Research Article

Catheter-related bloodstream infections ameliorated by *Costus igneus* in intensive care unit patient

Jai Rexlin[1], R. Gayathri[2]*, V. Vishnu Priya[2]

ABSTRACT

Aim: The aim of this was to determine the effect of *Costus igneus* on catheter-related bloodstream infection (CR-BSI) in intensive care unit patients. **Introduction:** The present study is aimed for the culture of the rhizome of *C. igneus* and the analysis of the induced *C. igneus* rhizome for its antimicrobial activity in different microorganisms such as *Enterococcus faecalis* and *Escherichia coli*. **Materials and Methods:** Bacterial strains were chosen based on their clinical and pharmacological importance and subcultured. After which, MeOH extract is prepared. Moreover, bacterial growth inhibitory potential was analyzed. **Results and Discussion:** With the increase in the concentration of CIE, the percentage of inhibition of *E. coli* and *E. faecalis* increased. Moreover, it is also very evident that the percentage of inhibition provided by *C. igneus* is higher than that of ampicillin in positive control. **Conclusion:** Administration of *C. igneus* as a medicine for CR-BSI could prove to be a good solution in treating the infections.

KEY WORDS: Costus igneus , Catheter infections, Intensive care unit patient

INTRODUCTION

Bloodstream infection refers to the recovery of a microbial pathogen in blood culture by infection not specimen contamination. A central venous catheter (CVC) is a catheter whose tip resides in a central vein, whereas the tip of peripheral venous catheter does not (a peripherally inserted central catheter is a CVC.[1] Catheter-related bloodstream infections (CR-BSIs) are associated with significant morbidity, mortality, and costs.[2,3] Interventions aimed at decreasing the infection rate are needed to reduce the serious public health consequences of this hospital-acquired infection. How many of these infections are preventable is unknown. Aside from strict adherence to aseptic practices during catheter insertion and during subsequent care, few interventions have been shown to effectively reduce infection rates. Innovative strategies to minimize the risk for infection that is being actively pursued include amelioration by *Costus igneus*. *C. igneus* is a recent introduction to India as an herbal cure and hence commonly called as "insulin plant."[4] It is a prostrate growing plant with spreading, rooting stems. Its leaves are slender and lance-shaped with tooted, scalloped, or lobed margins. They are grayish-green stained with red-purple above and darker purple beneath. The tiny white flowers grow intermittently throughout the year. This plant reaches an height of 6 inches and has an indefinite spread.[5-8]

The plant belongs to the family Costaceae. The whole plant Costus igneus is used as an antidiabetic drug and also to boost immunity. The rhizome has been used to treat fever, rash, asthma, bronchitis, intestinal worms, ailments of eyes, stomach, neck, jaws, tongue, and mouth and and also used for curing edema, wheezing (dyspnea), hemorrhoids, and spermaturia. In Siddha medicine, *C. igneus* root has been used as in the form of powder, decoction, and oil. Until now, *C. igneus* has been reported to contain resinoids, essential oil, and few alkaloids named saussurine, inulin, and resin.[9] The present study is aimed for the culture of the rhizome of *C. igneus* and the analysis of the induced *C. igneus* rhizome for its antimicrobial activity in different microorganisms such as *Enterococcus faecalis* and *Escherichia coli*.

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Risk Factors

Potential risk factors for CR-BSI include underlying disease, method of catheter insertion, site of catheter insertion and duration, and purpose of catheterization. The administration of parenteral nutrition through intravascular catheters increases CR-BSI risk.[10]

Clinical Presentation

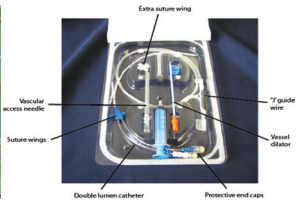
The diagnosis of CR-BSI is often suspected clinically in a patient using a CVC who represents with fever or chills, unexplained hypotension, and no other localizing sign.[11,12] Mild symptoms include malaise and nausea, and severe symptoms include high fever with rigors, hypotension, vomiting, and changes in mental status in the setting of a normal catheter exit site or tunnel, on physical examination.[13] Exit-site infection is indicated by the presence of erythema, swelling, tenderness, and purulent drainage around the catheter exit and the part of the tunnel external to the cuff. Severe sepsis and metastatic infectious complications, such as infective endocarditis, septic arthritis, osteomyelitis, spinal epidural abscess, and septic emboli, can prolong the course of CR-BSI.[14]

Short-Term Catheters, Including Arterial Catheters

For short-term catheter tip cultures, the roll-plate technique is recommended for routine clinical microbiological analysis.[15] For suspected pulmonary artery catheter infection, the introducer tip is cultured.[16]

Long-Term Catheters

A venous access subcutaneous port is removed for suspected CR-BSI, and the port is sent to the microbiology laboratory for the qualitative culture of the post reservoir contents, in addition to the catheter tip.[17]



MATERIALS AND METHODS

Bacterial strains (*E. faecalis* and *E. coli*) were chosen based on their clinical and pharmacological importance. The bacterial microorganisms were cultured on nutrient agar using spread plate technique and were incubated for 24 h at 37°C. The bacterial strains were grown in Mueller-Hilton agar plates at 37°C (the bacteria were grown in the nutrient broth at 37°C and maintained on nutrient agar slants at 4°C). The stock cultures were maintained at 4°C. Sterile spreader was used for inoculation of these organisms across respective media.

Preparation of MeOH Extract

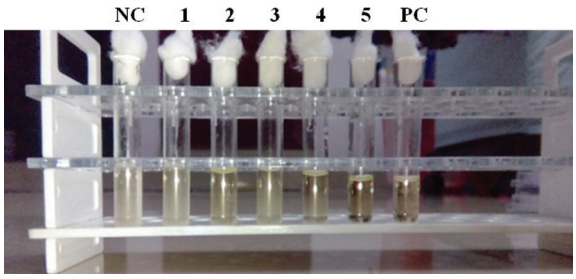
The rhizomes of *C. igneus* were collected, washed, and dried in shade. The dried rhizomes were powdered (520 g) and exhaustively extracted by maceration with methanol for 3 days. After 3 days, methanol layer was decanted off. The process was repeated for 3 times. The solvent from the total extent was distilled off and the concentrate was evaporated using rotary vacuum evaporator (25 rpm, 60°C).

Bacterial Growth Inhibitory Potential

Determination of minimum inhibition concentration

The minimum inhibitory concentration (MIC) of test product on bacterial strains was carried out using broth dilution method. The cultures were then incubated and subsequently serially diluted to reach the density of 2 × 10^4cells/ml. Cell counting was done using hemocytometer. 2 mm of Mueller-Hinton broth was dispensed in tubes, and 100 µL of different concentration of test sample (CIE) was added to each tube. Growth control was run in parallel with every experiment. All the experimental tubes were incubated in anaerobic jars for 48 h. After completion of incubation period, the optical density was measured at 600 nm. MIC was defined as the minimum concentration of extract that caused 20% inhibition in growth of test microorganism. Each experiment was carried out in a triplicate set. The lowest concentration before color change was considered as the MIC. The percentage of bacterial inhibition by the test product was computed using the following equation:

$$\text{Percentage Inhibition} = \frac{\text{OD in control} - \text{OD in test}}{\text{OD in control}} \times 100$$



RESULTS AND DISCUSSION

From Table 1, with the increase in the concentration of *C. igneus* extract, the percentage of inhibition of *E. coli* increased. For 50, 100, 250, 500, and 1000 µg/ml of concentration of *C. igneus* extract, the percentage of inhibition provided against *E. coli* was found to be 23.7%, 33%, 74.4%, 87%, and 95%, respectively. It is evident from the above-mentioned results that the percentage of inhibition offered in positive control by ampicillin is 89.4%, whereas the percentage of

Table 1: The *E. coli* minimum inhibitory concentration of the Costus igneus extract (CIE)

Concentration (µg/ml)	Absorbance at 600 nm	% of Inhibition
	Mean OD±SD	
50	0.325±0.15*	23.7
100	0.285±0.09*	33.0
250	0.109±0.26*	74.4
500	0.055±0.21*	87.0
1000	0.021±0.18*	95.0
Negative control	0.426±0.24	-
Positive control	0.045±0.20*	89.4

Values are mean±SD expressed as (n=3), *P<0.05 significantly different as compared with negative control untreated. *E. coli: Escherichia coli*, SD: Standard deviation

Table 2: The *E. faecalis* minimum inhibitory concentration of the CIE

Concentration(µg/ml)	Absorbance at 600 nm	% of Inhibition
	Mean OD±SD	
50	0.406±0.13*	21.1
100	0.309±0.10*	40.1
250	0.257±0.08*	50.0
500	0.189±0.11*	63.3
1000	0.106±0.15*	79.4
Negative control	0.515±0.29	-
Positive control	0.099±0.05*	80.7

Values are mean±SD expressed as (n=3), *P<0.05 significantly different as compared with negative control untreated. *E. faecalis: Enterococcus faecalis,* SD: Standard deviation

inhibition (95%) offered by 1000 µg/ml of *C. igneus* extract is higher than that of positive control.

From Table 2, with the increase in the concentration of *C. igneus* extract, the percentage of inhibition of *E. faecalis* increased. For 50, 100, 250, 500, and 1000 µg/ml of concentration of *C. igneus* extract, the percentage of inhibition provided against *E. faecalis* was found to be 21.1%, 40.1%, 50.0%, 63.3%, and 79.4%, respectively. It is evident from the above-mentioned results that the percentage of inhibition offered in positive control by ampicillin is 80.7%, whereas the percentage of inhibition (79.4%) offered by 1000 µg/ml of *C. igneus* extract is higher than that of positive control.

CONCLUSION

With the increase in the concentration of *C. igneus* extract, the percentage of inhibition of *E. coli* and *E. faecalis* increased. Moreover, it is also very evident that the percentage of inhibition provided by *C. igneus* with the concentration of 1000 µg/ml is higher than the percentage of inhibition provided by ampicillin in positive control.

E. coli and *E. faecalis* are the potential microorganisms causing CR-BSIs. Hence, the administration of *C. igneus* as a medicine for CR-BSIs could prove to be a good solution in treating the infections.

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