneling is done for central venous catheters which are required for a long duration. These catheters have an additional Dacron cuff which lies near the exit site on the external lumen. The cuff helps in adherence and also acts as a barrier to cutaneous micro-organisms that may invade the subcutaneous tract(4).

In non-tunneled central venous catheters, the site of insertion is adjacent to the site of entry into the vein. Non tunneled central venous catheters are the preferred catheters for emergency and short term use.

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2) Peripherally Inserted Central Catheters

Peripherally inserted central venous catheters are placed in the basilic, brachial or cephalic veins and threaded to reach the superior vena cava. They can be used for long term as well as short term use.

3**) Single versus multi-lumen catheters**

In critically ill patients who require rapid administration of multiple drugs and continuous infusions, catheters with multiple lumens are preferred.

Single lumen catheters are used in stable patients in case of inability to get peripheral venous access or prolonged intravenous antibiotic therapy.

4) Antibiotic coated catheters:

Central venous catheters can be coated with antibiotics or heparin which is thought to reduce infectious complications. The common antibiotics which are used for coating central venous catheters include a combination of chlorhexidine with silver sulfadiazine and minocycline with rifampin.

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5) Implantable ports:

They consist of a titanium or plastic container with a central silicone partition. These catheters are placed in the superior vena cava. These are used for long term therapy, usually in patients who are receiving chemotherapy. These are surgically inserted in the upper chest or arm.

COMPLICATIONS OF CENTRAL VENOUS CATHETERS:

Complications of central venous catheters include early periprocedural complications and late complications.

1) **Early complications** can occur during central venous catheter insertion. Early complications include catheter misplacement, pneumothorax, hemothorax, arterial puncture, hematoma formation, air embolism.

2) **Late complications** include colonization, bloodstream infection due to the catheter, infection of the exit site and catheter related thrombosis

   Central venous catheter related complications can also be classified as mechanical, thrombotic and infectious.

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MECHANICAL COMPLICATIONS:

Mechanical complications due to central venous catheter insertion include hematoma, arterial puncture or arterial cannulation, pneumothorax, hemothorax, placement failure, kinking of the guidewire and catheter tip malposition. Rates of mechanical complications range from 5 to 29% (5).

An Indian study by Mathai et al which examined 480 central venous catheter insertions over a 1 year period found the rate of mechanical complications to be 17.9%. Arterial puncture and hematoma were more frequent with 2 or more attempts at catheter insertion. Internal jugular catheter insertion was associated with increased probability of unsuccessful attempts at catheterisation (6). The probability of arterial puncture is highest with femoral followed by internal jugular central venous catheters. The chance of hematoma formation is also highest in the femoral group.

The possibility of pneumothorax and hemothorax occurs only in subclavian and internal jugular central venous catheters, the risk being higher in the subclavian group (5).

History of surgery or radiotherapy in the past, high body mass index, previous catheterization, age and higher time to catheter placement have been delineated as risk factors for mechanical complications. The risk of mechanical complications has been found to be higher with more than 2 attempts and inexperienced operators.

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The risk of pneumothorax is higher with multiple attempts at CVC insertion, emergency CVC insertions and a larger needle size. Failed attempt at CVC insertion is considered as a reliable predictor of mechanical complication. The risk of guide wire kinking is also increased if multiple attempts at CVC insertion are made.

In Sznajder's study which included 714 attempts at CVC insertion, failure rate was found to be significantly higher among inexperienced operators with less than 50 CVC insertions as compared to experienced operators (19 % versus 10 %). The rate of mechanical complications was 11% among experienced operators and 5% among inexperienced operators. (7) Central venous catheter insertion during the night has increased risk of mechanical complications. (8)

The use of ultrasound guided CVC insertions enables the operator to locate the vein, recognize anatomical variations, and also assess the patency of the vein. (9) Ultrasound guided internal jugular catheterization is associated with lower likelihood of failed attempts at catheterization, arterial puncture and hematoma formation. Time required for central venous catheter insertion is also shorter when insertion is under ultrasound guidance (5). In case of ultrasound guided CVC insertion, obesity and coagulopathy have not shown to increase the risk of mechanical complications (9)

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THROMBOTIC COMPLICATIONS

Central venous catheter related thrombosis can be clinical or subclinical. Clinically manifest thrombosis is associated with symptoms and signs including swelling, warmth, tenderness and edema and can be detected on Doppler screening. Subclinical thrombosis is detected by Doppler screening in the absence of signs and symptoms. The initial event is the formation of catheter sleeve composed of fibrin and collagen which promotes the formation of a thrombus. This mural thrombus can enlarge and form an occlusive thrombus. The thrombus is identified by non-compressibility of the vein and its direct visualization within the vein. The incidence of central venous catheter related thrombosis can be up to 28 %. Factor V Leiden and prothrombin G20210 A are associated with increased risk (relative risk 2.7) of central venous catheter related thrombosis.(10)

In a trial conducted by Rooden et al, out of 368 patients, 29% of patients had central venous catheter related thrombosis, of which 7 % had clinically manifest thrombosis and 22% were asymptomatic. The absence of anticoagulant therapy was associated with high risk of clinically manifest thrombosis (relative risk 4.7).The authors concluded that formation of a thrombus following central venous catheter insertion is a common occurrence and those with risk factors are more likely to progress to the stage of clinically manifest thrombosis (10)

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INFECTIOUS COMPLICATIONS

Infectious complications consist of colonization, exit site infection and catheter related bloodstream infection.

CATHETER TIP COLONIZATION:

Catheter tip colonization is usually asymptomatic and is a precedent to catheter related bloodstream infection. The predominant route of migration of micro-organisms for short term central venous catheters is from the insertion site via the outer catheter surface to the tip of the device. However, for long term central venous catheters, intraluminal contamination from hands of healthcare personnel is thought to be the most common mechanism. Rarely, haematogenous spread of organisms from a septic focus may result in seeding of a central line and catheter tip colonization. Semi-quantitative culture methods detect micro-organisms present on the outer surface of the catheter whereas quantitative culture methods detect intraluminal micro-organisms.

MAKI'S ROLL PLATE TECHNIQUE:

This is the commonly used method for central venous catheter tip cultures. This is a semi-quantitative method which involves rolling the external surface of the catheter on a blood agar plate five times to detect the presence of micro-organisms. The colony forming units are counted 24 to 48 hours following incubation at 37 degrees. The central

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venous catheter should be removed under aseptic precautions. The skin adjacent to the insertion site should disinfected with chlorhexidine or an alcohol based disinfectant. 5 cm of the catheter segment should be excised and sent for culture.

Maki's roll plate technique has a sensitivity and specificity of 83% and 85% respectively. The positive predictive value ranges from 40 to 80%. The positive predictive value increases with increase in the pretest probability. In a clinical setting with high pretest probability, in patients with fever, tenderness, redness or purulence at the catheter site, the positive predictive value of this technique approaches 80%.

However, the organisms present intraluminally cannot be cultured by this method. Quantitative culture methods can detect the presence of intraluminal organisms. Quantitative culture methods include sonication, centrifugation and vortexing. The sensitivity and specificity are 82% and 89–97% respectively. Direct visualization of micro-organisms via gram stain and acridine orange staining of the central venous catheter can also be done. The limitations of this method are that it is not practical for large number of samples and it is labour intensive. (11)

Catheter tip colonization is defined as "growth of more than 15 colony forming units from a 5 cm segment of the catheter tip by semi-quantitative (roll-plate) culture or growth of more than 100 colony forming units from a catheter by quantitative (sonication) broth culture"(12)

The roll plate technique is preferred for central venous catheter tip cultures. This technique has been shown to be superior to quantitative methods. (13,14)

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COLONIZATION AS A MARKER FOR CENTRAL LINE RELATED INFECTIOUS COMPLICATIONS:

As colonization of the central venous catheter tip is a precedent to central line related bloodstream infection, CVC tip cultures are useful in the assessment of central line related infectious complications. In a patient suspected of having nosocomial infection, a positive central venous catheter tip culture provides evidence to prove that the catheter is the source of infection. Catheter tip culture has been shown to have good correlation with CRBSI and is a useful surrogate end point for the same.(15)

For the definitive diagnosis of a catheter related bloodstream infection, the same micro-organism with the same species and sensitivity profile should be isolated from the catheter tip and peripheral blood. Positive catheter tip culture with Staphylococcus and Candida in the absence of bloodstream infection should warrant further evaluation. Positive central venous catheter tip cultures are associated with bacteremia in 10 to 14 % of cases.

A negative catheter tip culture is unlikely to be associated with bacteremia. In a clinical setting with low incidence of catheter related infectious complications and hence a low pretest probability of CRBSI, a negative catheter tip culture has a negative predictive value of 99%.

CATHETER RELATED LOCAL INFECTIONS:

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CRLI is defined as “any sign of local infection (induration, erythema, heat, pain, purulent drainage) and catheter tip colonization. This is considered to have a strong predictive value for catheter related bloodstream infection.

CATHETER RELATED BLOODSTREAM INFECTION (CRBSI):

Diagnosis of catheter related bloodstream infection comprises of demonstration of bloodstream infection as well as evidence that the intravascular catheter is the source of infection and there is no other source of infection. This consists of growth of the same organism from 1 percutaneous blood culture and from a catheter tip culture or culture from the catheter hub and from the peripheral vein meet criteria for quantitative blood cultures of differential time to positivity. (12)

1) *Differential time to positivity* is said to occur when simultaneous blood cultures from the peripheral vein and through the central venous catheter are positive. The culture via the catheter should become positive 2 hours or more before the peripherally drawn culture. This method has a sensitivity of 85% and specificity of 91%.(11)

2) *Quantitative blood cultures* are said to be positive when simultaneous blood cultures drawn via the catheter and percutaneously show growth with the catheter culture yielding a colony count that is 5 times or more than the peripherally drawn

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culture. This technique has been shown to have a very high specificity of 99%, with a sensitivity of 79%.

3) A *single quantitative blood culture* through the intravascular catheter is drawn and processed by pour plate or lysis centrifugation technique. Culture methods yielding more than 100 colony forming units is considered to be positive. However, this method may also give false positive results in bacteremia, especially in immunocompromised patients with sepsis.

4) *Qualitative culture from the catheter segment* after removal of the device can be used to diagnose CRBSI.

   In this technique, any growth is considered as evidence of infection. Qualitative culture of the catheter segment has been shown to have a specificity of 72% and a sensitivity of 90%.(11)

5) *Semi-quantitative catheter segment culture*: Growth of more than 15 colony forming units is considered significant by this method. The sensitivity and specificity of this technique are 85% and 82% respectively. The positive predictive value is 80% in the setting of high pre-test probability of catheter related bloodstream infection. However, in situations with low prevalence, the positive predictive value is low.

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6) *Quantitative catheter segment culture* that shows the growth of more than 1000 colony forming units can also aid in diagnosing CRBSI. This test has sensitivity and specificity of 83 and 87% respectively.

7) *Endoluminal brush sampling*: This is a newer diagnostic technique. Endoluminal catheter sampling with a special brush permits detection of catheter related bloodstream infection without removal of the catheter. This method also has the benefit of examining the whole catheter. This is a simple procedure to perform and does not have adverse effects.

CENTRAL LINE ASSOCIATED BLOODSTREAM INFECTIONS:

Central Line-Associated Bloodstream Infection (CLABSI) is defined as "a bloodstream infection where a central line or umbilical catheter was in place at the time of, or within 48 hours before, onset of the event."

LABORATORY CONFIRMED BLOODSTREAM INFECTION:

Laboratory confirmed bloodstream infections are "infections that are not secondary to a community-acquired infection or an HAI meeting CDC criteria at another body site."

Laboratory confirmed bloodstream infections should include at least one of the following:

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1. A recognized pathogen has been cultured from 1 or more blood cultures and organism cultured from blood is not related to an infection at another site.

2. Patient has at least 1 of the following signs or symptoms: Fever (temperature >= 38 ° C), chills, or hypotension. The patients' signs and symptoms and positive laboratory results should not be related to infection at another site. A common skin contaminant must be cultured from 2 or more blood cultures taken on separate occasions.

This refers to at least 2 blood draws that were collected within 2 days of each other.

CLABSI definition is used for surveillance and epidemiological purposes. The criteria for diagnosis of CLABSI are not stringent. Extensive laboratory evaluation is not necessary for a diagnosis of CLABSI.

Catheter related bloodstream infections constitute 11% of healthcare associated infections.(12) They can lead to bacteremia, septic shock, and other complications including infective endocarditis, osteomyelitis, spinal epidural abscess, and death. They lead to increase in the duration of hospital stay and cost of treatment and contribute to morbidity and mortality in these patients.

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EPIDEMIOLOGY

Hospital acquired or nosocomial infections are defined as "localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s). There must be no evidence that the infection was present or incubating at the time of admission to the acute care setting." (16) Nosocomial infections include urinary tract infections, ventilator associated pneumonia, bloodstream infections and surgical site infections.

Nosocomial infections can have endogenous or exogenous sources. Endogenous sources are body sites including cutaneous sources, mouth, nose and alimentary tract. Exogenous sources include healthcare workers, patient visitors and medical devices.

. It is estimated that 5% of all hospitalized patients eventually develop a nosocomial infection. (17) However, the percentage of patients who are affected by hospital acquired infections is higher among immunocompromised and elderly patients.

Catheter associated blood stream infections add to the morbidity and mortality of the patients. Studies have shown that catheter related bloodstream infections are associated with increase in mortality (Odds Ratio up to 9.5).(18) Patients with catheter related bloodstream infections have a longer duration of ICU stay and longer duration of stay in the hospital. Catheter related bloodstream infections also add to the healthcare costs. In developing countries, catheter related bloodstream infections contributed to 30% of all device associated infections. The mortality rate associated with catheter related bloodstream infections was 35.2%. (19)

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GLOBAL EPIDEMIOLOGY:

The Extended Prevalence of Infection in Intensive Care study was done to assess the prevalence of hospital acquired infections. Amongst 13,796 patients included in the study, 51% were classified as infected and catheter related bloodstream infections comprised 15 % of the above. Medical admission, renal replacement therapy, HIV infection, chronic obstructive pulmonary disease and mechanical ventilation were associated with greater chance of infection. (20)

In the Unites States, 2,50,000 catheter related bloodstream infections are estimated to occur every year of which 60,000 occur in critically ill patients. Mortality from catheter related bloodstream infection is estimated to be approximately 30,000 to 60,000 per year. The attributable mortality has been estimated to be up to 25 %. Each episode of catheter related bloodstream infection adds approximately 25,000 $ to healthcare costs. (21) In Europe, studies have estimated the rate of catheter related bloodstream infection to range from 1.12 to 4.2 per 1000 catheter days.(22) Bloodstream infections in critically ill patients prolong the duration of hospital stay by an average of 12 days. (23)

Studies have shown that central line related bloodstream infections occur more frequently in limited resource countries as compared to developed countries. The rate of central line related bloodstream infections ranged from 1.6 up to 44.6 per 1000 catheter days for adults in low income countries as compared to countries as compared to 1.5 per 1000 catheter days in the United States. This has been attributed to low nurse to patient ratio,

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inadequate infection control surveillance, lack of adherence to hand hygiene measures and limited medical supplies.(24)

The rate of catheter related bloodstream infections has shown a declining trend over the past few years. This is thought to be due to better adherence to aseptic measures, use of sterile barrier precautions during line insertion, catheter care and education of healthcare staff. In the United States of America, the rate of central line associated bloodstream infection has reduced from 43,000 in 2001 to 18,000 in 2009. The rate of central venous catheter associated infection has declined from 5 per 1000 catheter days to 2.05 per 1000 catheter days over a period of 10 years from 1998 to 2009 in the United States of America. (25) Other studies have demonstrated reduction of 70% in CRBSI rate. (26) Nevertheless CRBSI still result in significant morbidity and mortality.

EPIDEMIOLOGY - INDIA

The incidence of hospital acquired infections in a tertiary care hospital in India was found to be 17.6%. This observational study included 293 consecutive patients admitted to the Surgical Intensive Care Unit in 2009 - 2010. Amongst 37 patients who developed nosocomial infections, 50% had ventilator associated pneumonia, 27.7% had catheter related bloodstream infection and 22.2% of patients were found to have catheter associated UTI. There were 10 catheter related bloodstream infections during the study period, with a rate of 16 per 1000 catheter days. The chance of developing nosocomial infections significantly increased with the duration of stay in Intensive Care Unit. (27)

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In a study published by Chopdekar et al, over a 1 year period in 2008 – 2009, the bloodstream infection rate in critically ill adult patients due to central venous catheters was found to be 7.57 per 1000 catheter days. The rate in the neonatal and pediatric intensive care units in the same study was found to be 27.02 and 8.64 per 1000 catheter days respectively. Patients with catheter related bloodstream infection had mortality rate of 33% as compared to a rate of 20% in patients with bloodstream infection not related to central venous catheters. (28) In another study from India, rate of central line related bloodstream infections was 8.75 per 1000 catheter days. (29)

Our hospital has a nosocomial infection surveillance program as a part of which all patients in Intensive Care Units (ICU) are monitored. The catheter related bloodstream infection rate in the year 2012-2013 among patients in Medical Intensive Care Unit and High Dependency Unit was 2.4 per 1000 catheter days and 2.5 per 1000 catheter days respectively. (unpublished data)

EXPENDITURE:

The total attributable cost of catheter associated bloodstream infection was found to vary from 11,971$ to 13,585$ per episode in studies in the United States. (23,30).

In Europe, estimated additional costs due to CRBSI was 4200 to 11,380 euros per episode among different nations.(22)

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In a prospective observational study conducted over a 6 month period in Christian Medical College Vellore in 2012, the direct expenses (including hospital bill and cost of medications) associated with one CRBSI in critically ill patients was found to be 2.3 lac rupees. The average extra duration of hospital stay in patients with CRBSI was 9 days. (unpublished data)

PATHOGENESIS

Contamination of central venous catheters can occur via several routes.

1) *Extraluminal :*

Skin flora from the central venous catheter insertion site move along the exterior surface of the catheter. They proceed through the subcutaneous tract of the catheter ultimately reaching and colonizing the catheter tip.

2) *Intraluminal :*

Contamination of the catheter hub by healthcare workers hands, contaminated fluids or devices leads to colonization of the intraluminal surafceof the catheter.

3) *Hematogenous spread :*

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Bacteremia due to infection at another site can lead to hematogenous seeding and colonization of the catheter tip.

4) *Contaminated infusate*:

Acquiring infection due to contaminated infusate occurs rarely and leads to epidemics of catheter related bloodstream infection.

Other factors that play a role in the pathogenesis of catheter related bloodstream infection include the following:

1) *Material of the device*:

In a study by Hawser et al, biofilm formation by Candida species was found to be more with latex and silicone elastomer catheters as compared to polyurethrane and 100 % silicone catheters. (31) Irregularities of the surface of the central venous catheter also promotes development of colonization and infection. However, another study which included polyurethrane, polyvinyl chloride, and polytetrafluoroethylene central venous catheters did not find any difference in colonization rate between different catheter materials.

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2) *Virulence of the organism* :

Candida albicans has a more rapid biofilm formation is more pathogenic that Candida parapsilosis, Canida glabrata and Candida pseudotropicalis.(31) Staphylococcus aureus and Staphylococcus epidermidis produce clumping factors A and B and thrombospondin which facilitate adherence to the catheter surface. (32–34)

In a study conducted in the United States from 1998 to 2000, which included 1263 catheters with 35 bloodstream infections, 45% of the infections were extraluminally acquired and 26% were intraluminally acquired. (35)

BIOFILM FORMATION

In adverse environmental conditions, bacteria form biofilms. Biofilms are a matrix of extracellular polymeric substances produced by the bacteria along with an acellular or abiotic component. Biofilms confer resistance to antimicrobials by providing a diffusion barrier to antibiotics. The microorganisms have a slower growth rate and slow rate of antibiotic uptake.

Bacterial cells that grow in biofilms exist in adverse environmental conditions with unfavourable pH, nutrient and oxygen deficient conditions. They may undergo transformation into forms that have an altered, slower metabolic state. (36)

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Biofilms have an important role to play in the pathogenesis of infective endocarditis, chronic prostatitis, cystic fibrosis. They are also important in device related infections including catheter related bloodstream infection, catheter related urinary tract infection, contact lens infection, and prosthetic valve endocarditis. Mechanisms by which biofilms confer antimicrobial resistance include production of endotoxins and providing a niche for development of resistant bacteria. Detachment of bacteria from the biofilms can lead to bacteremia and catheter related urinary tract infections.(37)

Biofilms of central venous catheters can be present along the external or internal surface of the device. Migration of skin flora leads to biofilm formation on the outer surface whereas contamination from hands of healthcare workers at the catheter hub leads to biofilm formation on the inner surface. As central venous catheters are invariably in contact with blood, there is coating of the outer surface with plasma proteins including albumin, fibronectin, fibrinogen and laminin. This promotes adherence of bacteria especially Staphylococcus aureus and Staphylococcus epidermidis. (38) Central venous catheters with a fibrin sheath are more likely to be colonized that those without. (39)

Studies have shown that colonization happens within hours of central venous catheter insertion. The presence of a thrombus increases the risk of infectious complications.

For short term CVCS, organisms that are part of the cutaneous flora have been implicated in causing CRBSI. For long term CVCs, colonization of the catheter lumen is the predominant mechanism.

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The possibility of a catheter related blood stream infection should be suspected when the patient with an indwelling central venous catheter becomes febrile, the presence of warmth, tenderness, redness or pus at the CVC site.

MICROBIOLOGY

The normal skin flora consists of resident and transient bacteria.

The resident bacteria exist in the deeper layers of the skin, and are also known as colonizing bacteria. These are not removed during hand washing.

Transient or contaminating bacteria occur superficially and are removed by washing with soap and water. Both colonizing and non-colonizing bacteria are involved in the pathogenesis.

Central line related blood stream infections can be caused by Gram positive bacteria, Gram negative bacteria and fungi. Gram positive cocci account for the majority of intravascular catheter related bloodstream infections worldwide. Amongst Gram positive cocci, Coagulase negative Staphylococcus is the most common organism causing catheter related infection.

WORLD:

According to the SCOPE study, coagulase negative Staphylococcus accounted for 31% of bloodstream infections, whereas Staphylococcus aureus and Enterococcus account for

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20% and 9% of infections respectively. Gram negative organisms causing central line related bloodstream infection include Escherichia coli, Klebsiella, Acinetobacter, Pseudomonas aeruginosa and Serratia. Gram negative organisms accounted for 22% of intravascular device related infections. Candida species were found to cause 9% of catheter related bloodstream infections. (40)

This is in contrast to the pattern that was observed in the 1970s and 1980s in developed countries. Gram negative organisms caused the majority of catheter related bloodstream infections during those days, the commonest bacteria being Escherichia coli. (41)

INDIA:

The profile of micro-organisms causing catheter related bloodstream infections in India is diverse. Gram negative bacteria have been implicated in a significant proportion of central venous catheter related infections. The proportion of catheter related bloodstream infections due to Gram negative bacilli is higher in India compared to Western estimates. (42)A study conducted in a tertiary care cardiac centre in India over a 6 month period in 2001 found 35 catheter related bloodstream infections in 1314 patients admitted for cardiac surgery. 47% of infections were caused by Escherichia coli, 11.7 % by Acinetobacter, 5.8 % by Enterobacter, and 5.8% by Proteus species.(43). However, several other studies have found coagulase negative Staphylococci to be the most common organism implicated in catheter related bloodstream infection. (18,19,33).

The majority (87%) of catheter related bloodstream infections are monomicrobial. Coagulase negative Staphylococci, Acinetobacter, Serratia, Candida and Enterobacter

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were more likely to cause infection among ICU patients. Catheter related bloodstream infection in the ward was usually caused by Staphylococcus aureus, Klebsiella, and Escherichia coli. Fungal infections were caused most commonly by Candida albicans (54%), followed by Candida tropicalis, Candida parapsilosis and Candida glabrata. The mortality rate was found to be higher for Candida and Pseudomonas bloodstream infections as compared to Escherichia coli and coagulase negative Staphylococci . (40)

FACTORS THAT INFLUENCE THE DEVELOPMENT OF INFECTIOUS COMPLICATIONS

1) *Number of lumens*:

Central venous catheters can have up to 5 lumens. The use of multi-lumen catheters offers the advantage of simultaneous administration of several drugs, intravenous fluids or inotropes. However, multi-lumen central venous catheters have a higher chance of colonization and catheter related bloodstream infection. Increased manipulation in case of multi-lumen catheters have also been thought to be associated with a higher risks of catheter related bloodstream infection. Triple lumen catheters are the preferred catheters that are inserted in critically ill patients requiring a central venous access. A meta-analysis by Dezfulian et al looking at the rates of infectious complications between single and multi-lumen catheters found a higher incidence of catheter related bloodstream infection with multi-lumen catheters with an odds ratio of 2.15. However, they did not find any

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significant difference between the 2 groups with respect to catheter colonization. (44)

2) *Ultrasound* :

Ultrasound guided central venous catheter insertion has been found to have a lower rate of mechanical complications, number of attempts at insertion, reduced time for central venous catheter insertion . However, whether this translates into a lower chance of development of infectious complications is not clear. Further studies need to be conducted in this field to draw clinical implications.

3) *Duration:*

The chance of development of infectious complications is higher as the duration of CVC increases. In a case control study conducted in a tertiary care centre in India the duration of catheter was found to be a predisposing factor for the development of CRBSI.

The mean duration was found to be higher among the cases (14.06 days) than controls (10.96 days). (21)

Duration of catheterization more than 1 week was associated with increased colonization of the central venous catheter tip. (45) This led to the concept of periodic replacement of central venous catheters in critically ill patients. However, routine replacement of central venous catheters has not been shown to

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be useful. Replacement of central venous catheters at scheduled time intervals is not recommended.

Routine replacement of central venous catheters, pulmonary catheters and arterial line was studied by Eyer et al in 112 patients. Patients were randomized to 3 arms: I – Weekly change to a new site, II – Change only when clinically indicated to a new site, III – Weekly change to same site by catheter exchange. They did not find a difference in the rate of catheter tip colonization or central line related bloodstream infection between weekly change of CVC compared with patients whose catheters were replaced as indicated. (46)

It is prudent to keep central venous catheters in situ as long as they are indicated and they should be promptly removed when unnecessary. The available evidence does not support routine CVC changes unless clinically indicated. Though there is a definite risk of catheter related bloodstream infection with increase in the duration of the central venous catheter, one must consider the risk of mechanical complications involved with the change of central venous catheter when clinically not indicated

4) *Guidewire exchange strategies*:

A meta-analysis by Cook et al was conducted to evaluate the effect of scheduled catheter changes on the rate of catheter colonization and infection.

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Change of central venous catheters with the help of guide wires was associated with a trend toward a higher frequency of catheter colonization with relative risk of 1.26.

The rate of catheter exit site infection was higher in the guide wire exchange group. The frequency of central venous catheter related bacteremia also showed a rising trend in the guide wire exchange group though the difference was not statistically significant. (relative risk 1.72, 95% confidence interval 0.89 to 3.33).(47) Guide wire exchange as a strategy to reduce the rate of central venous catheter related complications is currently not recommended. (48)

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5) *Maximal sterile precautions:*

Use of maximal sterile barrier precautions is recommended during central venous catheter insertion. This includes wearing a cap, mask, sterile gloves and gown and a sterile drape. Raad et al compared standard sterile precautions consisting of sterile gloves and small drape to maximal sterile precautions consisting of mask, cap, sterile gloves, sterile gown and large drapes. A randomized controlled trial was performed in a 500 bedded tertiary care center which recruited 343 patients. The controls had 6 times the incidence of catheter related infectious complications compared to the maximal barrier group. Cost benefit analysis proved high cost effectiveness of this precaution. (49)

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Another prospective study by Lee et al included 133 seriously ill patients who received a central venous catheter insertion in the emergency department or intensive care unit in a hospital in Seoul, Korea over an 8 month period in 2006. Out of 42 patients for whom maximal sterile barrier precautions were used, only 1 patient (2.4%) developed a catheter related bloodstream infection. Among 91 patients without the benefit of such precautions,14 patients (15.4%) developed catheter related bloodstream infection. This difference was statistically significant with odds ratio of 5.205 (Confidence Interval 0.015–1.136) and p value of 0.023. This study also found that the use of a mask led to decreased rate of bloodstream infection secondary to CVC with an odds ratio of 4.707 (confidence interval 0.020–0.819) and p value of 0.030.

In a landmark initiative implemented by Pornovost et al, simple checklist guided management of central lines including the maximal sterile barrier precautions showed significant reduction in the central line related sepsis. The rate of central line related bloodstream infections was 2.7 per 1000 catheter days at baseline to 0.62 per 1000 catheter days at 3 months (p value 0.001, confidence interval 0.47–0.81) (50)

6) *Skin preparation:*

Skin preparation with chlorhexidine solution of more than 0.5% concentration along with alcohol is recommend during insertion and dressing changes of central venous catheter. Though povidone iodine was traditionally used for skin

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preparation, there is adequate evidence to support the use of chlorhexidine for skin preparation prior to central venous catheter insertion.

A prospective study by Maki et al was conducted to assess the efficacy of cutaneous antisepsis to prevent central venous catheter associated infections. They studied three antiseptics for disinfection of patients' catheter insertion sites - 10% povidone-iodine, 70% alcohol, or 2% aqueous chlorhexidine disinfection of the site before insertion and for site care every alternate day. The patients who were in the chlorhexidine arm had the lowest incidence of local catheter-related infection (2.3 per 100 catheters vs 7.1 and 9.3 for alcohol and povidone-iodine, respectively, p = 0.02). The incidence of catheter related bacteraemia was also lower in the chlorhexidine arm as compared to the other 2 arms with an odds ratio of 0.16 and p value of 0.04.

A trial published by Mimoz et al compared 10 % povidone iodine to a combination of chlorhexidine, benzalkonium and benzyl alcohol. This study included both central venous as well as arterial lines. The colonization rates in the chlorhexidine group and iodine group were 8 and 31 per 1000 catheter days respectively with a relative risk of 0.3, 945% confidence interval 0.1 to 1 and p value of 0.03. The sepsis rates were 5 and 19 per 1000 catheter days respectively with relative risk of 0.3, 95% confidence interval of 0.1 to 1 and p value of 0.02. Subgroup analysis revealed that Gram positive bacterial infections were prevented with a higher efficacy with chlorhexidine in this study.

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Dressings to cover the site of insertion of a central venous catheter include sterile gauze or transparent semipermeable dressings. However, gauze dressings are preferred if there is bleeding, oozing or if the patient is diaphoretic.

7) *Obesity:*

Though the association of obesity with catheter related infectious complications is not proven, obesity has been shown to influence the integrity of the catheter dressings and the colonization rate of central venous catheters. In a study done among internal medicine ward patients with central venous catheters, inadequate dressings were more likely among patients who were obese, adjusted odds ratio, 3.4 (51)

In a randomized controlled trial looking at the rates of infectious complications in hemodialysis catheters, patients with a higher BMI had higher incidence of colonization in the femoral group as compared to the jugular group – 50.9 versus 24.5 per 1000 catheter days respectively. Jugular catheterization was associated with increased incidence of catheter colonization as compared to femoral catheterization (45.4 vs 23.7 per 1000 catheter-days; HR, 2.10; 95% CI, 1.13-3.91; *P*=.017) in the patients with low BMI (24.2). However, there was no difference in catheter related bloodstream infection in patients with high and low BMI.

8) *Antibiotic coated catheters***:**

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Catheters coated with minocycline and rifampicin, chlorhexidine and sulfadiazine and silver impregnated catheters have been used in order to reduce catheter related infectious complications. Multiple studies have been done to assess the benefits of antibiotic coated catheters. A meta-analysis conducted by Hockenhull et all which included 38 randomized controlled trials found that central line related bloodstream infections were lower in the patients with antibiotic coated catheters (odds ratio 0.49 ; 95% confidence interval 0.37-0.64) (52). In a subgroup analysis the benefit was pronounced in the second generation central venous catheters. (Odds Ratio - 0.26, 95% confidence interval - 0.15-0.46). However, most of the studies had methodological flaws. There was wide heterogeneity in the studies and almost all studies were funded by the catheter manufacturing companies. Another systematic review by Neil-Weise et al consisted of 21 trials of which 18 trials showed benefit. The number needed to treat ranged from 12 to 182 and almost all the studies had methodological flaws. (53)

The risk of development of antibiotic resistance is a cause for concern when antibiotic coated catheters are used. The application of topical ointment or creams at insertion sites of central venous catheters is not recommended as it can promote bacterial resistance and fungal infection. (54,55)

9) Dressings:

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Various dressings are used to cover the insertion site of the central venous catheter over the skin. Gauze dressing is used traditionally and there are newer transparent polyurethane dressings like Tegaderm and Opsite. At present there is no clear benefit of either material. Polyurethane dressings bear the advantage of ease of application and earlier recognition of skin erythema and infection at the puncture site. A Cochrane review published in 2003 compared gauze and polyurethrane dressings. They did not find any significant difference in the rate of CRBSI between the 2 groups. (56) Another Cochrane systematic review published in 2011 found that catheter related bloodstream infections were more in the polyurethane group when compared with gauze dressings with an odds ratio of 4, 95% confidence interval ranging from 1.02 to 17.23. However, these comparisons were made with studies which had small sample sizes. (57)

SITE OF INSERTION

The site of insertion of the central venous catheter is thought to influence the rate of infectious complications. It is believed that femoral central venous catheters carry a greater risk of infectious complications compared to internal jugular and subclavian catheters. The femoral insertion site is in proximity to the perineal region which is colonized by the genitourinary flora. Femoral central venous catheters are preferred in an emergency. In such circumstances, adherence to aseptic precautions may not be strictly followed.

Earlier studies had shown a higher rate of infectious complications with femoral central venous catheters. In a study conducted in critical care units in France over a three year period from 1997 to 2000, mechanical, infectious and thrombotic complications of

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subclavian and femoral central venous catheters were assessed. Among the 270 catheters assessed for infectious complications, the incidence of infectious complications was 20 per 1000 in the femoral arm and 3.7 per 1000 in the subclavian arm. 4.4% of the femoral catheters had infectious complications as compared to 1.5% of the subclavian catheters.(5) A prospective observational study conducted in 2005 found a higher rate of colonization and catheter related bloodstream infection in femoral group as compared to the internal jugular and subclavian group.

However, over the last few years, the overall rate of infectious complications associated with central venous catheters has decreased. This is thought to be due to strict adherence to aseptic precautions during central venous catheter insertion, better catheter care and education and training of healthcare personnel.

A randomized controlled trial in France conducted from 2004 to 2007 found that the rate of colonization in hemodialysis catheters in the jugular and femoral group were 40.8 and 35.7 per 1000 catheter days with no statistically significant difference between the two groups.

The rate of catheter related bloodstream infection in the jugular and femoral groups were 2.3 per 1000 catheter days and 1.5 per 1000 catheter days respectively. The difference between the two groups was not statistically significant. (58)

A systematic review and meta-analysis to determine the risk of catheter related infectious complications due to CVCs at femoral region compared to neck CVCs was published by Maki et al in 2012. This review included randomized controlled trials as

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well as cohort and observational studies that compared the rate of catheter related bloodstream infection at the subclavian or internal jugular and femoral site. The frequency of venous thrombosis at different sites, along with the prevalence of CRBSI was recorded. The rate of CRBSI was 2.5±1.9 per 1000 central venous catheter days with a range of 0.6 to 7.2. There was no significant difference between the subclavian / internal jugular group and the femoral group in the risk of catheter related bloodstream infections in the randomized controlled trials. Other trials showed a significant risk with femoral site when compared to the internal jugular site with relative risk of 1.90 and confidence interval of 1.21 – 2.97. However this apparent difference could be explained by 2 studies which were statistical outliers. When those two studies were discounted, there was no significant difference (relative risk 1.35 (95% CI 0.84 – 2.19). Meta regression analysis was also done which showed that studies published earlier favoured the subclavian and internal jugular site of insertion of central venous catheters. There was no significant difference in the rate of catheter related bloodstream infection between the femoral and the internal jugular sites with a relative risk of 1.35 and confidence interval of 0.84 to 2.19. The risk of development of deep vein thrombosis was recorded in two studies. There was no significant difference in the rates of deep vein thrombosis between the different sites of central venous catheter insertion. However, there was heterogeneity between studies. (59)

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JUSTIFICATION FOR THE STUDY

Though earlier studies favoured the subclavian and internal jugular route of central venous catheter insertion as compared to the femoral route for prevention of infectious complications, recent studies have failed to show similar results.

The site of central venous catheter insertion should be chosen depending upon the skill of the operator as well as the risk of mechanical and infectious complications. The femoral site of central venous catheter insertion is often avoided as it is thought to be associated with a higher risk of infectious complications and deep venous thrombosis. However, the risk of life threatening mechanical complications, specifically pneumothorax and hemothorax is present only with the insertion of subclavian and internal jugular central venous catheters. In the event of puncture or cannulation of the adjacent artery, it is easier to apply compression to the femoral artery rather than the internal carotid or subclavian artery. Catheterization of the femoral vein requires less skill and can be done with ease by relatively inexperienced operators.

Over the years the overall rate of central venous catheter related bloodstream infections has shown a significant decline. Marik's study (59) demonstrated a relation between the rate of infections and the time of publication. The femoral CVCs had an increased CRBSI rate in the earlier studies whereas recent studies have shown little difference. There is limited data in this field in the Indian scenario.

Therefore we decided to do this study to conclude if one site is better than the other.

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METHODOLOGY

STUDY DESIGN: Randomized controlled trial

STUDY POPULATION: Patients more than 15 years of age admitted in Medical Intensive Care Unit and Medical High Dependency Unit who required the insertion of a central venous catheter were included in the study

STUDY SETTING: Christian Medical College Vellore is a teaching tertiary care hospital situated in Tamil Nadu 140 Km west of Chennai. It was established in 1900 and forms one of the important referral centers in South India. There are about 2700 bed overall with 168 beds dedicated for ICU care. Medical Intensive Care Unit (ICU) and Medical High Dependency Unit (HDU) have 12 beds each with a total of 24 beds which function as an open system with the General Medicine units admitting patients directly. Medical Intensive Care Unit admits patients from all specialties whereas Medical High Dependency Unit beds are restricted to the General Medical units only.

The average number of admissions is 67.1 per month in the MICU and 58.1 in MHDU. The number of central line days in MICU and MHDU are 252.4 and 240.4 days respectively.

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INTERVENTION: There were 2 arms

i) Internal jugular central venous catheter

ii) Femoral central venous catheter

Patients were allocated to the 2 arms with a 1:1 ratio

PRIMARY OUTCOME

The rate of colonization in internal jugular central venous catheters and femoral central venous catheters inserted in Medical Intensive Care Unit and Medical High Dependency Unit.

SECONDARY OUTCOME

The rate of catheter related bloodstream infection in internal jugular central venous catheters and femoral central venous catheters inserted in Medical Intensive Care Unit and Medical High Dependency Unit.

CATHETER TIP COLONIZATION

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This is defined as growth of more than 15 colony-forming units of a micro-organism from the central venous catheter tip using semi-quantitative culture methods (Maki's roll plate technique).

CATHETER RELATED BLOODSTREAM INFECTION (CRBSI)

This is defined as positive semi- quantitative (>15 CFU) cultures from the catheter tip and positive peripheral blood cultures where the same micro-organism with the same species and antibiogram is isolated from the catheter segment and peripheral blood.

STUDY PERIOD: This study was conducted over a 1 year period from July 2013 to June 2014

METHOD OF RANDOMIZATION: Computer generated block randomization with varying block size was used. There were 2 sets of random numbers. These were used for Medical Intensive Care Unit and Medical High Dependency Unit respectively.

ALLOCATION CONCEALMENT: Opaque sealed envelopes were used to ensure allocation concealment.

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BLINDING: This was a **s**ingle blinded randomized controlled trial. The microbiologists who interpreted the central venous catheter tip culture results were not aware of the site of the central venous catheter. The patient and physician were aware of the site of the central venous catheter.

TYPE OF TRIAL: Non inferiority trial

SAMPLE SIZE CALCULATION

This was based on an earlier study which compared the colonization rate between central venous catheters at different insertion sites. (8)

FORMULA FOR SAMPLE SIZE

$$n = \frac{2PQ(Z_{\frac{\alpha}{2}} + Z_{1-\beta})^2}{d^2}$$

where,

$Z_{\frac{\alpha}{2}}$ is 5% level of significance = 1.96

$Z_{1-\beta}$ is the power of the study = 0.842

d = 14% clinically important difference between the 2 groups

P = average percentage in the two groups

Q = 100 – P

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$$n' = \frac{n}{(1-r^2)}$$

Where, r = 5% exclusion for whom catheter tip is not sent for culture

With 80% power and 5% level of significance, with a clinically important difference of 14 % between the 2 groups, and 5% exclusion for whom the catheter tip is not sent for culture, the required sample size was 89 in each arm.

INCLUSION CRITERIA

Patients more than 15 years of age admitted in Medical Intensive Care Unit and Medical High Dependency Unit who require insertion of a central venous catheter.

EXCLUSION CRITERIA

- Deep vein thrombosis (upper or lower limb)
- Cardiac arrest in the last 24 hours
- Pregnant women
- Immunocompromised patients (HIV infection, malignancy, patients on immunosuppressant, chemotherapy and post renal transplant patients)

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- Coagulopathy (Coagulopathy was defined as INR of 2 or more or thrombocytopenia with platelet count less than 50,000/ml)
- Skin lesion (femoral or neck region)
- Profound volume overload that precludes putting the patient in Trendelenbergs position
- Insertion of a central venous catheter in the last 7 days
- Patients or relatives of patients who do not give consent
- Operator preference – If the physician who is performing the central venous catheter insertion is not confident of insertion of a central venous catheter in either the internal jugular or the femoral site for that patient

ANALYSIS: Per protocol analysis

REMOVAL OF CENTRAL VENOUS CATHETER

The central venous catheter was removed when deemed necessary by the treating physician.

Reasons for removal included the following:

1) Central venous catheter was no longer required
2) Suspected central venous catheter related bloodstream infection
3) Catheter related deep vein thrombosis
4) The patient had expired
5) Misplaced central venous catheter

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The central venous catheter tips of all the patients included in the study were sent for culture.

DESCRIPTION OF THE STUDY

This study was conducted with the purpose of assessing the rate of infectious complications of internal jugular and femoral central venous catheter. This was a randomized controlled trial in which the site of central venous catheter insertion was determined by randomization. Patients admitted to the Medical Intensive Care Unit and Medical High Dependency Unit who required the insertion of a central venous catheter were assessed for eligibility for inclusion into this study. Patients were recruited from July 2013 to June 2014. The treating physician assessed the patients for eligibility into the study. The details of the study were explained to the patient and/or relatives in their regional language. Those who were willing to participate in the study and gave written consent were recruited into the study. Opaque sealed envelopes were used. After a patient was decided to be included in the study, the physician would open the envelope where the site is mentioned.

The central venous catheters were inserted by registrars and interns (under the supervision of the registrars). The registrar had the option of inserting the catheter under ultrasound guidance or blindly with the help of anatomical landmarks. The ultrasound machine used was SonoSite MicroMaxx P 17/5-1 MHz, manufactured by SonoSite, Inc. Bothell, Washington, United States of America.

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There were 2 arms with equal allocation:

i) The first arm included patients with internal jugular central venous catheter.

ii) The second arm included patients with femoral central venous catheter.

Informed consent was obtained from the patients or the relatives of the patient (Informed consent form - Appendix I). The colonization and catheter related bloodstream infection rates in the patients included in the study were calculated.

Patients for whom the central venous catheter was being changed were excluded from the study. This is because infectious complications in these patients could be due to the new or the old central venous catheters.

If central venous catheter insertion at the specified site was unsuccessful after multiple attempts, then a different site would be chosen for insertion and the patient would be excluded from the study. Central venous catheters were inserted under aseptic precautions. The operator performing the catheter insertion wore sterile gown, mask, cap and gloves. The insertion site was cleaned with 2% chlorhexidine gluconate solution. In case of internal jugular vein catheters, the placement of the catheter was confirmed by chest X ray prior to administration of medication or intravenous fluids.

The central venous catheters used in this study were triple lumen catheters (Arrow Multi-lumen Central venous Catheterization Set with Blue FlexTip catheter REF CV – 12703) with a single 16 gauge lumen and two 18 gauge lumens. These catheters are made of polyurethrane. They are 7 French catheters which are 16 cm in length. They are radio opaque and are non-medicated catheters. Transparent film dressing were used which were

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changed every 3 days. In case of excessive secretions or oozing from the site, gauze dressings were used.

The central venous catheters were removed under aseptic precautions by the registrar or intern. The distal 5 cm of the catheter along with the tip was excised and sent for culture.

Semi-quantitative culture method was used Maki's roll plate technique. The catheter tip was rolled on agar culture plate and incubated at 37 degrees Celsius. The culture plate was examined at 24 and 48 hours to look for colony forming units. Colony morphology, gram staining and biochemical identification of the organism was done by the routine laboratory methods. At the time of recruitment of patients into the study, preliminary data was recorded. This included patient related factors (i.e. age, sex, comorbidities, current problems, diagnosis, indication for central venous catheter insertion) and procedure related factors (i.e number of attempts at catheter insertion, ultrasound guidance, registrar or intern and operator experience).

The patient was followed up for any symptoms and signs of central venous catheter related infection. Presence of new onset fever spikes, bacteremia as detected by blood culture, signs suggestive of Catheter Related Local Infection including pain, redness, purulent discharge at the site of CVC insertion were recorded.

The central venous catheter tip was sent for culture for all patients. For patients in whom CRBSI was suspected, the catheter tip was sent for culture as part of routine investigations. In patients for whom CRBSI was not suspected, the catheter tip was also sent for culture on removal of the catheter. This was funded by the study.

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The microbiologist interpreted the reports of the central venous catheter tip culture. Growth of more than 15 Colony Forming Units on culture of the central venous catheter tip was considered as colonization.

For patients with fever who were suspected to have a central line related bloodstream infection, peripheral blood cultures were also sent.

All blood cultures were drawn using chlorhexidine skin preparation. 6-10 ml of blood was sent in BacT/Alert 3D blood culture media. This consists of 40 ml of tryptic soy broth (TSB.) It is processed via BacT/Alert systems (bioMérieux, Hazelwood, Missouri, USA) with colorimetric sensor technology that allows complete automated detection of any growth. Growth is detected as early as 6 hours following incubation. In case of any positive result, it is incubated on blood agar and MacConkey agar. Further identification is made based on the colony morphology and biochemical methods based on the growth obtained. In case of no growth, the culture medium is left in the automated systems for 5-7 days before labeling as a negative culture.

DATA COLLECTION

Data was collected onto a predesigned clinical research form (Appendix II). At the time of central venous catheter insertion, the following were planned for collection:

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PATIENT RELATED FACTORS:

1. Age and sex
2. Indication for central venous catheter insertion
3. Comorbidities (diabetes mellitus, hypertension, chronic kidney disease, chronic obstructive pulmonary disease)
4. Site of insertion of central venous catheter
5. Number of days of hospital stay prior to insertion of central venous catheter
6. Admission diagnosis
7. Vitals signs at admission
8. APACHE II score (Appendix III)
9. Side and site of central venous catheter insertion

OPERATOR / PROCEDURE RELATED FACTORS:

1. Number of attempts at catheter insertion
2. Whether the catheter was inserted under ultrasound guidance
3. Time at which central venous catheter insertion was done
4. Place of central venous catheter insertion
5. Experience of the operator performing the central venous catheter insertions

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At the time of central venous catheter removal, the following data were planned for collection:

1. Final diagnosis of the patient
2. Number of central venous catheter days
3. Reason for removal of the central venous catheter
4. Immediate complications of central venous catheter insertion
5. Local examination – presence of purulence, warmth, tenderness at the catheter insertion site
6. Did the patient have fever, chills , hypotension from central venous catheter insertion till removal
7. Arterial line – site, number of days of arterial line
8. Whether the patient required mechanical ventilation
9. Whether the patient had a tracheostomy
10. Whether the patient required inotropic support

FUNDING

A FLUID Research grant (Institutional Grant) was approved for the purpose of the study. The fund was used for the culture of the central venous catheter tips.

INSTITUTIONAL REVIEW BOARD APPROVAL AND ETHICAL CONSIDERATIONS

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Institutional Review Board (Research and Ethics Committee) approval was obtained prior to the commencement of the study (IRB minutes number 8134 dated 19.12.2012- appendix VI). Written consent was obtained prior to insertion of central venous catheter for all patients. Permission was obtained from the parent units prior to including their patients in this study.

STATISTICAL ANALYSIS

Data from the Clinical Research Form was entered into Microsoft Excel spreadsheet. The distribution of continuous variables like age was expressed in terms of mean and standard deviation. All categorical variables were expressed using frequencies and percentages. Chi-square test exact was used to find the difference between the colonization rates across the 2 groups. The results were analyzed using SPSS version 17. Per protocol analysis was done.

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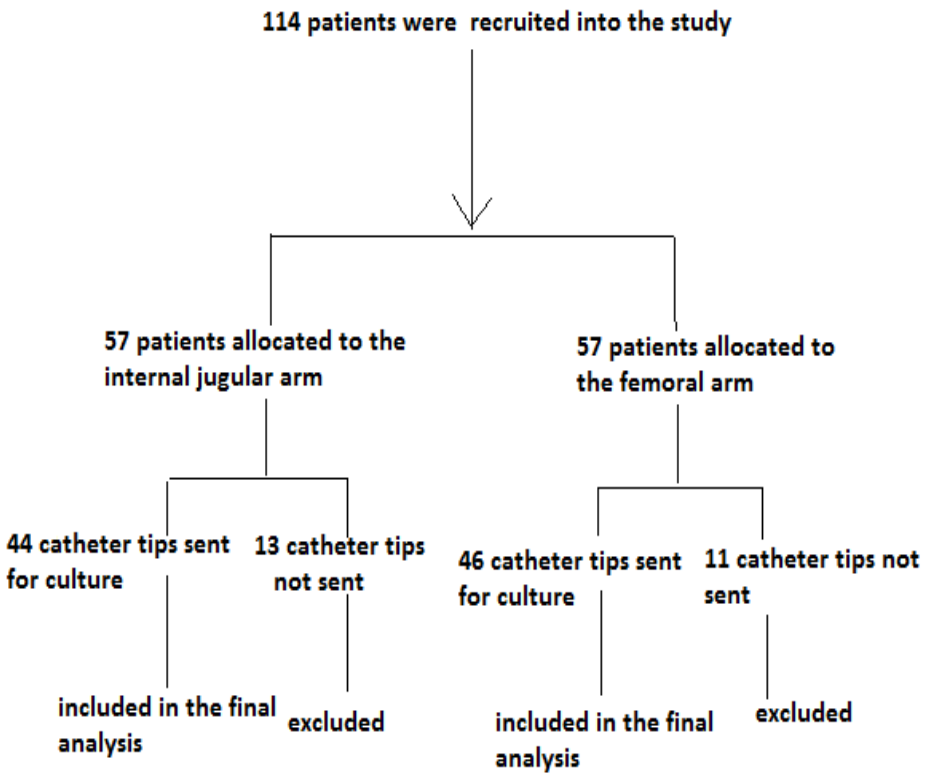
RESULTS

Flowchart of patients included in the study:



One hundred and fourteen patients were included in the study. Fifty seven patients were recruited in the femoral and internal jugular arm each. Informed consent was obtained from all patient / patients relatives for participation in the study. In the patients in the jugular arm, forty four tips were sent for culture. For 13 patients, the central venous catheter tips were not

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sent for culture. The femoral arm had 57 patients, of whom central venous catheter tips were sent for culture in 46 patients. 90 patients were included in the final analysis.

The reason for tips not being sent for culture were that the central venous catheter was discarded after removal, the patient was discharged at request with the central venous catheter in situ or the patient was transferred to another healthcare facility with the central venous catheter.

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS:

AGE DISTRIBUTION

The mean age of patients in the jugular group and femoral groups were similar (45.84 versus 45.84 years) respectively.

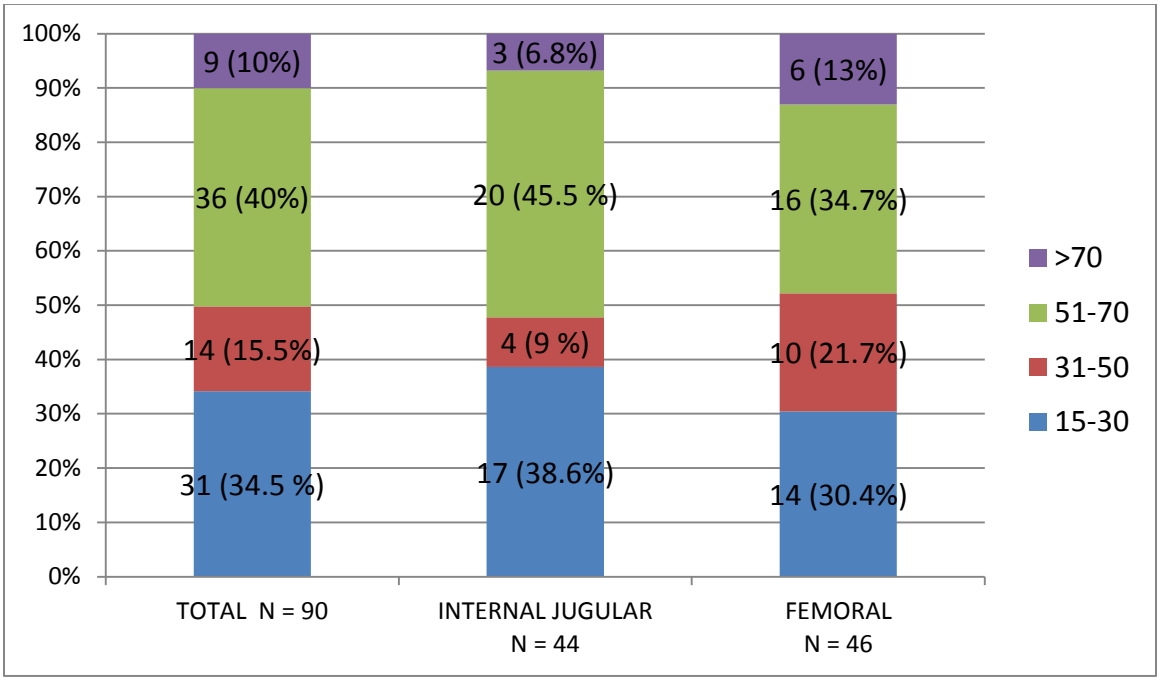

Fig. 1: Age distribution of patients in the jugular and femoral group.

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The majority of patients across both arms belonged to 51 to 70 year age group (Figure 1). In the internal jugular group, 45% of the patients were between 51 – 70 years. 38.6% of the patients were between 15 – 30 years of age in the internal jugular group. In patients with femoral catheters, 34% belonged to the 51 – 70 year age group and 30% in the 15 – 30 year age group. 13% of patients in the femoral group were above 70 years as compared to 6.8% in the jugular group.

SEX DISTRIBUTION

In this study, 64.4 % of patients were males and 35.6% were females (Figure 2). Sex ratio (1.77 : 1) was in favour of males. 61.3% of patients in the internal jugular group were males whereas 67.4% in the femoral group were males.

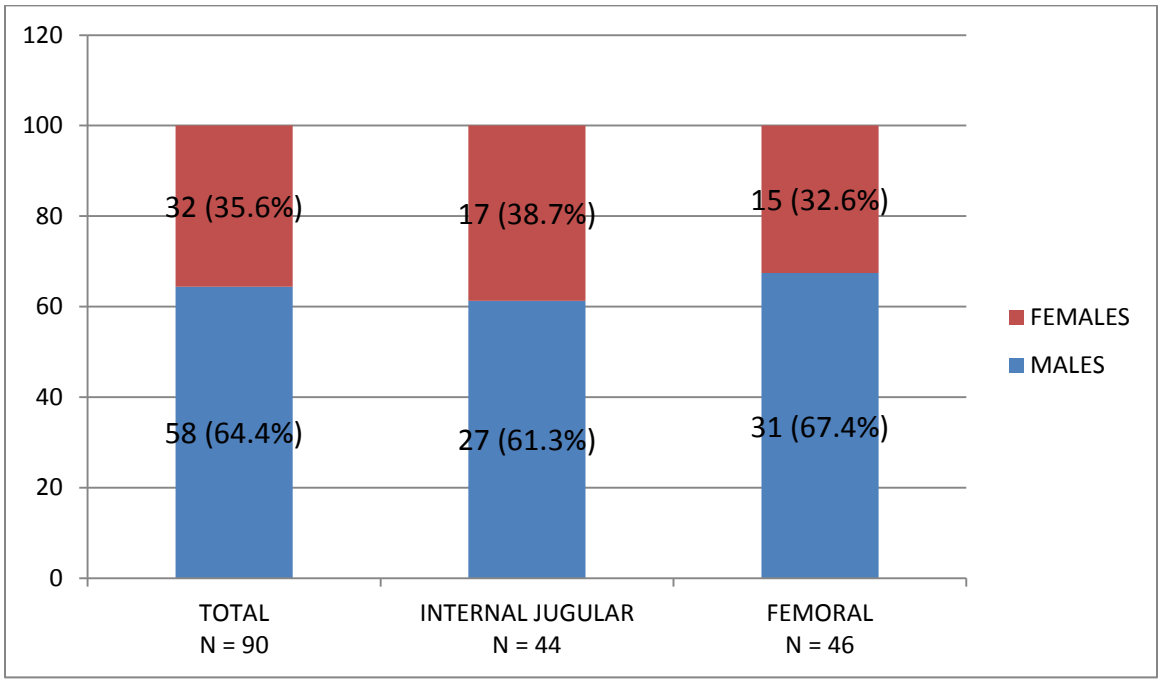

Fig. 2: Sex Distribution in the internal jugular and femoral groups

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STATE WISE DISTRIBUTION OF PATIENTS

Table 1: State wise distribution of patients

STATE	NUMBER OF PATIENTS	PERCENTAGE
Andhra Pradesh	14	15.6%
Jharkhand	1	1.1%
Karnataka	1	1.1%
Kerala	1	1.1%
Tamil Nadu	67	74.5%
West Bengal	6	6.6%

Most of the patients were from Tamil Nadu (74%). Andhra Pradesh and West Bengal contributed to 15.5% and 6.6% of patients respectively (Table 1).

COMORBID CONDITIONS

1) DIABETES MELLITUS:

30 (33.3%) out of 90 patients in this study were diabetics (Figure 3). In the internal jugular group, 36% of patients were diabetics whereas in the femoral group 30 % had diabetes mellitus.

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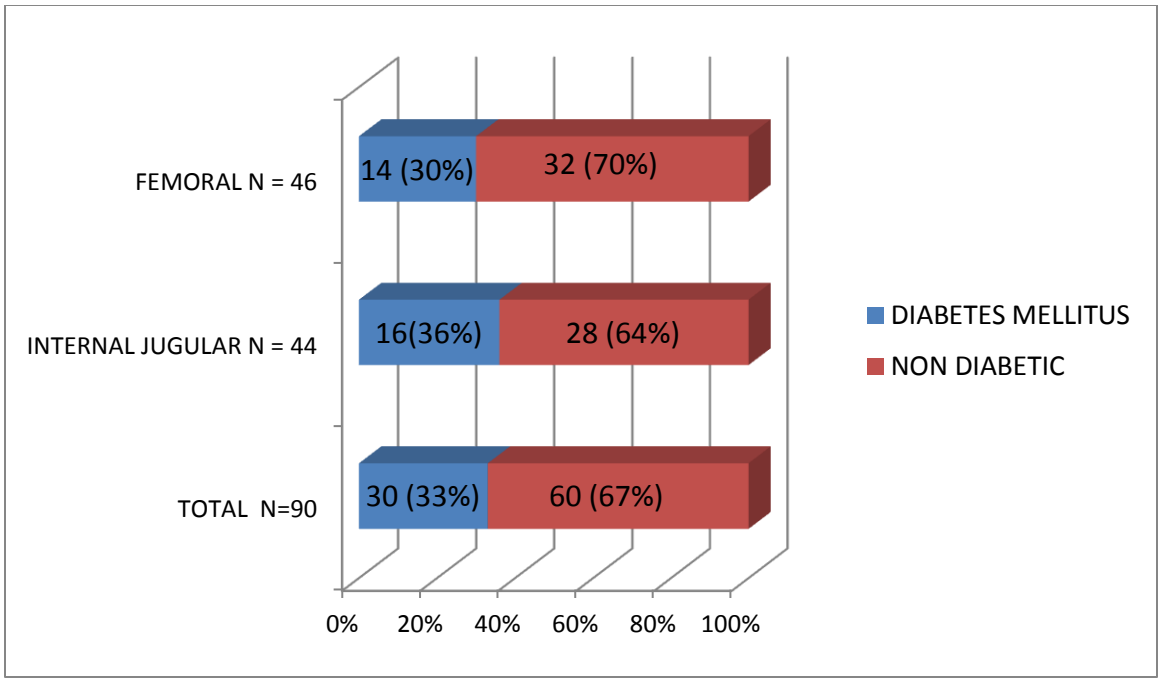

Fig. 3: Percentage of Patients with Diabetes Mellitus

2) HYPERTENSION

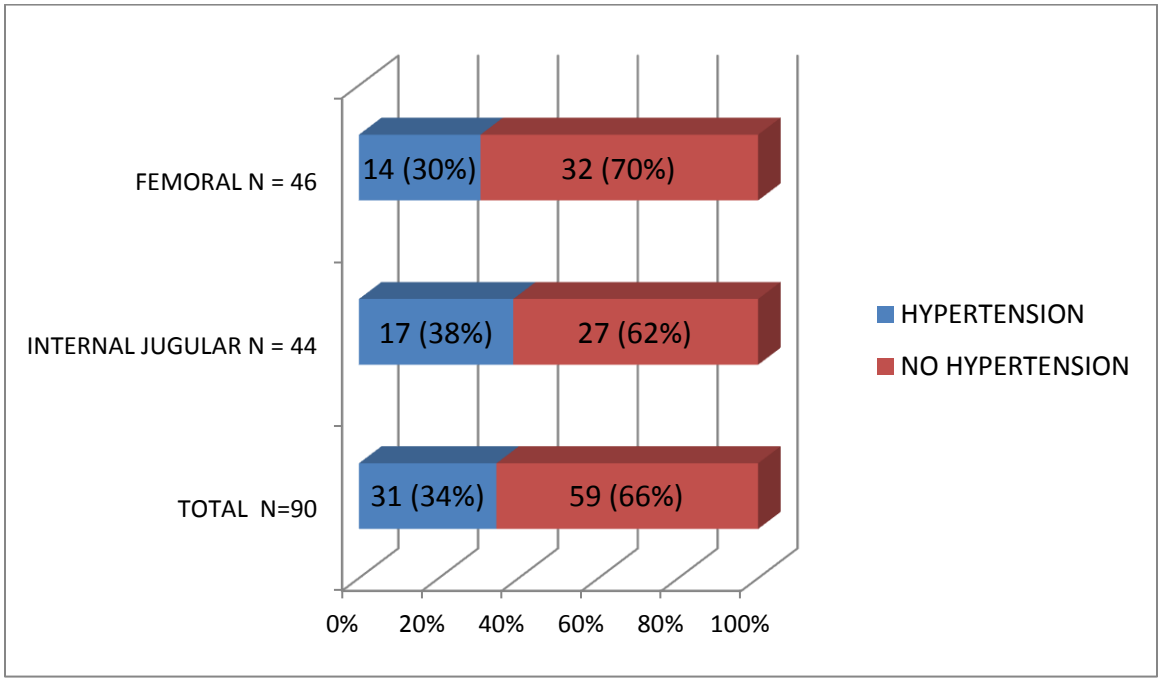

Fig. 4: Percentage of patients with hypertension

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34% of the patients in this study had essential hypertension (Figure 4).

The femoral group had a lower proportion of patients with essential hypertension as compared to the internal jugular group (30% versus 38%).

3) CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) :

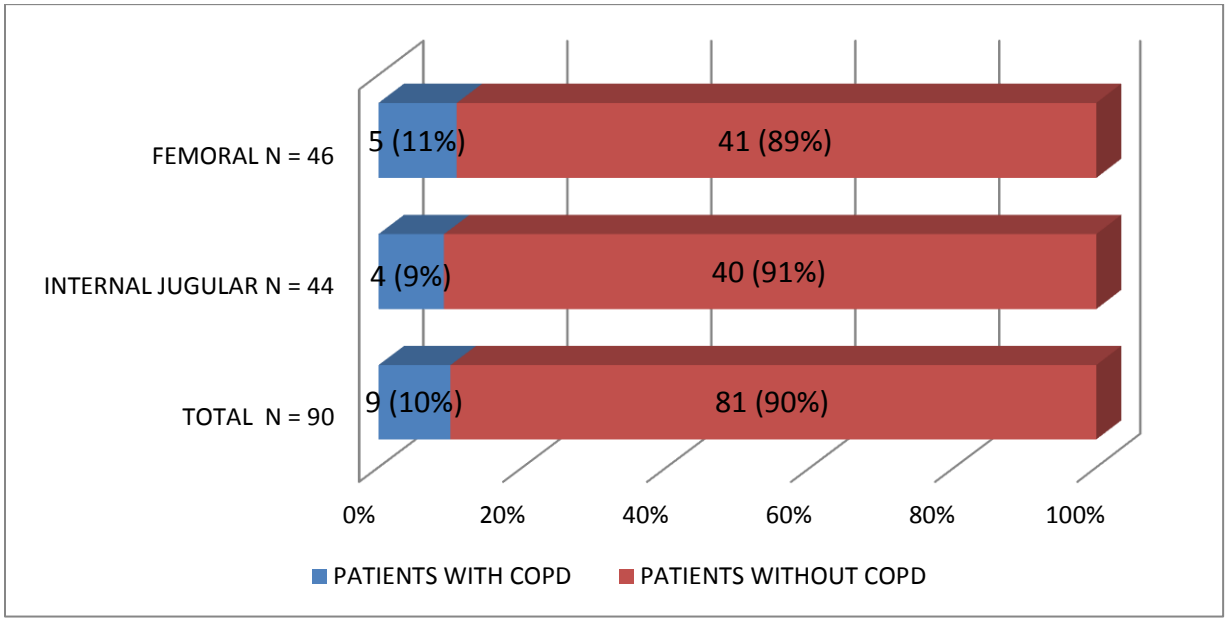

Fig. 5: Percentage of patients with chronic obstructive pulmonary disease

Among 90 patients included in this study, 9 patients (10%) had chronic obstructive pulmonary disease (Figure 5).

4 patients (9%) in the internal jugular group had chronic obstructive pulmonary disease as compared to 5 patients (11%) in the femoral group.

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4) CHRONIC KIDNEY DISEASE (CKD)

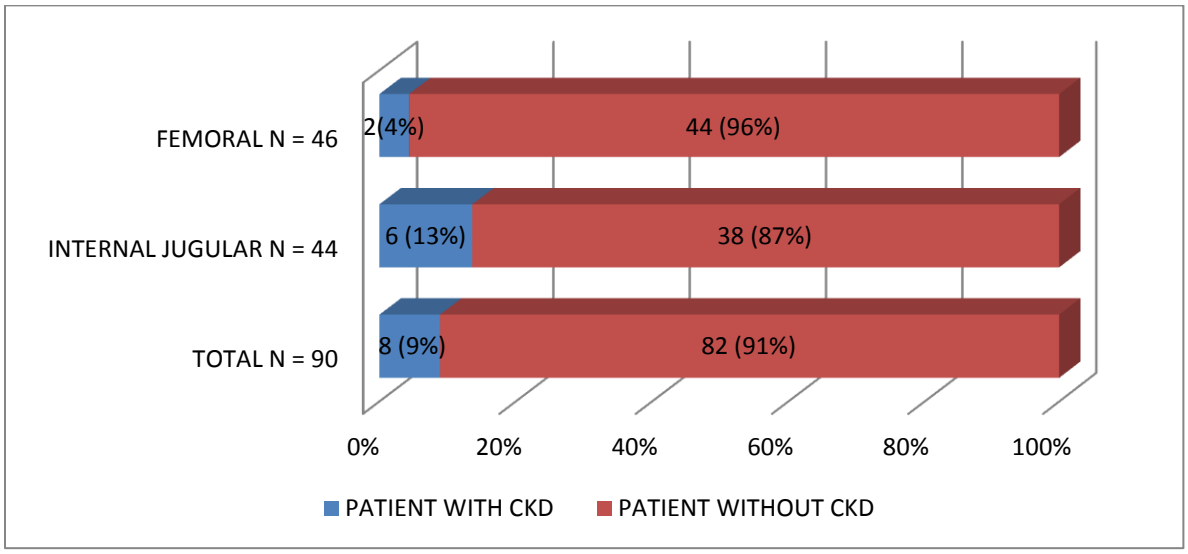

Fig. 6: Percentage of patients with chronic kidney disease

In this study, 8 (9%) out of 90 patients had chronic kidney disease (Figure 6).

The femoral group had a lower proportion of patients with chronic kidney disease as compared to the internal jugular group (4 % versus 13 % respectively).

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ADMISSION DIAGNOSIS

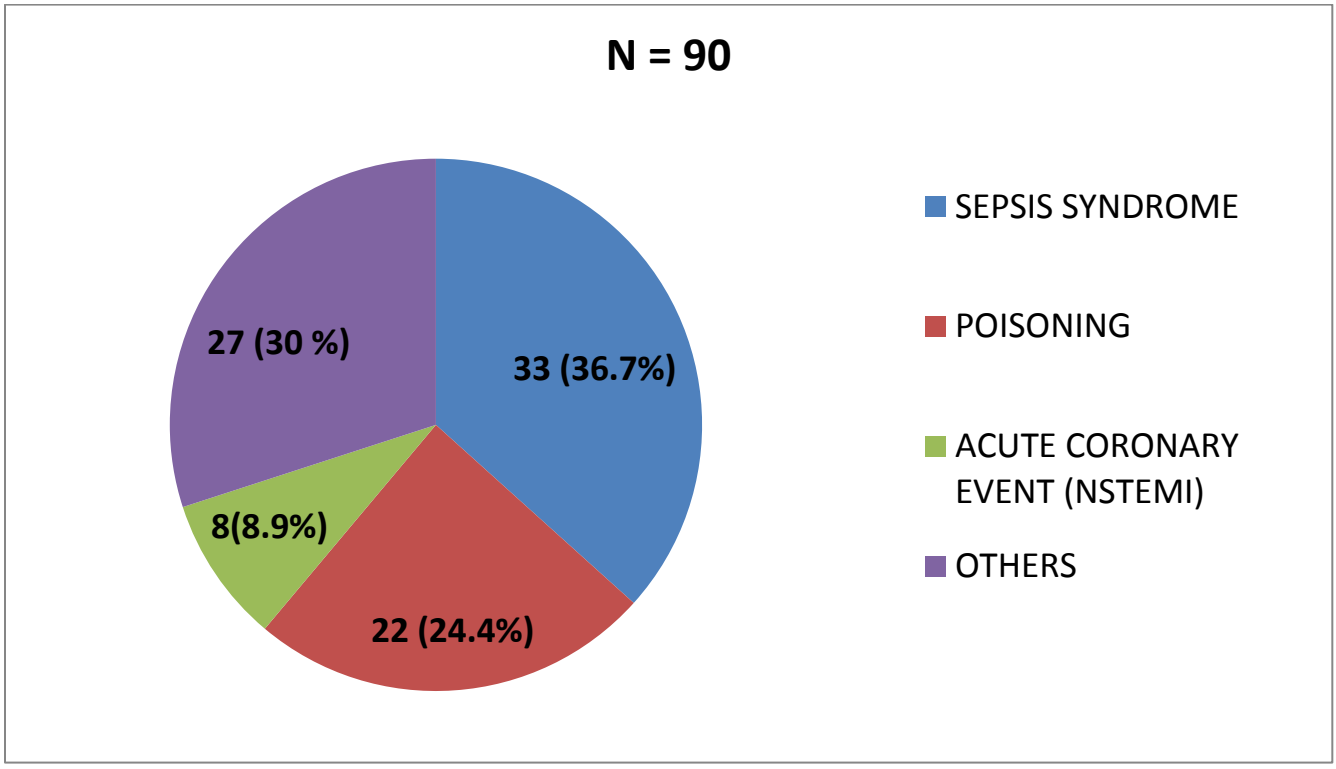

Fig. 7: Admission diagnosis of the patients included in the study

Most of the patients included in the study were admitted with a diagnosis of sepsis syndrome (36.7%) (Figure 7)

22 patients (24.4%) had an admission diagnosis of poisoning and 8 patients (8.9%) were admitted with history of non ST elevation myocardial infarction.

Others: The diagnosis of patients under this category is included in appendix IV.

.

Table 2: Profile of patients with sepsis syndrome

Pneumonia	10 (30.3%)	Infective Exacerbation of COPD	2 (6.1 %)
No definite focus of infection*	6 (18.1%)	Meningitis	2 (6.1%)
Scrub Typhus	5 (15.1%)	Infective endocarditis	1 (3 %)
Pyelonephritis	4 (12.1%)	Dengue	1 (3 %)
Skin and Soft Tissue Infections	2 (6.1 %)		

*there were no localizing features

Among the patients with sepsis, 10 patients (30.3%) had pneumonia (Table 2).

6 patients (18.1%) did not have definite localizing features or focus of infection at admission. 4 patients (12.1%) were diagnosed to have pyelonephritis.

There were 2 patients with skin and soft tissue infections. One patient had cellulitis and the other patient had necrotizing fasciitis. There were 2 patients with pyogenic meningitis and 2 patients with infective exacerbation of chronic obstructive pulmonary disease.

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Table 3: Profile of Poisoning patients

Organophosphorus	18	Amitriptylene	1
Nitrobenzene	1	Carbamazepine	1
Oduvanthalai	1		

Among the patients with poisoning, 18 (81.8%) out of 22 patients had history of consumption of organophosphorus compounds (Table 3). There were 2 patients admitted with drug overdose. One patient had history of consumption of amitriptylene and the other patient had consumed carbamazepine tablets.

Table 4: Admission diagnosis of patients in the internal jugular and femoral group

	INTERNAL JUGULAR	FEMORAL
SEPSIS SYNDROME	15 (34%)	18 (39.1%)
POISONING	9 (20.4%)	13 (28.2%)
ACUTE CORONARY SYNDROME (NSTEMI)	6 (13.6%)	2 (4.3%)
OTHERS	14 (31.8%)	13 (28.2%)
TOTAL	44	46

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The femoral group had a higher proportion of patients with sepsis syndrome as compared to the internal jugular group. (39.1% versus 34.1%) (Table 4). Patients with poisoning were also more in the femoral group than the jugular group. (28.2 % versus 20.4%)

APACHE II SCORE

Table 5: APACHE II score of patients in the internal jugular and femoral groups

	INTERNAL JUGULAR	FEMORAL
MEAN APACHE II SCORE	19.93	19.62
STANDARD DEVIATION	6.713	6.043
MINIMUM SCORE	8	9
MAXIMUM SCORE	33	35

The mean APACHE II score (Appendix III) in the jugular group and femoral group were similar (19.93 versus 19.62) (Table 5). The scores ranged from 8 to 33 in the jugular group and from 9 to 35 in the femoral group.

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INDICATION OF CENTRAL VENOUS CATHETER INSERTION

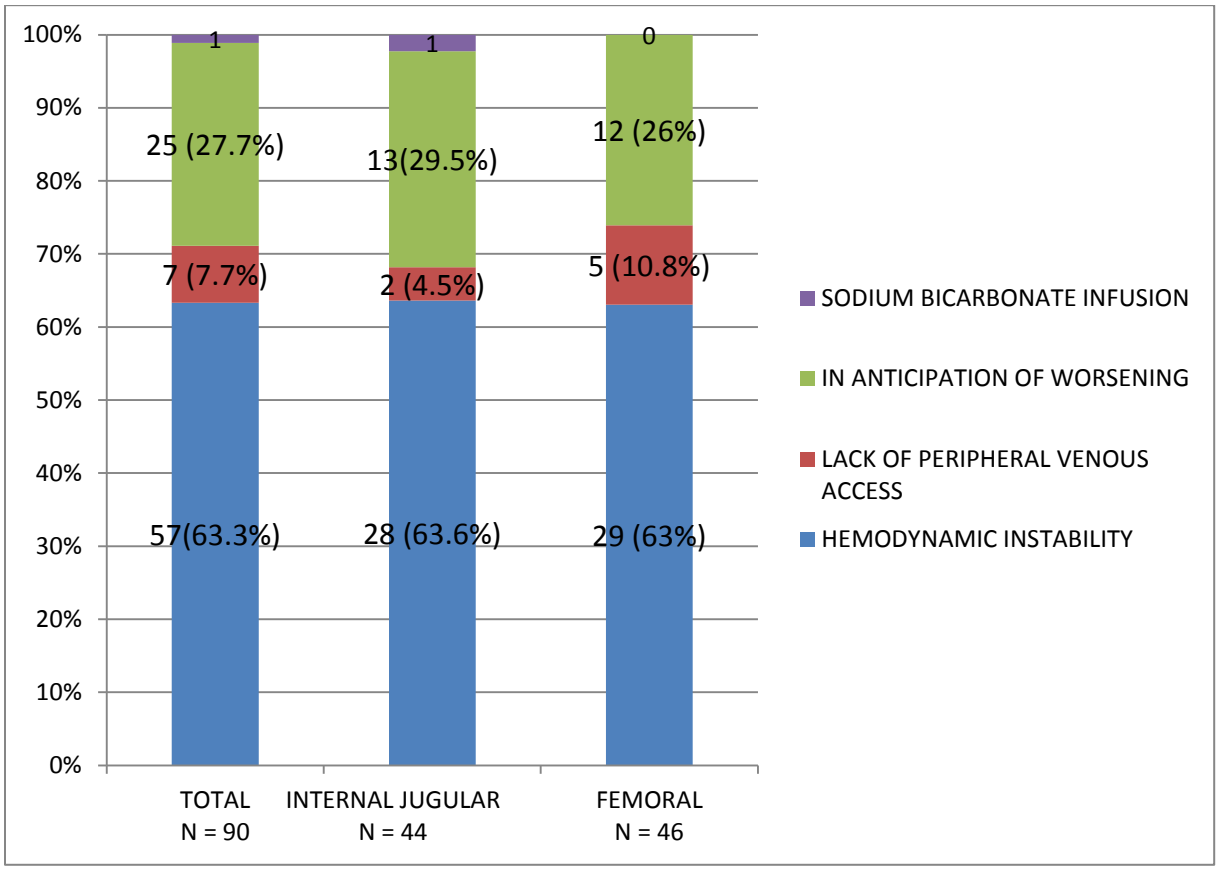

Fig 8: Indication of central venous catheter insertion

The most common indication for insertion of central venous catheters was hemodynamic instability in both groups (63%) (Figure 8).

Central venous catheter insertion was performed in anticipation of worsening of the patient's condition in 27.7% and lack of a peripheral venous access in 7.7%. Central venous catheter insertion was done for 1 patient in the internal jugular group as the patient required continuous sodium bicarbonate infusion.

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DAYS OF HOSPITAL STAY PRIOR TO CATHETER INSERTION

The mean number of days of hospital stay prior to central venous catheter insertion was 4.2 days in the internal jugular group and 2.5 days in the femoral group.

MECHANICAL VENTILATION

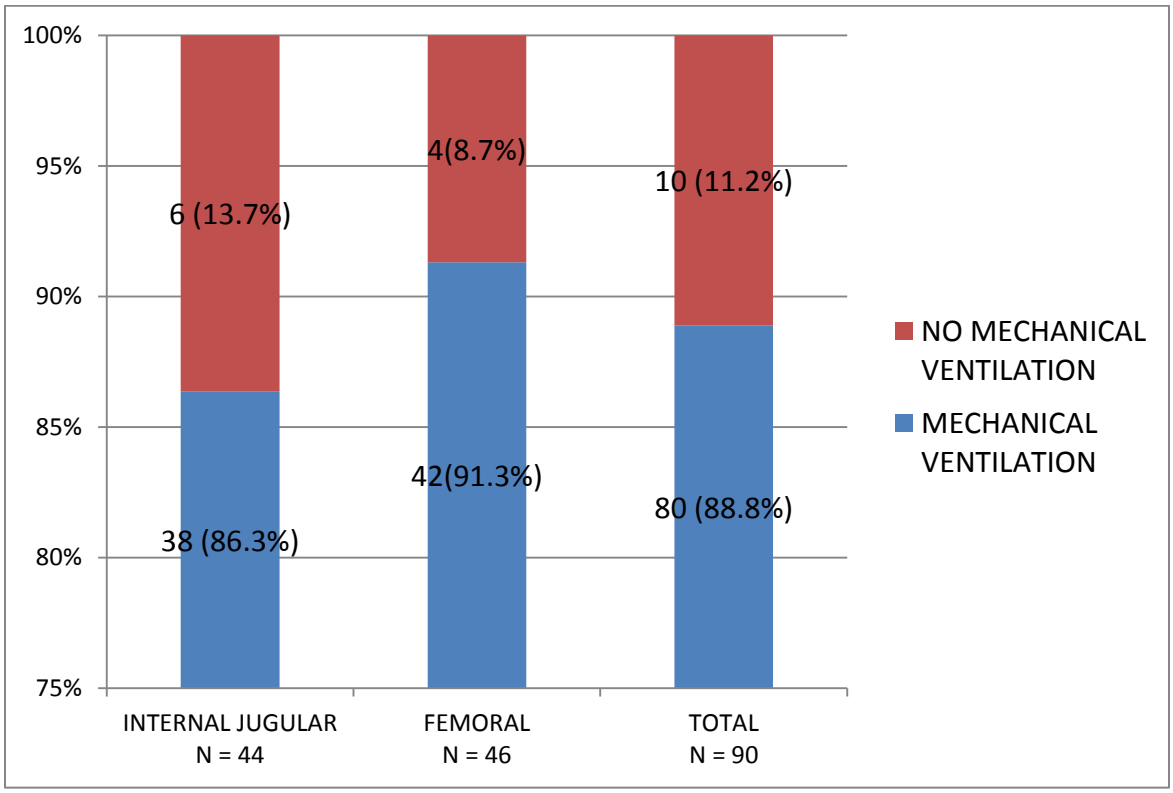

Fig. 9: Mechanical ventilation in the internal jugular and femoral group.

Among 90 patients included in the study, 80 (88.88%) patients required invasive ventilation (Figure 9). 42 patients (91.3%) required invasive ventilation (intubation) in the femoral group as compared to 38 (86.3%) patients in the internal jugular group. The percentage of patients requiring mechanical ventilation was higher in the femoral group.

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TRACHEOSTOMY

Table 6: Patients with and without tracheostomy in the internal jugular and femoral groups

TRACHEOSTOMY	INTERNAL JUGULAR	FEMORAL
YES	8 (18%)	18 (39%)
NO	36 (82%)	28 (61%)
	44	46

Among 90 patients included in this study, 26 patients (29%) had a tracheostomy during the course of their hospital stay. A higher proportion of patients in the femoral group had a tracheostomy during the course of their hospital stay as compared to the internal jugular group (39% versus 18%) (Table 6).

The presence of a tracheostomy is a potential source of infection for the internal jugular central venous catheter. In this study, 8 patients in the internal jugular group had a tracheostomy during the course of their hospital stay. However, 4 out of these 8 patients had a tracheostomy in situ during the period in which the internal jugular central venous catheter was present. Among these patients, colonization of the central venous catheter tip was seen in 1 patient. (25%)

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PATIENTS REQUIRING INOTROPIC SUPPORT

Table 7: Patients requiring inotropic support in the internal jugular and the femoral group

	INTERNAL JUGULAR	FEMORAL
REQUIRED INOTROPES	9 (21.4%)	11 (23.9%)
DID NOT REQUIRE INOTROPES	33 (78.5%)	35(76.08%)
	42	46

In the internal jugular group, 9 (21.4%) patients were on inotropes. In the femoral group, 13 (23.9%) patients required inotropic support (Table 7). Data for 2 patients was not available.

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PATIENTS REQUIRING ARTERIAL CATHETER INSERTION:

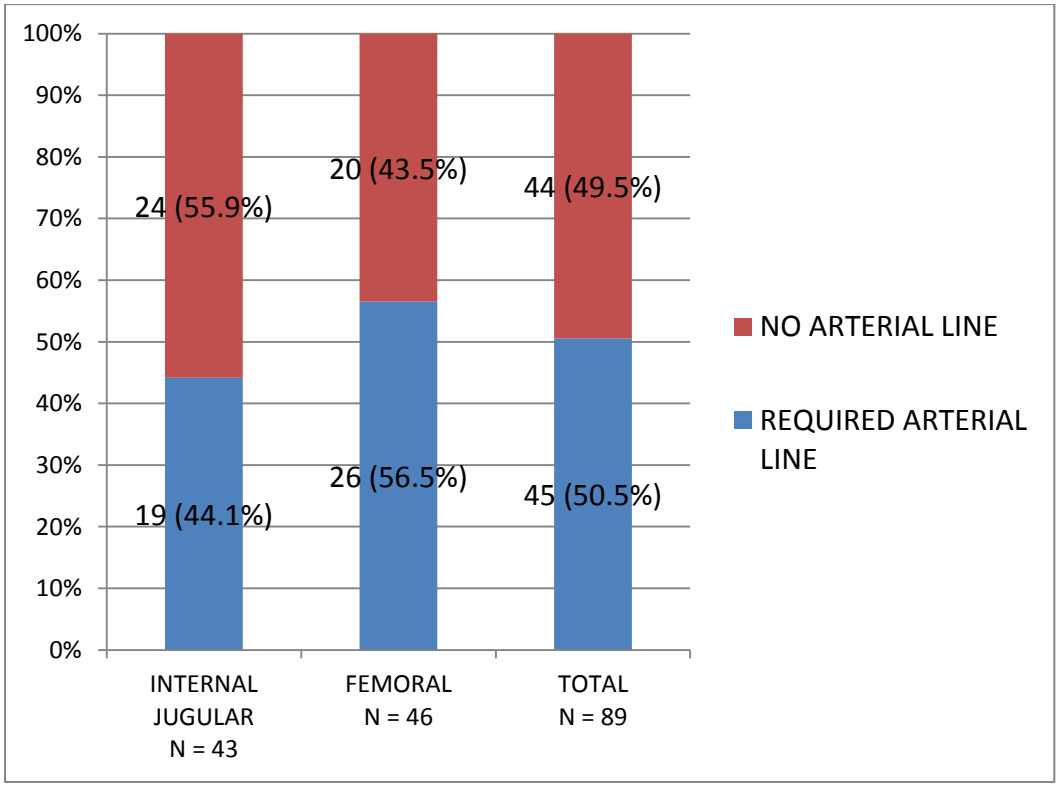

Fig 10: Patients requiring arterial catheters in the internal jugular and femoral groups

45 patients in this study required insertion of a radial or femoral arterial catheter for hemodynamic monitoring.

In the internal jugular group, 19 patients (44.1 %) required insertion of an arterial catheter. In the femoral group, 26 (56%) of patients underwent insertion of arterial catheter. A higher proportion of patients in the femoral group required insertion of arterial catheter as compared to the internal jugular group.

Data for 1 patient in the internal jugular group was not available. Overall, 50.5 % of patients in this study required insertion of an arterial catheter also along with a central venous catheter.

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Among the 3 patients who developed central line related bloodstream infection, 2 patients had an arterial catheter.

REASON FOR REMOVAL OF CENTRAL VENOUS CATHETERS

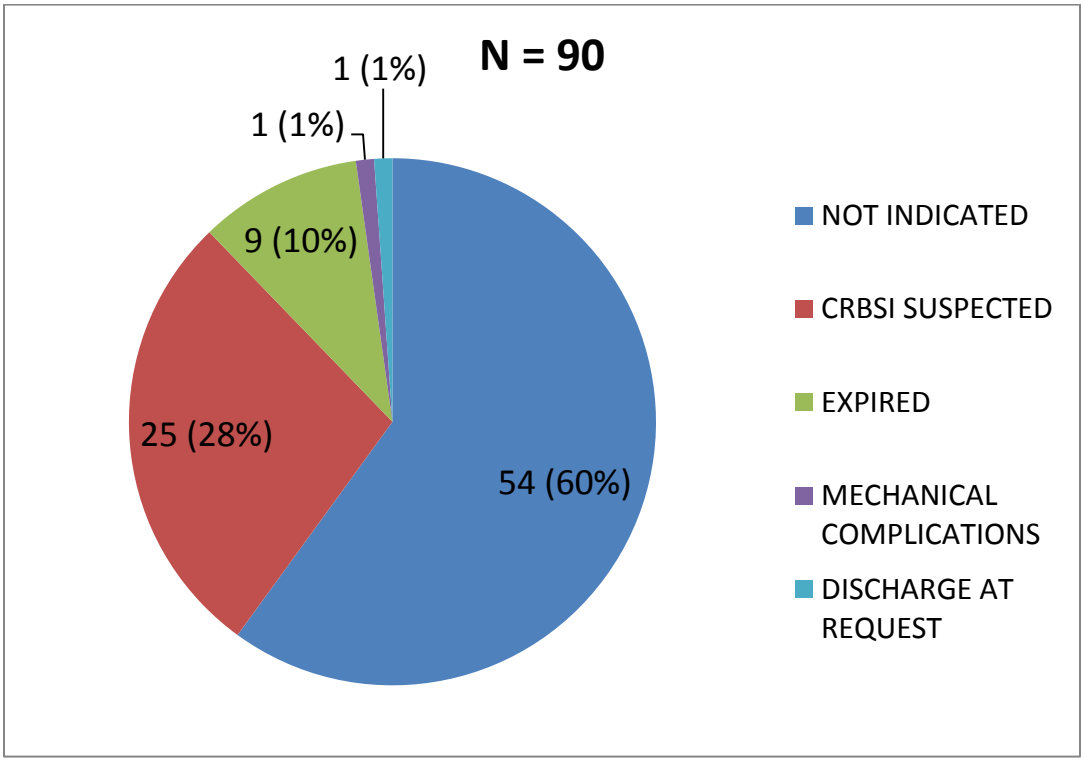

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Fig 11: Reason for removal of central venous catheters

Central venous catheters were removed when they were not indicated. Suspicion of a catheter related infectious complication, presence of mechanical complications like deep vein thrombosis and misplacement of the catheter were other indications for removal. In patients who had expired, the central venous catheter was removed (Figure 11).

In this study, majority (60%) of the catheters were removed as they were no longer required.

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This was the most common reason for removal in the internal jugular as well as the femoral group (Figure 12).

25 catheters (27.7%) were removed because a catheter related bloodstream infection was suspected. One patient in the femoral group had developed deep vein thrombosis following which the catheter was removed.

A higher number of femoral catheters as compared to internal jugular catheters were removed as CRBSI was suspected. One patient in the internal jugular group was discharged at request and transferred home. His catheter was removed prior to discharge.

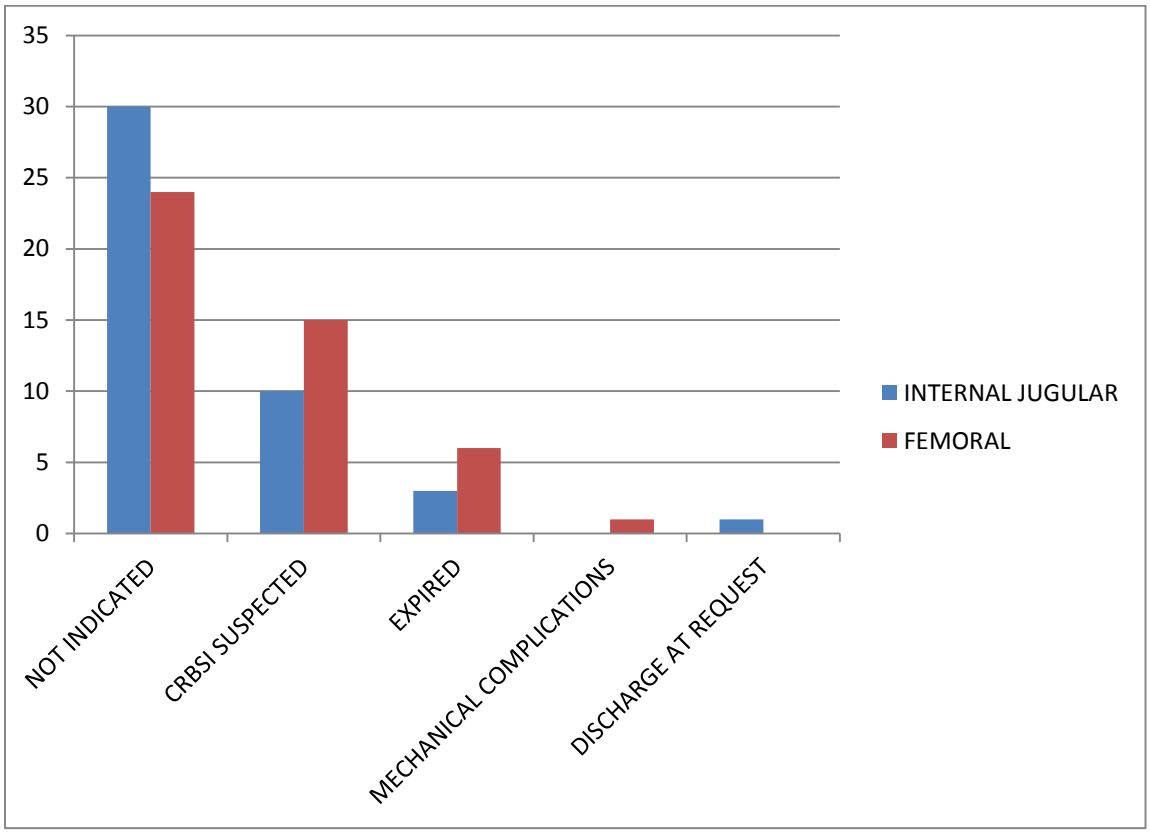

Fig 12: Reason for catheter removal in internal jugular and femoral groups

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DURATION OF CENTRAL VENOUS CATHETER

The average duration that the central venous catheter was in situ was 6.66 days (Standard Deviation 2.72) in the internal jugular group. This varied from a minimum of 2 days to a maximum of 15 days.

In the group with femoral central venous catheters, the mean duration of catheters was 6.41 days (Standard deviation 2.35). The minimum number of days in this group was 2 days and the maximum number of days was 15 days

PRIMARY OUTCOME

Table 8: Colonization in the internal jugular and femoral group

	COLONIZATION PRESENT	NO COLONIZATION
INTERNAL JUGULAR N=44	9 (20.5%)	35 (79.5%)
FEMORAL N = 46	11(23.9%)	35 (76.1%)
TOTAL N = 90	20 (22.2%)	70 (77.8%)

Among the 44 patients in the group with internal jugular catheters, 9 patients (20.5%) had colonization of the central venous catheter tip. Among the 46 patients in the group with femoral central venous catheters, 11 patients (23.9%) were found to have colonization of the central venous catheter tip. Overall, 90 patients were included in the study and catheter tips were found to have colonization for 20 (22.2%) of these patients (Table 8).

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There was no significant difference between the internal jugular and the femoral group with respect to catheter tip colonization. The p value was 0.802 with confidence interval of 0.451 to 3.315. Odds ratio of colonization of femoral catheter tips as compared to internal jugular was 1.22. However, more patients need to be included in the study to draw clinical implications.

The rate of colonization in the internal jugular group was 31.5 per 1000 catheter days and in the femoral group was 36.6 per 1000 catheter days. Overall the catheter tip colonization rate in this study was 33.99 per 1000 catheter days.

Out of the catheter tips which were found to be colonized, 45% belonged to the internal jugular group and 55% belonged to the femoral group.

SECONDARY OUTCOME

Table 9: CRBSI in the internal jugular and femoral groups

	HAD CRBSI	DID NOT HAVE CRBSI
INTERNAL JUGULAR N = 44	0	44 (100%)
FEMORAL N = 46	3 (6.5%)	43 (93.5%)
TOTAL N = 90	3 (3.3%)	87 (96.7%)

There were 3 catheter related bloodstream infections (CRBSI) among the patients included in this study. All catheter related bloodstream infections occurred in the group with femoral central venous catheters (Table 9). The catheter related bloodstream infection rate (CRBSI) rate in this study was 5.099 per 1000 catheter days.

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The difference in the rates of catheter related bloodstream infection among the 2 groups was not significant. The p value was 0.242.

However, there was a trend towards a higher rate of catheter related bloodstream infections in the group with femoral central venous catheters.

BACTERIOLOGICAL PROFILE

COLONIZATION

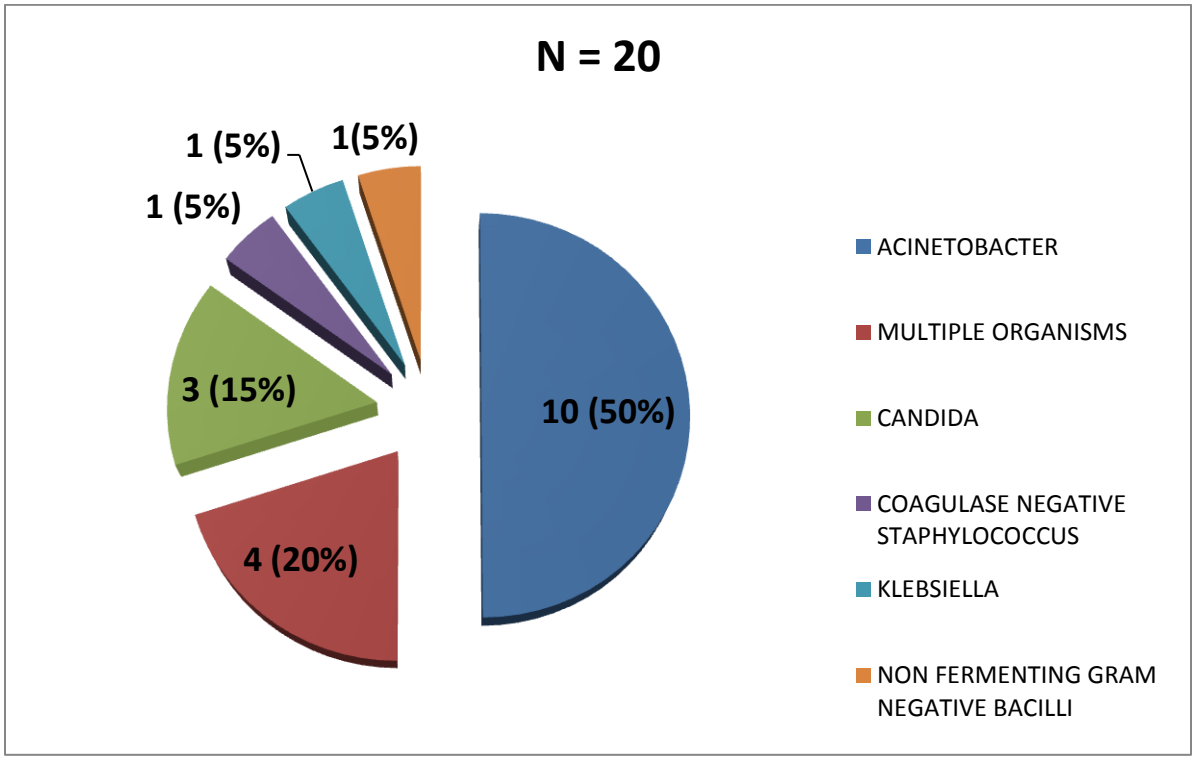

Fig 13: Bacteriological profile – Colonization

Acinetobacter was the most common organism (50%) that was isolated from colonized central venous catheter tips (Figure 13).

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Multiple organisms were isolated from 4 (20%) patients. In these patients, Acinetobacter was isolated from 3 patients (Table 10).

Candida tropicalis was isolated in 2 patients and Candida parapsilosis in 1 patient.
Klebsiella, and coagulase negative Staphylococcus were isolated from 1 patient each. Non fermenting Gram negative bacilli was isolated from the catheter tip of 1 patient.

Gram negative organisms were isolated from the majority (80%) of central venous catheter tips. Fungal infection accounted for 25% and Gram positive organisms were isolated from only 5% of colonized central venous catheter tips.

Table 10: Bacteriological Profile of patients – Multiple organisms

Patient 1	Acinetobacter and Enterococcus
Patient 2	Acinetobacter and Klebsiella
Patient 3	Acinetobacter, Coagulase negative Staphylococcus, Enterococcus and Providentia
Patient 4	Escherichia coli, Enterococcus and Coagulase negative Staphylococcus

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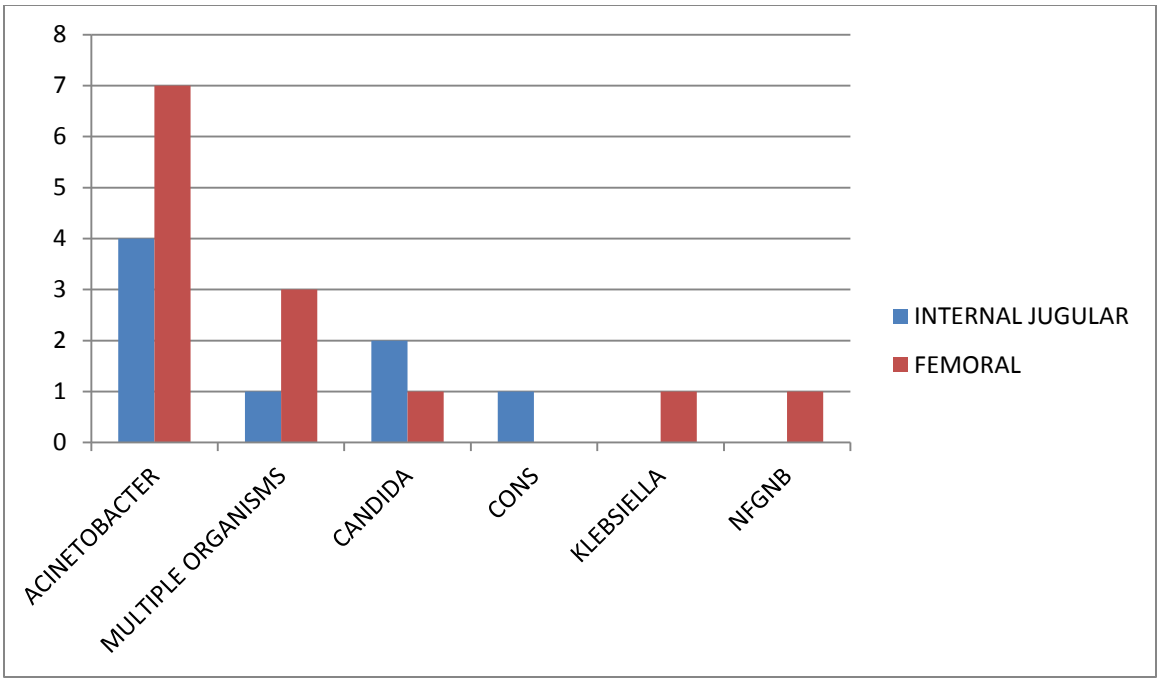

NFGNB = Non fermenting Gram negative bacilli

CONS = Coagulase negative Staphylococcus

Fig 14: Bacteriological profile in internal jugular and femoral central venous catheters

A higher proportion of femoral catheters were colonized with multiple organisms (Figure 14). This may be due to proximity of femoral central venous catheters to the perineal region.

CATHETER RELATED BLOODSTREAM INFECTION

Klebsiella was isolated from 2 patients and Enterococcus isolated from 1 patient with catheter related bloodstream infection (Figure 15). The catheter tip of the patient with Enterococcus infection had grown multiple organisms including Acinetobacter. All the patients with catheter related bloodstream infections had femoral catheters.

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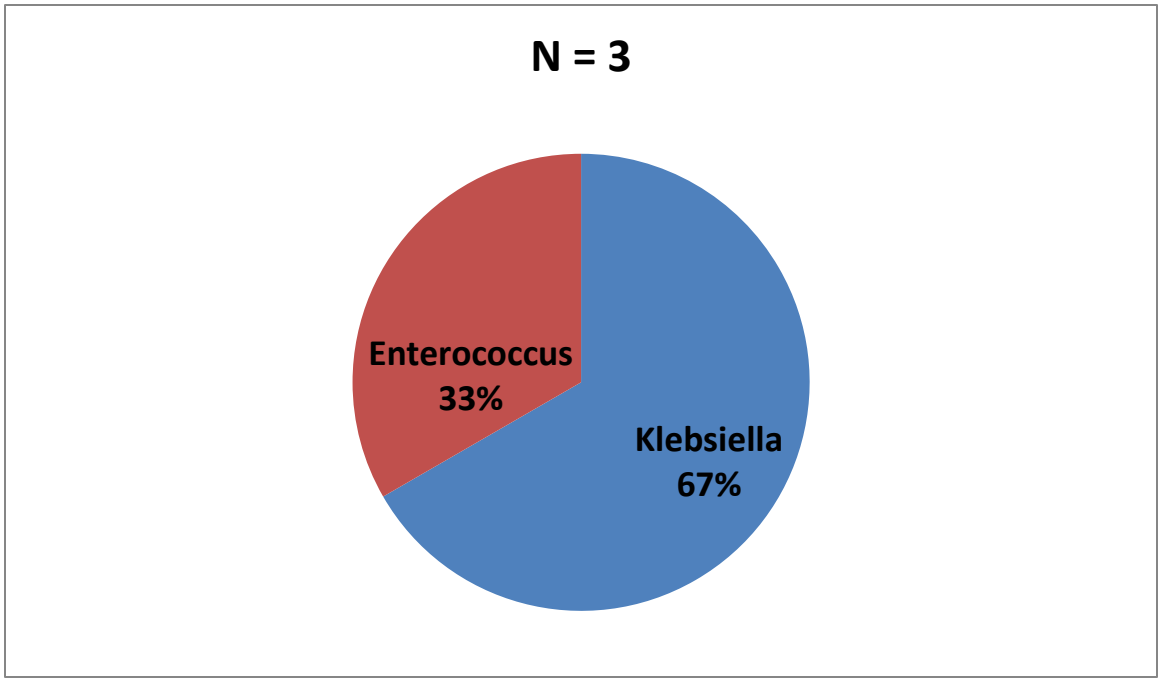

Fig 15: Bacteriological Profile - CRBSI

PROFILE OF PATIENTS WITH CRBSI

Patient 1:

This 56 year old lady was admitted with history of consumption of organophosphate (chlorpyrifos compound). She developed intermediate syndrome and hypotension for which she required mechanical ventilation and inotropic support. Her hospital course was complicated by the fact that she developed a non ST segment myocardial infarction during the course of her hospital stay. She developed CRBSI due to Enterococcus and was treated with meropenem and vancomycin injections. She was discharged in a stable state. Duration of ICU stay was 20 days and duration of hospital stay was 32 days.

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Patient 2:

This 40 year old man had chronic calcific pancreatitis and secondary diabetes and had presented with history of binge drinking and hypoglycemia. He required intubation and mechanical ventilation for low sensorium. He developed Klebsiella CRBSI for which he was treated with cefoperazone-sulbactam injections for 2 weeks. He was stable at discharge. Duration of hospital stay and ICU stay were 27 days and 9 days respectively.

Patient 3:

35 year old man presented with history of consumption of organophosphate (chlorpyrifos along with cypermethrin). He required intubation and mechanical ventilation for impending respiratory failure. He developed catheter related bloodstream infection secondary to Klebsiella which was sensitive to amoxicillin, gentamicin, cotrimoxazole, cefpodoxime. He was initiated on meropenem injections. His hospital course was complicated by upper gastrointestinal bleed secondary to gastric ulcer and acute renal failure requiring hemodialysis. He succumbed to his illness after 20 days of ICU treatment.

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ANTIBIOTIC SUSCEPTIBILITY PATTERN

GRAM NEGATIVE ORGANISMS

Among 18 Gram negative organisms isolated from catheter tips, 15 (83.3%) were carbapenem resistant organisms. Acinetobacter was isolated from 13 catheter tips, of which 12 (92%) were resistant to carbapenems.

GRAM POSITIVE ORGANISMS

Gram positive organisms were isolated from 6 catheter tips. Coagulase negative Staphylococcus and Enterococcus were isolated from 3 catheter tips each.

All isolates of Coagulase negative Staphylococcus were resistant to oxacillin.

2 out of 3 Enterococcus isolates were susceptible to ampicillin, gentamicin, vancomycin, linezolid and teicoplanin. 1 patient had catheter tip colonization with Enterococcus that was resistant to ampicillin and gentamicin, but susceptible to linezolid, teicoplanin and vancomycin.

LENGTH OF HOSPITAL STAY

The mean duration of hospital stay was 18.19 days across both groups.

In the Internal jugular group, patients were admitted for 19.93 days (SD 21.528) whereas in the femoral group the mean duration of hospitalization was 16.5 days. (SD 11.804).

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LENGTH OF ICU STAY

The mean duration of stay in the Intensive Care Unit was 13.3 days (SD 22.1) in the internal jugular group and 11.80 days (SD 7.57) in the group with femoral central venous catheters.

MORTALITY

Among the 90 patients who were included in the study, 24 (26.9%) patients died.

Table 11: Mortality in the internal jugular and femoral groups

MORTALITY→	NUMBER	PERCENTAGE
INTERNAL JUGULAR	11 / 44	25%
FEMORAL	13 / 45	28.8%
TOTAL	24 / 89	26.9%

In the group with internal jugular central venous catheters, 25 % of the patients died as compared to 29.5% in the femoral group (Table 11). 1 patient with a femoral catheter was discharged at request.

This difference in mortality rates across different sites of central venous catheter insertion was not statistically significant. (p value 0.520, confidence interval 0.274 to 2.694)

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Table 12: Mortality in patients with and without catheter tip colonization

MORTALITY→	NUMBER	PERCENTAGE
COLONIZATION PRESENT	5 / 20	25%
NO COLONIZATION	19 / 70	27.1%

The mortality rate in patients with colonization was 25% as compared to 27.1% in those without colonization of the catheter tip (Table 12).

This difference was not statistically significant (p value 0.520, confidence interval 0.274-2.694).

Table 13: Mortality in patients with and without catheter related bloodstream infection (CRBSI)

MORTALITY→	NUMBER	PERCENTAGE
CRBSI PRESENT	1 / 3	33.3%
NO CRBSI	23 / 87	26.4%

The mortality rate was higher in patients with CRBSI compared to those who did not have CRBSI.(33% versus 26.4%). (Table 13).

However, this difference was not statistically significant. (p value 0.620)

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FACTORS AFFECTING THE RATE OF COLONIZATION

1) OPERATOR EXPERIENCE

The physicians performing central venous catheter insertions were divided into high, intermediate or low operator experience.

Physicians who had performed insertion of more than 15 central venous catheter insertions at the specified site (internal jugular or femoral) were included in high operator experience group. Physicians who had performed more than 4 but less than or equal to 15 central venous catheter insertions in the specified site were included in the intermediate operator experience group. Physicians who had inserted only 4 or lesser number of central venous catheters at the specified site were included in the low operator experience category. Data for 2 central venous catheter insertions in the internal jugular group was not available.

Table 14: Percentage of catheters inserted by physicians with high, intermediate and low operator experience

OPERATOR EXPERIENCE	LOW	INTERMEDIATE	HIGH
INTERNAL JUGULAR N = 42	12	25	5
FEMORAL N = 46	11	26	9
TOTAL N = 88	23 (25%)	51 (59.1%)	14 (15.9%)

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Most of the central venous catheter insertions (59.1%) were performed by physicians with intermediate experience. (Table 14) .This was similar in the jugular as well as the femoral group.

Table 15: Colonization in high, intermediate and low operator experience groups.

COLONIZATION→	CATHETERS WITH COLONIZATION	PERCENTAGE
LOW EXPERIENCE	4 / 23	17.3%
INTERMEDIATE EXPERIENCE	12 / 51	23.5%
HIGH EXPERIENCE	4 / 14	28.6%

Surprisingly, 17.3% of central venous catheters were found to have colonization in the group with low operator experience whereas 28.6% of central venous catheters were found to be colonized in the group with high operator experience.(Table 15)

However, there was no statistically significant difference in colonization rates between different levels of operator experience. (p value 0.76)

Table 16: CRBSI in patients with low, intermediate and high operator experience.

CRBSI →	CATHETERS WITH CRBSI	TOTAL
LOW EXPERIENCE	1 / 21	4.7%
INTERMEDIATE EXPERIENCE	2 / 50	4%
HIGH EXPERIENCE	0 / 14	0%

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There were 3 catheter related bloodstream infections among the patients included in this study.(Table 16) 2 infections were in the group with intermediate operator experience and 1 infection was seen in the group with low operator experience. There were no catheter related bloodstream infections in the group with high operator experience.

2) REGISTRAR VERSUS INTERN PERFORMING INSERTION OF THE CENTRAL VENOUS CATHETER:

Table 17: Central venous catheters inserted by registrars and interns in the internal jugular and femoral groups

	REGISTRAR	INTERN
INTERNAL JUGULAR	34 (80.9%)	8 (19%)
FEMORAL	33 (71.7%)	13 (28.2%)
TOTAL	67 (76.1%)	21 (23.8%)

In this study, 67 central venous catheter insertions were done by registrars and 21 insertions were done by interns (Table 17). Data was not available for 2 patients.

In the internal jugular group, 34 (80.9%) central venous catheters were inserted by registrars and 8 (19%) were inserted by interns. In the group with femoral central venous catheters, a higher proportion (28.2%) of catheters were inserted by interns.

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Table 18: Colonization in the central venous catheters inserted by registrars and interns

COLONIZATION	NUMBER	PERCENTAGE
REGISTRAR	16 / 67	23.8%
INTERN	4 / 21	19%

4 (19%) out of 21 central venous catheter insertions done by the interns were found to have colonization. Out of the 67 central venous catheters inserted by registrars, 16 (23.9%) had colonization (Table 18).

There was no statistically significant difference in colonization rates between central venous catheters inserted by registrars and interns. (p value 0.447)

3) NUMBER OF ATTEMPTS AT CENTRAL VENOUS CATHETER INSERTION

The mean number of attempts at central venous catheter insertion in the internal jugular catheter group was 1.26 (Standard deviation 0.544). The minimum number of attempts in this group was once, and the maximum was 3 attempts. Number of attempts could not be recorded for 2 patients in internal jugular group.

The mean number of attempts at central venous catheter insertion in the femoral group was 1.35. (Standard deviation 1.066) The minimum number of attempts in the femoral group was once, and the maximum number of attempts was 7. Details on number of attempts at catheter insertion could not be recorded for 3 patients in this group.

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Among the central venous catheters which were found to have colonization, the mean number of attempts was 1.25 (Standard deviation 0.716). The mean number of attempts was 1.31 (standard deviation 0.895) among the patients without colonization of the central venous catheter.

There was no statistically significant difference in colonization rates with respect to the number of attempts at catheter insertion. (p value 0.623)

4) ULTRASOUND GUIDANCE:

In this study, all the central venous catheter insertions done in the internal jugular group were under ultrasound guidance. In the femoral group, 33 (80.4%) central venous catheter insertions were done with the help of ultrasound guidance whereas 10 (19.6%) were done blindly, using anatomical landmarks. Details on whether central venous catheter insertion was done under ultrasound guidance or not was not available for 5 patients.

Table 19: Colonization in central venous catheters inserted with and without ultrasound guidance

COLONIZATION	NUMBER	PERCENTAGE
WITH ULTRASOUND GUIDANCE	16 / 75	21.3%
WITHOUT ULTRASOUND GUIDANCE	2 / 10	20%

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Among the central venous catheters which were inserted under ultrasound guidance, 21.3% were found to have colonization of the catheter tip. 20% of the central venous catheters inserted without ultrasound guidance were detected to have colonization (Table 19).

This difference was not found to be statistically significant. (p value 0.447)

In this study, 3 patients, all of who were in the femoral group, developed catheter related bloodstream infection. Central venous catheter insertion was done under ultrasound guidance for all the 3 patients.

5) PLACE OF CENTRAL VENOUS CATHETER INSERTION:

Table 20: Percentage of catheters inserted in the Medical Intensive care Unit (MICU) and the Medical High Dependency Unit (MHDU)

	INTERNAL JUGULAR	FEMORAL	TOTAL
MICU	16	16	32 (35.5%)
MHDU	28	30	58 (64.5%)

In this study, central venous catheters were inserted in the Medical Intensive Care Unit and Medical High Dependency Unit.

Among the patients included in the study, a higher proportion of central venous catheter insertions were done in the Medical High Dependency Unit as compared to the Medical Intensive Care Unit (63.6% versus 36.4%) (Table 20). This is probably because central venous catheter

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insertion for many patients in Medical Intensive Care Unit had been done in the ward or Emergency Department prior to their transfer to ICU.

Table 21: Colonization of central venous catheters inserted in the Medical Intensive care Unit (MICU) and the Medical High Dependency Unit (MHDU)

COLONIZATION	NUMBER	PERCENTAGE
MHDU	14 / 58	24.1%
MICU	6 / 32	18.8%

The rate of colonization of central venous catheters was 24.1% in Medical High Dependency Unit and 18.8% in the Medical Intensive Care Unit (Table 21).

This difference was not statistically significant.(p value 0.378)

6) TIME OF CENTRAL VENOUS CATHETER INSERTION

The time of day during which central venous catheter insertion was done was recorded. This was divided into 3 shifts – morning (8 AM to 4 PM), evening (4 PM to 10 PM) and the night shift (10 PM to 8 AM). This corresponds to the shifts for the registrars and interns.

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17 (19.7%) of central venous catheters included on this study were inserted during the morning shift, 31 (36%) were inserted during the evening shift, and 38 (44%) during the night shift. Data related to time of insertion of the central venous catheter was not available for 2 patients.

Table 22: Time of insertion of internal jugular and femoral central venous catheters

	MORNING SHIFT (8 A.M. – 4 P.M.)	EVENING SHIFT (4 P.M. – 10 P. M.)	NIGHT SHIFT (10 P.M. – 8 A.M.)
INTERNAL JUGULAR N = 44	8 (19.0%)	14 (33.3%)	20 (47.6%)
FEMORAL N = 44	9 (20.4%)	17 (38.6%)	18 (40.9%)
TOTAL N = 88	17 (19.7%)	31 (36%)	38 (44%)

A higher number of central venous catheter insertions were done during the night shift (44%). This was consistent across both groups (Table 22).

In the internal jugular catheter group, 47.6% of catheter insertions were done in the night shift, 33.3% in the evening shift and 19% during the morning shift. In the group with femoral central venous catheter insertions, 40.9% of catheters were inserted during the night shift, 38.6% during the evening shift and 20.4% during the morning shift.

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Table 23: Colonization in central venous catheter tips inserted in the morning, evening and night shifts

COLONIZATION →	NUMBER	PERCENTAGE
MORNING SHIFT (8 A.M. – 4 P.M.)	4 / 17	23.5%
EVENING SHIFT (4 P.M. – 10 P. M.)	7 / 31	22.6%
NIGHT SHIFT (10 P.M. – 8 A.M.)	8 / 38	21.1%

The colonization rate for central venous catheters inserted in the morning, evening and night shift were 23.5%, 22.6% and 21.1% respectively (Table 23).

There was no statistically significant difference in the colonization rate between central venous catheters inserted during the morning, evening and night shift.

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SIDE OF CENTRAL VENOUS CATHETER INSERTION

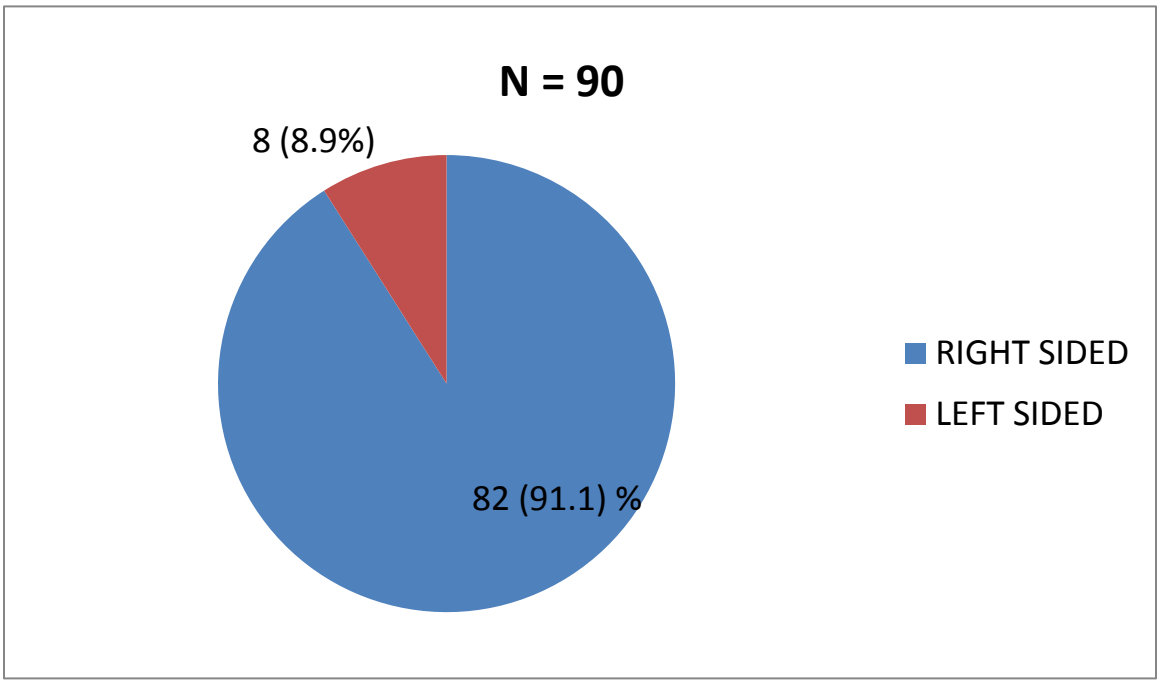
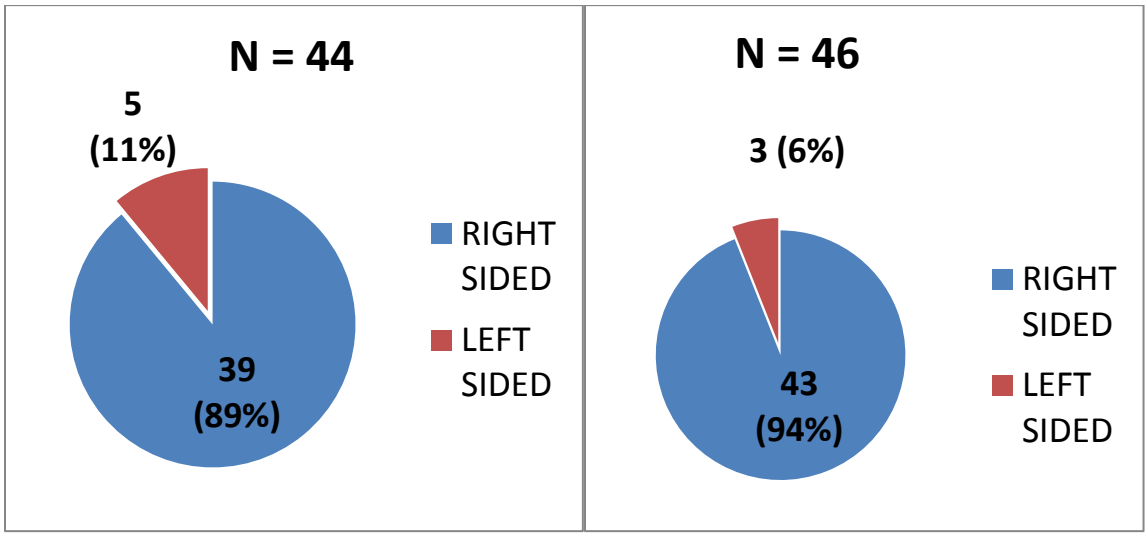


Fig. 16: Side of Central venous Catheter Insertion

The majority of central venous catheters were inserted in the right side (91.1%) (Figure 16)



INTERNAL JUGULAR **FEMORAL**

Fig. 17: Side of Central Venous Catheter Insertion in the Internal Jugular and femoral group

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89% of central venous catheters in the jugular group were inserted in the right side. 94% of the femoral central venous catheters were right sided. The internal jugular group had a higher number of left sided central venous catheters as compared to the femoral group (11 % versus 6%) (Figure 17)

Table 24: Colonization of central venous catheters inserted in the right and left side

COLONIZATION →	NUMBER	PERCENTAGE
RIGHT	16 / 82	19.5%
LEFT	4 / 8	50%

Out of the 82 central venous catheters inserted on the right side, 19.5% were found to have colonization of the central venous catheter tip.

There were 8 left sided central venous catheters, of which 4 (50%) were found to have colonization of the central venous catheter tip.

The rate of catheter tip colonization was higher in left sided central venous catheters as compared to right sided central venous catheters (50% versus 19.5%) (Table 24).

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FEVER

Among the 90 patients included in this study, 45 (51.1%) had at least 1 episode of fever with temperature greater than 101° F when the central venous catheter was in situ.

Out of 45 patients with fever, catheter related bloodstream infection was found to be present in 3 (6.66%) of patients. However, all the 3 patients with catheter related bloodstream infection had fever.

DIABETES MELLITUS

Among 30 diabetic patients who were part of the study, 6 patients (20%) were found to have colonization of the central venous catheter tip. Out of 60 patients included in this study who did not have diabetes mellitus, 14 patients (23.3%) were found to have colonization of the central venous catheter tip (Table 25).

There was no statistically significant difference between the colonization rates of the central venous catheter tip among patients with and without diabetes mellitus. (p value 0.558)

Table 25: Colonization of central venous catheters in patients with and without diabetes mellitus

COLONIZATION →	NUMBER	PERCENTAGE
WITH DIABETES	6 / 30	20%
WITHOUT DIABETES	14 / 60	23.3%

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LOCAL EXAMINATION

In this study, 3 patients had abnormalities on local examination.

2 patients had tenderness at the catheter insertion site. 1 patient had redness and warmth at the insertion site. These 3 patients were in the femoral group.

None of the patients who had abnormalities on local examination had catheter related bloodstream infection.

However, 2 out of the 3 patients had colonization of the central venous catheter tip.

Non fermenting Gram negative bacilli were isolated from the catheter tip of one patient.

For the second patient, multiple organisms (Escherichia coli, Enterococcus, and coagulase negative Staphylococcus) were isolated from the central venous catheter tip.

MECHANICAL COMPLICATIONS

2 femoral catheters were associated with mechanical complications.

One patient had hematoma formation at the insertion site of the catheter.

The other patient developed deep vein thrombosis due to which the catheter had to be removed.

In the internal jugular group, there were no mechanical complications.

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DISCUSSION

This study assessed the rate of colonization and catheter related bloodstream infections in internal jugular and femoral central venous catheters in patients admitted in Medical Intensive Care Unit and High Dependency Unit in a tertiary care hospital in South India.

PRIMARY OUTCOME

Out of 44 patients in the jugular group, 9 (20.5%) patients had catheter tip colonization. In the femoral group, 11 (23.9%) out of 46 patients had colonization of the catheter tip.

Though the femoral group had a higher rate of colonization, this difference was not statistically significant. However, the number of patients studied was not adequate to derive conclusive results. More patients need to be included in the study to draw clinical implications.

The overall colonization rate was 33.99 per 1000 catheter days. The colonization rate in the jugular and femoral groups were 31.5 per 1000 catheter days and 36.6 per 1000 catheter days respectively.

The colonization rate of central venous catheter tip in an Indian study published by Patil et al was 27.77 per 1000 catheter days.(60) In another Indian study by Mathai et al, the

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colonization rate of the central venous catheter tip was 10.43 and 5.23 per 1000 catheter days for internal jugular and subclavian venous catheters respectively. (6) However, this study has shown a higher colonization rate than previous data, reasons for which are not evident at this point.

SECONDARY OUTCOME

There were 3 catheter related bloodstream infections among the patients included in the study. All 3 infections were in the femoral group. 2 infections were due to Klebsiella and 1 infection was caused by Enterococcus.
There were no catheter related bloodstream infections in patients with internal jugular catheters.

The catheter related bloodstream infection rate in this study was 5.099 per 1000 catheter days. The CRBSI rate in other Indian studies ranges from 2.79 to 8 per 1000 catheter days. (6,28)

Catheter related bloodstream infection rate is the secondary outcome of the study. The study was not powered to detect a difference in catheter related bloodstream infection rate between the jugular and femoral groups. However, there is a trend towards higher number of catheter related bloodstream infections in the femoral group in spite of similar colonization rates.

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Possible reasons include proximity of the femoral catheter to the perineal region leading to higher burden of organisms and subsequent catheter related infections.

An observational study from our institution conducted in 2012 noted that an admission diagnosis of sepsis syndrome is a risk factor for developing catheter related infection. (unpublished data). The femoral group had a higher number of patients with sepsis than the jugular group (39% versus 34%) and this may have been a predisposing factor for the development of catheter related bloodstream infections in patients with femoral central venous catheters.

MICROBIOLOGICAL PROFILE

Gram negative bacilli were isolated from 80% of colonized central venous catheter tips. The most common organism causing colonization of central venous catheters is Acinetobacter species (50%). Gram positive organisms were isolated from a small percentage (5%) of colonized central venous catheter tips.

This is consistent with other reports from India where Gram negative bacilli are the predominant pathogen causing catheter tip colonization. (6,41) . However, in Western countries, Gram positive organisms including coagulase negative Staphylococcus, Enterococcus and Staphylococcus aureus are the predominant pathogens. (39)

Colonization and catheter related bloodstream infection secondary to Gram negative bacilli is usually acquired from the hands of healthcare workers. Emphasis on

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handwashing and careful handling of central venous catheters can be implemented to reduce the rate of catheter related infectious complications.

CATHETER INSERTION RELATED FACTORS

There was no statistically significant difference in colonization rates noted with ultrasound guidance, time and place of central venous catheter insertion, number of attempts at insertion, and duration of the central venous catheter. However, other Indian studies have shown prolonged duration of central venous catheter and multiple insertion attempts to be associated with higher rates of catheter related infectious complications.(6)

There was no association between operator experience or registrar versus intern performing insertion of the central venous catheter with catheter tip colonization rates.

In our study, there were 3 catheter related bloodstream infections. 2 occurred in the group with intermediate operator experience and 1 in the group with low operator experience. There were no catheter related bloodstream infections in the group with high operator experience. However, the number of catheter related bloodstream infections in this study is small and more patients need to be studied to draw clinical implications.

However, several other studies have shown lower rates of catheter related complications with experienced operators

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Left sided central venous catheters showed a trend towards a higher colonization rate compared to right sided catheters (50% versus 19.5%). Operators are trained and used to right sided catheter insertions. They are unfamiliar with left sided central venous catheter insertions and this may have led to a higher rate of infectious complications with left sided catheters.

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LIMITATIONS

One of the limitations is that the number of patients studied was not enough to draw clinical implications.

Patients who underwent central venous catheter insertion in the ward or the emergency department prior to transfer to the Intensive Care Unit were not included in the study as adherence to sterile barrier precautions may not have been adequate.

Catheter related bloodstream infection would have been the ideal end point. However, this was not feasible due to low rates of catheter related bloodstream infections.

Catheter tips were not sent for culture for some of the patients in this study.

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CONCLUSION

- There was no significant difference in the colonization rate in internal jugular and femoral central venous catheters in critically ill patients.

- There is a trend towards a higher rate of central line related bloodstream infections in the femoral group.

  However, interpretation of these results should be made keeping in mind that the number of patients studied was not enough. More patients need to be included in the study to draw clinical implications.

- Gram negative bacilli were the most common organisms implicated in colonization and catheter related bloodstream infection. Gram positive organisms caused only a small percentage of infections.

- Factors related to catheter insertion - ultrasound guidance during catheter insertion, number of attempts at insertion, operator experience, time of insertion did not influence the rate of colonization.

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APPENDIX I

INFORMED CONSENT FORM

Study title: Comparison of the rate of colonization of femoral central venous catheters versus internal jugular central venous catheters in the Medical ICU and HDU

Study pattern: randomized controlled trial

Place of Study: Christian Medical College, Vellore

PART I : INFORMATION SHEET

Introduction:

We are doing a study on central line related infections.

A central line is a catheter / tube that is passed through a vein to end up in the heart or in one of the large veins returning blood to the heart.

It is used to administer medicines and fluids in sick patients.

Purpose of the research:

Central lines can be inserted in the neck and the groin.

Insertion of central line is associated with a small chance of complications including bleeding from an artery, infections, air in the chest, fluid in the chest, bleeding into or under the skin.

Previous research studies have shown varying results and it is still not certain whether there is a difference in the central line infection rates inserted in the 2 sites.

This is a study to compare the rates of infections due to central lines inserted in the neck and groin.

Type of research intervention:

The site of central line insertion (neck or groin) will be selected by chance as if tossing a coin.

Participant selection:

Patients who require central line insertion and are admitted to the MICU/MHDU will be enrolled in the study.

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Procedures and protocol:

We will collect information about you (i.e. age, existing medical conditions, present problems) at the time the line is inserted.

The central line will be inserted by a trained doctor. It is a minor procedure done under local anaesthesia. After cleaning the skin with antiseptic solutions, injection will be given to numb the area so that you do not feel any pain.

With the help of a needle, a guidewire will be passed into the vein. After that, the central line will be passed over the guidewire and the guidewire removed.

The central line will be secured with the help of 2 stitches.

We will monitor you for signs of infection (i.e fever, results of blood tests). If signs of infection are present, the tip of the central line will be sent to the laboratory for tests.

This will tell us whether it is infected and the causative organisms.

The results of the test will help us in choosing the medicine to treat you with. This is part of standard treatment followed in the Medical ICU/HDU.

If you don't have fever or other signs of infection when the central line is removed, then the central line tip will still be sent for culture . In this case, the expenses of the test will be covered by a special fund.

In the event of death of the participant, the central line will be removed and sent to the laboratory for the test. In this case, the expense of the test will be covered by a special fund.

Potential Benefits:

There may not be any benefit for you but your participation is likely to help us find the answer to the research question which will benefit patients in future.

Voluntary Participation:

Your participation in this study is entirely voluntary.

If you do not wish to participate in the study, you will be offered the treatment that is routinely offered in this hospital for the disease that you have.

You are free to withdraw from the study at any time. This will not affect your treatment in any way.

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PART II : CONSENT SHEET

Study Title: Comparison of the rate of colonization of femoral central venous catheters versus internal jugular central venous catheters in the Medical ICU and HDU

Study Number:

Subject's Initials: _____ Subject's Name: _____

Date of Birth / Age:_____

Please initial box

(Subject)

(i) I confirm that I have read and understood the information sheet dated _____ for the above study and have had the opportunity to ask questions. [ ]

(ii) I understand that my participation in the study is voluntary and that I am

free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. [ ]

(iii) I understand that the Sponsor of the clinical trial, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published. [ ]

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s) [ ]

(v) I agree to take part in the above study. [ ]

Signature (or Thumb impression) of the Subject/Legally Acceptable Representative:_____

Date: _____/_____/_____

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Signatory's Name: _____

Signature of the Investigator: _____

Date: _____/_____/_____

Study Investigator's Name: _____

Signature of the Witness: _____

Date:_____/_____/_____

Name of the Witness: _____

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APPENDIX II - PROFORMA

COMPARISON OF THE RATE OF COLONIZATION OF INTERNAL JUGULAR VERSUS FEMORAL CENTRAL VENOUS CATHETERS ***PART I : DATA ABSTRACTION FORM (TO BE FILLED AT THE TIME OF CVC INSERTION)***

Name		Hospital Number	
Age		Serial Number*	
Sex	Male / Female	Date	

* please write the number written on the envelope

PATIENT RELATED FACTORS: Indication for catheter insertion (please circle if applicable):

Hemodynamic instability	Lack of peripheral venous access	Anticipate worsening

Pre existing medical Conditions:

Diabetes mellitus	Hypertension	Chronic kidney disease	COPD

Site of CVC insertion:

Left / Right	Internal Jugular/ Femoral

Has the patient received antibiotics before admission	Yes / No
Number of days of hospital stay prior to insertion of CVC	
Does the patient have fever (temperature ≥ 101 °C	Yes / No
Admission Diagnosis	

Pulse Rate		Blood Pressure	
Respiratory rate		SpO2 (Room air)	

OPERATOR / PROCEDURE RELATED FACTORS:

Number of attempts	1	2	3
Under USG guidance	Yes / No	Time of Insertion	_ _ : _ _ (HH:MM)
Place of CVC insertion	Emergency Medicine Dept / MICU / MHDU		
CVC inserted by	Consultant / Registrar / Intern		

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Total no. of CVCs inserted by the operator	<10	10 – 30	>30
No of CVCs inserted at this site	<5	5 – 15	>15

PART 2: DATA ABSTRACTION FORM (TO BE FILLED AT THE TIME OF CVC REMOVAL)

Name		Hospital Number	
Age		Serial Number*	
Sex	Male / Female	Date	

Final Diagnosis :

No. of CVC days :

≤3	4 - 6	7 – 9	10 – 12	13 – 16	>16

Reason for CVC removal (Please circle if applicable):

CVC is no longer required	Suspected catheter related infection	The patient has expired
CVC related complication	Discharge against medical advice / at request	CVC is in the wrong location

Were there any immediate complications of CVC insertion:

Pneumothorax	Haemothorax	Arterial puncture
Hematoma	Others (please specify)	

Local examination of the CVC insertion site (Please circle if applicable):

Redness	Warmth	Tenderness	Purulent discharge

Did the patient have fever (temp ≥ 100.4 °C) after CVC insertion till removal:	Yes / No
Did the patient have chills :	Yes / No
Did the patient have hypotension after CVC insertion till removal :	Yes / No

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If yes, then (please circle if applicable):

Require fluid resuscitation	Require inotropes	Systolic BP≤90 mmHg	Diastolic BP≤60 mmHg

Please fill in the following (recent values):

Total WBC count		Differential WBC count	
Procalcitonin			

Any other evident source of infection:

Sputum	Urine	Collections/abscesses	Others

Any positive and source

Yes / No

cultures: If yes , please mention the date __/__/__

No. of Colony Forming Units: _____

Did the patient also have an arterial line ?

Yes / No

If yes, the please mention the site

Radial / Femoral

No. of days of arterial line

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APPENDIX III - The APACHE II Severity of Disease Classification System

Physiologic Variable	High Abnormal Range					Low Abnormal Range				
	+4	**+3**	**+2**	**+1**	**0**	**+1**	**+2**	**+3**	**+4**	**Points**
Temperature - rectal (°C)	≥41°	39 to 40.9°		38.5 to 38.9°	36 to 38.4°	34 to 35.9°	32 to 33.9°	30 to 31.9°	≤29.9°	
Mean Arterial Pressure - mm Hg	≥160	130 to 159	110 to 129		70 to 109		50 to 69		≤49	
Heart Rate (ventricular response)	≥180	140 to 179	110 to 139		70 to 109		55 to 69	40 to 54	≤39	
Respiratory Rate (non-ventilated or ventilated)	≥50	35 to 49		25 to 34	12 to 24	10 to 11	6 to 9		≤5	
Oxygenation: a. FIO_2 ≥0.5 record A-aDO2 b. FIO_2 <0.5 record PaO2	≥500	350 to 499	200 to 349		<200 PO2>70	PO2 61 to 70		PO2 55 to 60	PO2<55	
Arterial pH (preferred)	≥7.7	7.6 to 7.69		7.5 to 7.59	7.33 to 7.49		7.25 to 7.32	7.15 to 7.24	<7.15	
Serum HCO3 (venous mEq/l) (not preferred, but may use if no ABGs)	≥52	41 to 51.9		32 to 40.9	22 to 31.9		18 to 21.9	15 to 17.9	<15	
Serum Sodium (mEq/l)	≥180	160 to 179	155 to 159	150 to 154	130 to 149		120 to 129	111 to 119	≤110	
Serum Potassium (mEq/l)	≥7	6 to 6.9		5.5 to 5.9	3.5 to 5.4	3 to 3.4	2.5 to 2.9		<2.5	
Serum Creatinine (mg/dl) Double point score for acute renal failure	≥3.5	2 to 3.4	1.5 to 1.9		0.6 to 1.4		<0.6			
Hematocrit (%)	≥60		50 to 59.9	46 to 49.9	30 to 45.9		20 to 29.9		<20	
White Blood Count (total/mm3) (in 1000s)	≥40		20 to 39.9	15 to 19.9	3 to 14.9		1 to 2.9		<1	
Glasgow Coma Score (GCS) Score = 15 minus actual GCS										
A. Total Acute Physiology Score (sum of 12 above points)										
B. Age points (years) ≤44=0; 45 to 54=2; 55 to 64=3; 65 to 74=5; ≥75=6										
C. Chronic Health Points (see below)										
Total APACHE II Score (add together the points from A+B+C)										

5 points for nonoperative or emergency postoperative patients

2 points for elective postoperative patients

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APPENDIX IV – ADMISSION DIAGNOSIS – OTHERS/MISCELLANEOUS GROUP

DIAGNOSIS	NUMBER OF PATIENTS
Sputum positive pulmonary tuberculosis	2
Disseminated tuberculosis	1
Tuberculous meningitis	3
Hanging	3
Pulmonary edema, chronic kidney disease	2
Myasthenia gravis	1
Status epilepticus	1
Snake bite	1
Heat stroke	1
Gastrointestinal bleed, decompensated chronic liver disease	1
Cervical myelopathy	1
CNS vasculitis	2
Corrosive Injury - oesophagus	1
Cerebrovascular accident	3
Acute pancreatitis	1
Pre eclampsia	1
Porphyria	1
Hepatic Encephalopathy	1

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APPENDIX V – LIST OF TABLES AND FIGURES

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UNIT	APACHE SCORE	SEX	SITE J/F	FINAL DX	SIDE L/R	TIP C/S CF	TIP C/S ORG	DOLI	DOLR
PULM MED	28	2	2	SPUTUM POSITIVE PULMONARY TUBERCULOSIS / DRUG INDUCED HEPATITI	1	0		19-02-14	20-Feb
NEPHROLOGY 1	31	2	1	ACUTE KIDNEY DISEASE PROGRESSING TO CHRONIC KIDNEY DISEASE	1	0	0	20-07-14	27-02-14
MEDICINE 4	21	2	2	MENINGOENCEPHALITIS / SEPTIC SHOCK / VENTILATOR ASSOCIATED PNEU	2	SCANTY	NFGNB	02-03-14	04-03-14
MEDICINE 4	11	2	1	OP POISONING / INTERMEDIATE SYNDROME / CATHETER RELATED BLOODS	1	4	KLEBSIELLA	05-03-14	10-03-14
MEDICINE 2	23	2	2	AMITRYPTILENE OVERDOSE / DYSTHYMIA / DYSELECTROLYTEMIA	1	0		10-03-14	12-03-14
MEDICINE 1	19	2	2	CARBAMAZEPINE OVERDOSE SPUTUM POSITIVE PULMONARY TB ATT INDU	1	0		09-03-14	17-03-14
MEDICINE 3	16	1	2	OP POISONING - MONOCROTOPHOS / IMTERMEDIATE SYNDROME / VENTI	1	0		09-03-14	15-03-14
MEDICINE 1	31	1	2	MRSA PNEUMONIA WITH SEPTIC SHOCK	1	0		13-03-14	22-03-14
MEDICINE 3	10	2	2	OP POISONING - CHLORPYRIPHOS	2	0		17-03-14	23-03-14
MEDICINE 2	35	1	2	KLEBSIELLA PNEUMONIA / VENTILATOR ASSOCIATED PNEUMONIA / SEIZUI	1	150 / 4	NFGNB SEN	01-04-14	08-04-14
MEDICINE 1	8	2	1	PNEUMONIA BIBASAL CONSOLIDATION / SEPTIC SHOCK	1	0		15-04-14	23-04-14
NEUROLOGY	15	1	2	COMLETE HANGING / ALCOHOL INTOXICATION / DELIBERATE SELF HARM	1	0		08-05-14	09-05-14
NEUROLOGY	22	1	2	MYAESTHENIA GRAVIS	1	0004/01	KLEBSIELLA	18-05-14	27-05-14
GASTRO	26	1	1	CLD?NAFLD?CRYPTOGENIC VARICEAL BLEED POST EVL ACUTE ON CKD	1	0		26-05-14	01-06-14
MEDICINE 4	12	2	2	SYSTEMIC ARTERIAL HYPERTENSION / PYELONEPHRITIS / HYPOTHYROIDISM	1	0		31-05-14	03-06-14
MEDICINE 2	18	1	2	SEPTIC SHOCK	1	0		26-03-14	29-03-14
MEDICINE 1	20	1	2	OP POISONING DVT 2 UPPER LIMB PROVOKED MSSA BACTEREMIA VAP	1	0		30-03-14	04-04-14
MEDICINE 2	12	2	1	OP POISONING / PROFENOFOS / INTERMEDIATE SYNDROME / GRAM NEGA	1	34	NFGNB PAN	16-04-14	21-04-14
MEDICINE 3	25	1	2	OP POISONING PROFENOPHOS VAP INTERMEDIATE SYNDROME	1	0	0	25-04-14	27-04-14
MEDICINE 1	28	1	1	DISCHARGED AT REQUEST - meningitis	1	0		26-04-14	28-04-14
MEDICINE 4	not available	1	1	ODUVANTHALAI POISONING	1	0		26-04-14	04-05-14
MEDICINE 5	9	2	1	SNAKE BITE	1	0		28-05-14	02-06-14
MEDICINE 1	14	1	1	TUBERCULOUS MENINGITISCHRONIC HEPATITIS B INFECTION ATT INDUCED HEPATITS	1	0		20-05-14	27-05-14
MEDICINE 4	15	1	1	INFECTIVE ENDOCARDITIS MARFANS CEREBRAL PALSY ASPIRATION PNEUM	1	0		20-05-14	27-05-14
MEDICINE 2	18	1	1	PYELONEPHRITIS ECOLI ESBL DCLD PORTAL HTN	1	>1000	Candida tro	07-01-14	09-01-14
MEDICINE 3	14	2	1	SEPTIC SHOCK / PARAPARESIS / NECTROTIZING FASCITIS RIGHT GLUTEAL R	1	0		10-01-14	18-01-14
NEUROLOGY	9	1	2	CRYPTOGENIC NEW ONSET STATUS EPILEPTICUS / RIGHT INTRAVENTRICUL	1	0		10-01-14	18-01-14
PULM MED	28	1	1	ACUTE INFECTIVE EXACERBATION OF COPD	1	0		10-01-14	15-01-14
MEDICINE 1	17	2	1	SEPTIC SHOCK	1	0		23-12-13	27-12-13
MEDICINE 3	22	1	1	RHABDOMYOLYSIS - SECONDARY TO CHROMIUM INTOXICATION / MYOCAR	1	0		11-01-14	18-01-14
MEDICINE 3	13	1	2	REFRACTORY SEPTIC SHOCK / SECONDARY ENTEROCOCCAL SEPSIS / PNEUM	1	0		12-01-14	16-01-14
MEDICINE 4	15	2	2	CNS VASCULITIS / AIHA / MYOCARDITIS / ENTEROCOCCAL SEPSIS / LEFT PN	1	0		12-01-14	18-01-14
GERIATRIC	14	1	2	DILUTIONAL HYPONATREMIA/NSTEMI/ CAUDA EQUINA SYNDROME / CERV	1	SCANTY	YEAST	16-01-14	21-01-14
MEDICINE 1	20	1	2	SPUTUM POSITIVE PULMONARY TUBERCULOSIS	1	0		17-01-14	22-01-14
MEDICINE 1	24	1	1	SCRUB TYPHUS WITH ARDS	1	0		16-01-14	21-01-14
MEDICINE 3	33	1	1	PYELONEPHRITIS - RECURRENT INFECTION	1	0		16-01-14	24-01-14
PULM MED	27	1	2	INFECTIVE EXACERBATION OF COPD / NSTEMI / HYPOVITAMINOSIS-D	1	0		19-01-14	24-01-14
MEDICINE 3	19	2	1	SYSTEMIC LUPUS ERYTHREMOATOSUS / CNS AND RENAL INVOLVEMENT / F	2	0		21-01-14	25-01-14
MEDICINE 3	15	1	1	CERVICAL CORD COMPRESSION C2 TO C6 / RECURRENT ASPIRATION PNEUI	2	25	CONS	17-04-14	22-04-14
MEDICINE 2	21	1	1	OP POISONING HEACONAZOLE / INTERMEDIATE SYNDROME / NOSOCOMIA	1	200	NFGNB	25-02-14	31-01-14
MEDICINE 4	11	1	2	SCRUB TYPHUS DVT RIGHT LEG PROVOKED LV DYSFUNCTION	1	120	NFGNB	28-01-14	30-01-14
MEDICINE 3	23	1	1	REFRACTORY SEPTIC SHOCK / DYSLIPIDEMIA	1	0		29-01-14	10-02-14
GASTRO	18	2	2	CORROSIVE INJURY OESOPHAGUS / VAP / FEEDING JEJUNOSTOMY / IRON DEFICINECY ANEMIA	1	21	CANDIDA P.	30-01-14	06-02-14
NEUROLOGY	16	2	1	DELIBRATE SELF HARM (HIGH INTENTIONALITY AND LETHALITY) COMPLETE HANGING - POPE PROBABLE ORGANIC PSYCHOSIS	2	0		30-01-14	02-02-14

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DAYS OF C	INDICATION	DM	HTN	CKD	COPD	ANTIBIOT	DAYS OF HOSP STAY	FEVER>10	ADMISSION DX	PR	RR	BP	SPO2	NO OF AT	USG	PLACE	REGISTRA	PAST EXP	TOTAL NU	TIME OF IN
2	1	0	0	0	0	ATT O/S	2	0	SPUTUM POSITIVE	110	28	130/80	80	1	1	2	1	2	2	2
8	1	0	0	1	0	0	0	0	ACCELARATED HY	110	GASPING	230/130	NR	1	1	2	1	2	2	2
3	1	0	0	0	0	1	0	1	MENINGOENCEPH	110	22	88/60	100	INTUB	4	1	1	1	2	2	3
6	2	0	0	0	0	0	1	0	OP POISONING	120	30	120/60	96	1	1	1	1	2	2	3
3	3	0	1	0	0	0	0	0	AMITRYPTILENE P	99	24	130/80	82	1	1	1	1	2	2	1
10	2	0	0	0	0	0	3	0	DISSEMINATED TU	88	16	110/60	96	1	0	1	1	2	2	3
7	1	0	1	0	0	0	0	0	OP POISONING M	125	20	150/90	98	1	0	2	1	2	2	3
10	1	1	0	0	1	1	3	1	COMMUNITY ACC	140	BAGGING	80/50	99	INTUBA	2	1	1	1	2	2	3
7	1	0	0	0	0	0	1	0	OP POISONING - (	100	20	110/70	98	2	1	1	1	2	2	3
8	1	1	0	0	0	0	1	1	COMMUNITY ACC	108	18	120/60	91	1	1	2	1	3	3	3
9	1	0	0	0	0	0	0	1	COMMUNITY ACC	153	46	80/60	88	2	1	2	1	2	2	2
2	1	0	0	0	0	0	0	0	COMPLETE HANGI	86		80/60	70	1	1	2	1	2	2	
10	2	0	0	0	0	1	9	0	MYAESTHENIA GR	112	32	100/60	95	1	1	2	1	1	1	2
7	4	1	1	1	0	0	3	0	GI BLEED	84	28	130/60	95	1	1	2	1	1	1	3
4	3	0	1	0	0	1	0	1	DYSELECTROLYTE	110	16	140/90	100	1	1	2	1	2	2	1
4	1	0	1	0	0	0	0	1	SEPTIC SHOCK	130	GASPING	170/100	80	1	1	1	2	1	1	1
6	2	0	0	0	0	1	7	1	OP POISONING C	90	NA	110/60	NA	1	1	1	1	2	2	2
6	4	0	0	0	0	0	0	0	OP POISONING PI	102	21	128/80	100	INTUB	1	1	1	1	1	1	1
3	3	0	0	0	0	0	0	1	OP POISONING	150	46	100/60	80	1	1	1	1	2	2	3
3	3	1	1	0	0	0	1	1	UTI	106	24	100/80	92	3	1	1	1	3	3	3
9	5	0	0	0	0	0	0	0	ODUVANTHALAI F	110	20	110/60	96	1	1	1	1	1	1	3
6	1	0	0	0	0	0	0	0	SNAKE BITE	NA	NA	NA	NA			1			NA	3
8	1	0	0	0	0	ATT O/S	4	1	TUBERCULOUS ME	86	NA	95/50	NA	2	1	1	1	1	1	3
8	1	0	0	0	0	1- O/S 0T S	0	1	INFECTIVE ENDOC	110	20	100/60	100	1	1	1	1	1	1	3
3	1	0	0	0	0	DOXY AZIT	6	0	ACUTE FEBRILE ILL	94	44	160/80	87	1	1	1	1	1	2	2
9	1	1	0	0	0	0	0	1	CELLULITIS / SEPTI	100	30	70/50	96	1	1	1	1	2	2	3
9	3	1	0	0	0	1	5	1	SEIZURES UNDER I	112	23	102/68	100	1	0	2	1	3	3	1
6	1	1	1	0	1	0	1	1	COPD EXACERBAT	100	24	120/80	NR			2		NR	NR	
5	1	1	1	0	0	0	0	0	SEPTIC SHOCK	110	34	80/60	79	1	1	2	1	2	2	1
8	1	0	0	0	0	1 DETAILS	0	0	SEPTIC SHOCK / A	124	36	90/50	90	2	1	1	2	1	1	1
5	1	0	0	0	1	0	1	1	COMMUNITY ACC	112	33	150/90	83	1	1	1	2	1	1	2
7	1	0	0	0	0	1	1	1	MENINGITIS / SEP	138	36	80/50	88	1	0	1	1	3	3	2
6	1	1	1	1	1	0	1	0	SYMPTOMATIC HY	81	16	130/80	99	1	0	2	1	2	2	2
6	1	0	0	0	0	1	1	1	?PULMONARY TB	130	20	90/40	96	1	1	1	2	1	1	3
6	3	0	0	0	0	0	5	1	SCRUB TYPHUS	120	40	130/80	92	2	1	1	1	2	2	3
11	3	1	0	1	0	0	15	0	pyelonephritis	122	32	128/68	96	2	1	1	2	1	1	2
6	1	1	1	0	1	1	0	0	COPD EXACERBAT	70	40	100/60	92	2	1	2	2	2	2	2
5	1	0	0	0	0	0	0	0	SYSTEMIC LUPUS I	110	26	100/60	86	1	1	2	1	2	2	2
6	1	0	0	0	0	1	82	1	?WERNICKE S ENC	66	24	90/60	100	1	1	1	1	2	2	3
7	3	1	1	0	0	0	0	0	OP POISONING	84	NR	90/60	64	1	1	2	1	2	2	1
3	3	1	1	0	0	0	0	0	SCRUB TYPHUS	92	20	110/70	90	1	1	1	2	1	1	2
13	1	1	1	0	0	0	13	1	NSTEMI/CONGEC	80	18	130/80	99	INTUBA	1	1	2	2	2	2	2
8	3	0	0	0	0	0	1	0	CORROSIVE POIS(	140	40	120/80	?	1	0	2	1	3	3	3
4	2	0	0	0	0	0	2	0	PARTIAL HANGIN(	97	18	117/76	98	1	1	2	1	3	3	3

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REASON F	COMP	L/E	FEVER WI	CHILLS	HYPOTENS	FUIDS/I0T	ART LINE	SIDE	SITE	DAYS ART	CRBSI Y/N	COLONIZA	DAYS ICU	NUMBER (	TRACHEOS	DIED/ALIV	AGE
3	0	0	0	0	0	0	1	1	1	2	0	0	2	4	0	2	25
1	0	0	1	0	1	3	1	1	1	3	0	0	5	25	0	1	22
3	3	0	1		1	3	1	1	1	3	0	0	3	3	0	2	24
2	0	0	1		1	3	1	1	1	7	0	0	15	21	1	1	29
3	0	0	0	0	0	0	0				0	0	3	7	0	1	63
1	0	0	0	0	0	0	0				0	0	10	12	0	1	53
2	0	0	1	0	0	0	0				0	0	16	21	1	1	46
3	0	0	1	0	1	3	1	1	1	6	0	0	11	14	0	2	66
1	0	0	1	0	0	0	0				0	0	8	10	0	1	16
2	0	0	1		1	3	1	1	1	13	0	1	15	16	0	2	68
2	0	0	1	0	1	3	1	1	1	7	0	0	18	18	0	2	30
1	0	0	1	0	1	1	0				0	0	3	4	0	1	46
	0	0	0	0	0	0					0	0	?	?	1	1	35
1	0	0	0	0	0	0	1	1	1	5	0	0	5	13	0	1	59
3	0	0	0	0	0	0	0				0	0	3	20	0	1	24
3	0	0	1	0	1	3	1	1	1	3	0	0	3	3	0	1	70
1	0	0	1	1	0	0	0				0	0	13	16	1	1	23
1	0	0	0	0	0	0	0				0	1	12	17	0	1	27
1	0	0	1	0	0	0	0				0	0	20	27	1	1	26
2	0	0	1	0	1	3	0				0	0	4	15	0	1	60
1	0	0	0	0	0	0	0				0	0	4	12	0	1	19
1	0		0	0	0	3	1	1	1	4	0	0	6	6	0	2	68
3	0	0	1	0	0	0	1	2	1	6	0	0	27	29	1	1	27
1	0	0	1	0	1	BOTH	1	1	1	5	0	0	28	35	1	2	36
1	0	0	0	0	1	FLUIDS	0				0	1	5	7	0	1	75
2	0	0	1	0	0	0	1	1	1	6	0	0	14	34	0	1	40
1	0	0	1	0	1	3	0				0	0	13	25	0	1	40
3	0	0				NR					0	0	6	10	0	2	59
1	0	0	0	0	0	0	1	1	1	5	0	0	5	7	0	1	57
1	0	0	1	0	0	0	0				0	0	9	27	0	1	22
2	0	0	1	0	1	3	1	1	1	5	0	0	11	11	0	2	75
2	0	0	1		1	3	1	RIGHT +LE	1	23	0	0	30	30	1	2	22
1	0	0	0	0	0	0	0				0	0	2	11	0	1	72
1	0	0	0	0	0	0	0				0	0	6	10	0	1	16
1	0	0	0	0	0	0	0				0	0	4	7	0	1	46
1	0	0	0	0	0	0	0				0	0	9	15	0	1	47
1	0	0	0	0	0	0	1	1	1	6	0	0	5	11	0	1	61
1	0	0	1	0	0	0	0				0	0	2	8	0	1	20
2	0	0	1	0	0	0	0	0	0	0	0	1	141	141	1	2	64
1	0	0	1	0	0	0	0				0	1	12	21	0	1	61
4	5	1	0	0	0	0	0				0	1	9	4	0	1	64
2	0	0	1	0	1	3	1	1	1	14	0	0	14	26	1	2	70
2	0	0	1	1	0	0	1	1	1	6	0	1	13	31	1	1	17
1	0	0	0	0	0	0	0				0	0	6	8	0	1	27

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				PROBABLE ORGANOPHOSPHORUS POISONING INTERMEDIATE SYNDROME DELAYED ORGANOPHOSPHORUS ENCEPHALOPATHY E. Coli BACTEREMIA WITH SEPTIC SHOCK						
MEDICINE 2	not available		1	2 PROBABLE ASPIRATION PNEUMONIA	1	150	NFGNB PAN	01-02-14	08-02-14
MEDICINE 1	14		1	2 OP POSONING ENTEROCOCCAL SEPSIS GASTRITIS REFRACTORY SHOCK	1	22	KLEBSIELLA	06-02-14	12-03-14
NEPHROLOGY 1	30		1	1 ACUTE ON CHRONIC KIDNEY DISEASE / VAP / ACUTE PULMONARY EDEMA	1	0		07-01-14	17-02-14
MEDICINE 2	18		1	1 SCRUB TYPHUS	1	0		09-02-14	11-02-14
MEDICINE 4	17		1	2 ACUTE FEBRILE ILLNESS	1	0	0	08-02-14	13-02-14
MEDICINE 3	20		1	ALCOHOL DEPENDENCE SYNDROME HEPATIC ENCEPHALOPATHY 1 CLD ASPIRATION PNEUMONIA	1	120	NFGNB SEN	24-08-13	31-08-13
MEDICINE 3	25		1	1 NSTEMI PULMONARY EDEMA ACUTE ON CHRONIC KIDNEY DISEASE	1	0		25-08-13	29-08-13
MEDICINE 1	15		1	1 CARBAPHOS POISONING	1	0		28-08-13	30-08-13
MEDICINE 3	11		1	2 NITROBENZENE POISONING	1	0		30-08-13	02-09-13
MEDICINE 4	15		2	1 SCRUB TYPHUS WITH SHOCK / AKI/ HYPOCORTISOLEMIA UNDER EVALUATI	1	0		02-09-13	04-09-13
MEDICINE 1	19		2	2 SCRUB TYPHUS WITH SHOCK / VAP/ ARDS	1	100	NFGNB SEN	03-09-13	09-09-13
ENDOCRINOLOG	26		1	CHRONIC CALCIFIC PANCREATITIS SECONDARY DIABETES MELLITUS HEAD INJURY BILATERAL VOCAL CORD ADDUCTOR PALSY DIABETIC NEPHROPATHY DIABETIC SENSORY NEUROPATHY ALCOHOL DEPENDENCE SYNDROME VITAMIN D DEFECIENCY HYPONATREMIA - DEPLETIONAL 2 ANAEMIA - MULTIFACTORICAL	1	400	NFGNB KLEI	04-09-13	09-09-13
ENDOCRINOLOG	21		2	1 CORONARY ARTERY DISEASE - TRIPLE VESSEL DISEASE / PAROXYSMAL ATRI	1	0		27-09-13	04-10-13
MEDICINE 3	13		2	2 NSTEMI OP POISONING CHLORPYRIFOS INTERMEDIATE SYNDROME	1	733	CONS/NFGI	06-10-13	15-Oct
MEDICINE 1	19		1	ORGANOPHOSPHATE POISONING INTERMEDIATE SYNDROME 1 DELAYED OP INDUCED ENCEPHALOPATHY	2	0		10-Oct	16-10-13
MEDICINE 4	18		2	2 OP POISONING PHORATE / VAP/ INTERMEDIATE SYNDROME	1	SCANTY	CONS	09-10-13	19-10-13
NEUROLOGY	13		2	2 PARTIAL HANGING / POPE/ PARANOID SCHIZOPHRENIA	1	0		10-10-13	13-10-13
HAEMATOLOGY	22		1	2 H3N1 PNEUMONIA WITH MYOCARDITIS	1	0		15-10-13	20-10-13
MEDICINE 4	17		1	2 OP POISONING NEONICOTINOID / BILATERAL ADDUCTOR PALSY	1	0		23-10-13	30-10-13
MEDICINE 2	20		2	1 PHORATE POISONING VITAMIN B 12 DEFICIENCY	1	0		27-10-13	31-10-13
MEDICINE 2	21		1	2 LEFT LEG CELLULITIS AKI ?SECONDARY TO PSGN SEPTIC SHOCK	1	0		28-10-13	30-10-13
MEDICINE 4	32		1	1 ACUTE CORONARY SYNDROME / EXACERBATION OF COPD	1	0		30-10-13	31-10-13
MEDICINE 1	28		2	1 RHEUMATOID ARTHRITIS ILD H3NI PNEUMONIA HYPOTHYROIDISM	1	0		02-11-13	07-11-13
PULM MED	18		2	2 ILD SCLERODERMA MODS SEPTIC SHOCK PROBABLE VAP	1	0		03-11-13	10-11-13
MEDICINE 1	19		1	2 OP POISONING ETHION D2/VAP/SEPTIC SHOCK/ ESOPHAGEAL INTUBATIC	1	SCANTY	CONS	03-11-13	07-11-13
MEDICINE 2	15		2	1 OP POISONING METHYL PARATHION /DOPE/LEFT VOCAL CORD PALSY/CA U	1	460	Candida tro	04-11-14	08-11-14
MEDICINE 2	19		1	1 PROBABLE TUBERCULOUS MENINGITIS	1	0		12-11-13	16-11-13
MEDICINE 3	23		1	2 COMMUNITY ACQUIRED PNEUMONIA / SEPSIS	1	0		18-11-13	23-11-13
MEDICINE 1	25		2	1 SEVERE PRE ECLAMPSIA / CA UTI / FLASH PULMONARY EDEMA WITH AKI/ V	1	130	NFGNB	10-12-13	13-12-13
MEDICINE 3	20		1	1 HYPOXIC ENCEPHALOPATHY CARDIOGENIC SHOCK NSTEMI	1	0		14-12-13	22-12-13
MEDICINE 1	25		1	2 SEPTIC SHOCK/ HYPOSTATIC PNEUMONIA/ BRONCHIAL ASTHMA	1	0		26-12-13	02-01-14
MEDICINE 1	11		2	1 IDIOPATHIC DILATED CARDIOMYOPATHY DM HTN ASTHMA	1	0		29-05-14	01-06-14
MEDICINE 5	20		2	2 CVA/HONC	1	0		02-06-14	10-06-14

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8	1	0	0	0	0	0	1	0	PROBABLE OP PO	150	18	76/50	91	INTUBA	1	0	2	1	3	3	2
7	1	0	0	0	0	0	0	0	OP POISONING CH	120	24	130/70	97		1	1	1	1	2	2	2
11	1	0	1	0	0	1 ON AUG	1	0	ACUTE PULMONA	132	32	210/110	86		1	1	2	1	2	2	1
	1	1	1	0	0	1 OFLOX		0	SCRUB TYPHUS	113	24	140/60	95		1	1	1	1	1	1	
6	3	0	0	0	0	0	3	1	ACUTE FEBRILE ILL	108	30	153/77	97		1	1	1	1	3	3	3
8	1	0	0	0	0	0	0	0	?ALCOHOL WITHD	103	40	128/70	88		2	1	1	1	3	3	2
5	3	1	1	1	0	0	1	0	ACUTE FEBRILE ILL	96	30	130/80	90		3	1	2	2	1	1	3
3	1	0	0	0	0	0	1	1	CARBAPHOS POIS	124	20	110/60	93		1	1	1	1	2	3	3
4	3	0	0	0	0	1	0	0	NITROBENZENE PI	114	INTUBATE	110/70	94				1	2	2	2	3
3	3	0	1	0	0	0	0	1	ACUTE FEBRILE ILL	118	24	80/60	95		1	1	1	2	2	2	3
7	3	1	0	0	0	1	0	0	ACUTE FEBRILE ILL	101	60	99/64	78		1	1	1	1	2	2	3
6	3	1	0	0	0	0	0	1	DIABETIC KETOAC	110	20	100/60	75		1	1	2	2	2	2	3
8	3	1	1	0	1	0	3	0	EXACERBATION O	100	32	140/80	85		1	1	2	1	2	2	1
10	2	0	0	0	0	0	7	0	OP POISONING CH	86	12	140/77	99		1	1	1	2	1	1	1
7	3	0	0	0	0	0	1	0	OP POISONING Q	140	26	160/90	95		1	1	1	1	2	2	1
11	1	1	1	0	0	0	1	0	OP POISONING PH	100	30	250/110	56		1	1	1	1	2	2	3
4	1	0	0	0	0	0	0	0	PARTIAL HANGIN(	120	28	120/80	90		1	1	2	1	2	2	1
6	1	1	0	0	0	0	0	1	ACUTE FEBRILE ILL	104	24	80/60	93		1	0	2	1	3	3	2
8	1	0	0	0	0	0	0	0	OP POISONING N	106	BAGGING	100/80	100		1	1	2	2	2	2	3
5	1	0	0	0	0	0	1	0	PHORATE POISON	112	26	100/70	97		1	1	2	2	1	1	2
3	1	0	1	0	0	0	1	0	LEFT LEG CELLULIT	105	22	127/57	83		1	1	1	1	3	2	1
2	1	1	1	0	0	1	0	0	EXACERBATION O	148	27	120/70	80		1	1	1	1	3	3	3
6	3	0	1	0	0	0	1	1	COMMUNITY ACQ	101	48	160/90	80		1	1	1	2	3	3	3
8	1	0	1	0	0	0	4	0	SCLERODERMA ILL	114	BAGGING	128/88	99	INTUBA	1	0	2	1	2	2	3
5	1	0	0	0	0	0	0	1	OP POISONING ET	121	25	103/60	80	ESOPH/	5	1	1	2	1	1	2
5	3	0	0	0	0	0	8	1	OP POISONING ET	180	18	130/70	88%		1	1	1	1	2	2	1
5	3	0	0	0	0	1 STREPTO	3	1	TUBERCULOUS ME	141	20	124/74	99		1	1	1	1	2	2	
6	1	1	0	0	1	0	2	1	COMMUNITY ACQ	96	36	130/80	85		2	1	1	2	1	1	2
4	1	0	0	0	0	0	13	1	ACUTE PULMONA	130	BAGGING	143/109	99	INTUBA	1	1	2	2	2	2	3
9	1	1	1	0	0	0	0	0	CARDIOGENIC SH(	124	34	160/100	96		1	1	2	1	2	2	2
8	1	0	1	1	0	0	1	1	AFI ?UROSEPSIS	126	40	120/80	99		4	1	1	2	2	2	3
4	1	1	1	1	0	0	1	0	DILATED CARDIOM	80	26	60 SYSTOL	95		1	1	1	1	1	1	2
9	3	1	1	0	0	0	0	1	HONC/UTI	90	20	90/60	94		1	0	1	1	2	2	2

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2	0	0	1		1	3	1	2	1	5	0	1	13	13	1	2	42
2	0	0	1	0	0	0		1	1	7	1	1	24	24	1	2	35
1	0	0	0		0	0	1	1	1	3	0	0	19	19	0	2	62
1	0	0	0	0	0	0	0				0	0	4	6	0	1	61
1	0	0	0	0	0	0	0				0	0	13	15	0	1	40
1	0	0	1		1	3	0				0	1	10	16	0	1	51
1	0	0	0	0	0	0	1	1	1	5	0	0	7	11	0	1	76
1	0	0	0		0	0	1	1	1	4	0	0	4	7	0	1	21
1	0	0	0		0	0	0				0	0	5	7	0	1	20
1	0	0	0	0	0	0	0				0	0	3	10	0	1	64
2	0	0	1	0	1	3	1	1	1	14	0	1	14	14	0	2	71

2	0	0	1	0	0	0	1	1	1	6	1	1	9	27	0	1	40
1	0	0	0	0	0	0	0				0	0	5	23	0	1	76
1+2	0	0	1	0	0	0	0				1	1	20	32	1	1	56
1	0	0	0	0	0	0	0				0	0	21	29	1	1	24
1	0	0	1	0	0	0	0				0	0	22	26	1	1	64
1	0	0	0	0	0	0	0				0	0	4	5	0	1	23
1	0	0	1	0	1	1+2	0	0	0	6	0	0	6	7	0	1	18
1	0	0	0	0	0		0				0	0	14	17	1	1	21
1	0	0	0	0	0	0	0				0	0	5	8	0	1	19
1	0	0	0	0	0	0	0				0	0	4	7	0	1	71
5	0	0	0	0	0	0	1	1	1	2	0	0	2	2	0	1	66
1	0	0			0	0	1	1	1	3	0	0	7	12	0	2	61
2	0	0	0	0	0	0					0	0	26	26	1	2	61
2	0	0	1	1	1	3	1	1	1	NR	0	0	18	19	1	2	49
1+2	0	0	1		0	0	0	0	0		0	1	5	18	1	1	30
3	0	0	1	0	0	0	0		NA	NA	0	0	6	13	0	2	20
1	0	0	1	0	0	0	0				0	0	8	19	1	DAMA	78
1	0	0	1	0	0	0	0				0	1	24	29	0	1	24
1	0	0	0	0	1	1	1	1	1		0	0	6	14	0	2	66
1	0	0	0	0	0	0	0				0	0	11	19	0	1	61
1	0	0	0	0	0	1	0				0	0	4	14	0	1	48
2	0	1	1	0	0	1	0				0	0	10	16	0	1	62

MEDICINE 1	18	1	2	CEREBROVASCULAR ACCIDENT / RIGHT THALAMIC BLEED	1	0	0	29-03-14	03-04-14
MEDICINE 1	10	1	1	OP POISONING / TRIAZOPHOS AND DELTAMETHRIN / ALCOHOLIC HEPATIT	1	0	0	22-03-14	28-03-14
MEDICINE 2	27	2	2	COMMUNITY ACQUIRED PNEUMONIA / SEPTIC SHOCK / ACUTE KIDNEY INJ	1	370	E COLI / ENT	29-12-13	04-01-14
MEDICINE 4	20	1	2	PYELONEPHRITIS / LEFT HYDROURETERONEPHROSIS / CHRONIC ACTIVE HE	1	120	NFGNB	03-01-14	07-01-14
				ATRIAL FIBRILLATION LOWER GI BLEED ACUTE INFECTIVE EXACERBATION OF COPD VENTILLATOR ASSOCIATED PNEUMONIA DIABETES MELLITUS ACUTE ON CHRONIC KIDNEY DISEASE ANEMIA METABOLIC ACIDOSIS / HYPERKALEMIA					
MEDICINE 1	22	1	1	SEPTIC SHOCK	1	0	0	18-12-13	02-01-14
MEDICINE 3	20	1	2	DENGUE/VAP/AGE CHOLERA	2	300	NFGNB RES	11-06-14	16-06-14
MEDICINE 4	19	1	1	PROBABLE TUBERCULOUS MENINGITIS / ASPIRATION PNEUMONIA	2	1	1	15-06-14	16-06-14
MEDICINE 2	33	1	2	UROSEPSIS WITH E COLI BACTEREMIA / PROBABLE NOSOCOMIAL PNEUMO	1	0		10-06-14	17-06-14
MEDICINE 1	26	2	1	PYREXIA OF UNLNOWN ORIGIN SEE D/S	1	1000 / 50	NFGNB / EN	13-06-14	21-06-14
MEDICINE 3	12	1	1	RIGHT PARIETO OCCIPETAL BLEED WITH INTRAVENTRICULAR EXTENSION Y	1	0		29-10-13	02-11-13
				DISSEMINATED TUBERCULOSIS IMMUNE MEDIATED POLYNEUROPATHY WITH SENSORY MOTOR AXONOPATHY PROABABLE SYSTEMIC VASCULITIS ANEMIA OF CHRONIC DISEASE STEROID INDUCED DIABETES MELLITUS					
MEDICINE 4	20	1	2	SEIZURE DISORDER	1	0		19-06-14	26-06-14
MEDICINE 3	27	1	2	ACUTE INTERMITTENT PORPHYRIA / ASPIRATION PNEUMONIA	1	0		14-Jun	23-06-14
PULM MED	31	1	1	CHRONIC OBSTRUCTIVE PULMONARY DISEASE / NSTEMI / OBSTRUCTIVE SLEEP APNOEA/ PROBABLE OBESITY HYPOVENTILLATION SYNDROME	1	0		19-02-14	24-02-14
						100	NFGNB		

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6	1	0	1	0	0	0	0	0	CEREBROVASCUL	80	26	160/100	90	1	1	1	1	3	3	1	
7	1	0	0	0	0	0	8	1	TRIAZOPHOS AND	86	24	120/80	88	1	1	1	1	2	2	3	
7	1	0	0	0	0	0	0	1	COMMUNITY ACQ	70	32	60/40	80			1	1	2	2	3	
5	1	0	0	0	0	0	2	1	ACUTE FEBRILE ILL	110	30	98/60	84			1	1	2	2	3	
15	1	1	0	1	1	0	2	1	ATRIAL FIBRILLATI	104	40	140/90	88	1	1	1	1	2	2	2	
6	1	1	1	0	0	0	5	1	AFI/DELIRIUM TRE	110	NR	60 SYSTOL	NR	1	1	1	1	1	1	2	
	3	0	0	0	0	1		1	MENINGITIS	180	44	130/80	88	2	1	1	1	2	1		
8	3	1	0	0	0	0	6	1	UROSEPSIS HYPER	126	38	130/80	88	1	1	1	2	1	1	2	
9	3	0	0	0	0	0	1	1	PYREXIA OF UNKN	110	22	110/70	100	1	1	1	1	2	2	2	
5	1	0	1	0	0	0	2	0	CVA	92	16	210/150	99	1	1	1	1	2	1	2	
8	1	0	0	0	0	1	45	1	PERIPHERAL NEUF	148	68	130/80	96 ON 6L C	1	1	1	1	2	2	2	
10	2	0	0	0	0	0	3	1	SEIZURES UNDER	110	40	110/70	88	1	1	1	1	1	1	2	
6	1	1	1	0	1	0	0	0	ACUTE EXACERBA	106	46	180/110	62	1	1	2	1	2	2	1	

1	0	0	0	0	0	0	0	1	1	1	6	0	0	11	9	1	2	76		
2	0	0	1	0	1	3	1	1	1	7	0	0	17	35	1	1	66			
2	0	1	1	0	1	3	1	1	1	8	0	1	15	25	1	1	49			
1	0	0	0	0	0	0	1	1	1	7	0	0	20	5	0	1	53			
2	0	0	1	0	0	0	1	1	1	6	0	0	59	59	0	1	68			
1+2	0	0	1	0			0				0	1	11	17	0	1	58			
2	0	0	1	0	0	0	0				0	1	10	12	0	1	23			
1	0	0	0	0	1	3	1	1	1	5	0	0	14	14	1	2	56			
1	0	0	0	0	0	0	0				0	1	8	18	0	1	16			
1	0	0	0	0	0	0	1	1	1	3	0	0	3	9	0	1	43			
1	0	0	0	0	0	0	0	0	0	0	0	0	34	72	0	1	57			
1	0	0	1	0	0	0	0				0	0	6	21	1	1	25			
1	0	0	0			NR	0				0	0	6	11	0	2	67			

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CODE																				
								REASON FOR CVC REMOVAL												
								NO LONGER REQUIRED					1							
	MHDU	1						CRI SUSPECTED					2							
	MICU	2						PATIENT HAS EXPIRED					3							
								CVC RELATED (MECH) COMP					4							
	SEX							DAMA /DISCHARGE AT REQUEST					5							
	male	1						WRONG LOCATION/ MALPOSITION					6							
	Female	2																		
								IMMEDIATE COMPLICATIONS OF CVC INSERTION												
	INDICATION :							PNEUMOTHORAX					1							
	HEMODYNAMIC INSTABILITY					1		HEMOTHORAX					2							
	LACK OF PERIPHERAL VENOUS ACCESS					2		HEMATOMA					3							
	ANTICIPATE WORSENING					3		ARTERIAL PUNCTURE					4							
	more than 1 indication					4		dvt					5							
	hemo. Inst. And NaHCO3					5														
	PRE EXISTING MEDICAL CONDITIONS							LOCAL EXAMINATION												
	DM	YES = 1	NO=0					REDNESS					1							
	HTN	YES = 1	NO=0					WARMTH					2							
	CKD	YES = 1	NO=0					TENDERNESS					3							
	COPD	YES = 1	NO=0					PURULENT DISCHARGE					4							
	SITE							FEVER FROM CVC INSERTION TO REMOVAL												
	IJV	1										YES = 1	NO = 0							
	FEMORAL	2																		
								DID THE PT HAVE HYPOTENSION FROM INSERTION TO REMOVAL												
	SIDE																			
	RIGHT	1						YES = 1												
	LEFT	2						NO = 0												
	HAS THE PATIENT RECEIVED ANTIBOTICS BEFORE ADMISSION											IF YES THEN DID HE REQUIRE								
												FLUIDS	1							
	YES = 1											INOTROPE	2							
	NO = 0											BOTH	3							
	DOES THE PATIENT HAVE FEVER AT THE TIME OF CVC INSERTION (TEMP >101)											CHILLS	YES = 1							
	YES = 1												NO = 0							
	NO = 0																			
								OTHER EVIDENT SOURCE OF INFECTION:												
	OPERATO	FACTORS						SPUTUM		YES = 1	NO = 0			sputum	YES = 1	NO = 0	not done = 2			
	ULTRASOUND GUIDANCE							URINE		YES = 1	NO = 0			urine	YES = 1	NO = 0	not done = 2			
	YES = 1																			
	NO = 0							COLLECTION/ABSCES		YES = 1	NO = 0									
														arterial line		side art line				
	PLACE OF CVC INSERTION							POSITIVE CULTURE S		YES = 1	NO = 0			right = 1		right				
	MHDU	1												left = 2						
	MICU	2						ART LINE		YES = 1	NO = 0			none = 0						
								SITE		RADIAL = 1										
		INSERTED BY								FEMORAL = 2										
		REGISTRA	1																	
		INTERN	2					ALIVE	1											
		CONSULTA	3					DIED	2											
	TOTAL NO OF CVC INSERTED BY THE OPERATOR :																			

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							DIAGNOSIS		
	<10	1	low						
	10 TO 30	2	intermediate				OP POISONING		1
	> 30	3	high				PNEUMONIA		2
							PYELONEPHRITIS		3
	CVC S AT THIS SITE		operator experience				SEPTIC SHOCH		4
	<5	1	LOW				CARDIOGENIC SHOCK / DCMY		5
	5 TO 15	2	INTERMEDIATE				PULMONARY TUBERCULOSIS		6
	> 15	3	HIGH				TUBERCULOUS MENINGITIS		7
							GI BLEED		8
							SCRUB TYPHUS		9
	MORNING SHIFT		1				HANGING		10
	EVENING SHIFT		2				CHRONIC KIDNEY DISEASE		11
	NIGHT SHIFT		3				MENINGOENCEPHALITIS		12
							AMITRYPTILENE OVERDOSE		13
							CARBAMAZEPINE OVERDOSE		14
							MYAESTHENIA GRAVIS		15
							VARICEAL BLEED		16
							ODUVANTHALAI POISONING		17
							SNAKE BITE		18
							CVA		19
							INFECTIVE ENDOCARDITIS		20
							NECROTIZING FASCITIS		21
							STATUS EPILEPTICUS		22
							ACUTE EXACERBATION OF COPI		23
							CHROMIUM INTOXICATION		24
							CNS VASCULITIS		25
							HYPONATREMIA		26
							PORPYRIA		27
							DISSEMINATED TUBERCULOSIS		28
							AFI		29
							DENGUE		30
							PRE ECLAMPSIA		31
							ACS		32
							CELLULITIS		33
							ATRIAL FIBRILLATION		34
							ALCOHOL INTOXICATION		35
							HYPOGLYCEMIA		36
							NITROBENZENE POISONING		37
							PULMONARY EDEMA		38
							HEPATIC ENCEPHALOPATHY		39
							SLE		40
							CERVICAL MYELOPATHY		41
							CORROSIVE INJURY		

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