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ASSESSMENT OF EXTRINSIC CONTAMINATION OF INFUSATE IN THE TERTIARY CARE HOSPITAL OF QUETTA CITY, PAKISTAN

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ABSTRACT

Hospitalized patients are given parenteral therapy thus they are at high risk of developing infection due to extrinsic contamination when the infusion containers are vented. The current study was therefore designed to evaluate the extrinsic contamination of infusate, the type of bacteria involved in contamination of infustae and practice of the health care professionals in terms of maintaining central line in the tertiary care hospital of Quetta city Pakistan. Two hundred and ten samples were taken from different wards of a tertiary care hospital in Quetta city, Pakistan. The infusates of Dextrose solutions and Ringer lactate solutions were cultured on the media and was checked for the type of bacteria afterwards. The gynaecological ward had most of the positive sample i.e. 6.19% followed by the trauma centre (5.23%). Klebsiella, Enterococcus, E. coli, and Staphylococcus aureus were the major bacteria which were identified from the sample infusate. The nursing staff used to vent the container by spiking the container with needle so as to deliver the solution to patient, consequently providing an opportunity for contamination. To prevent bacteraemia in a practical way, we recommend improving pharmacy services in the hospitals which will diminish the compounding of intravenous admixtures in nursing units. Meanwhile it is also recommended that infusate should be cultured routinely to estimate contamination especially in those patients where there is no clinically proven source of infection.

KEYWORDS: Infusate, Extrinsic contamination, Sandeman Provincial Hospital, Quetta, Pakistan.

INTRODUCTION

Hospitalized patients on parenteral therapy have the chances of developing bloodstream infections. Such infections result due to intravenous line which ultimately leads to increase in hospitalization stay, expense, and also mortality. Intravenous fluids have high chances to be contaminated in the process of preparation of intravenous admixture, its setup, and administration. Chances of extrinsic contamination increases when the open infusion containers are vented (Crnich & Maki, 2001; Salomao et al., 2008).

Both closed and open infusion containers are used worldwide. Containers for closed infusion are composed of fully collapsible plastic that don't use or require external vent (needle or air filter) to empty the solution. Containers for open infusion on the other hand are composed of rigid (burette, glass) or semi-rigid plastic which must admit air (needle or air filter) to release the fillings. To avoid health care linked infections, standard practice shall be the incorporation of closed system like pneumonia associated to ventilator, urinary tract infection associated to catheter, infections associated to surgeries, and blood stream infections associated to central line. Outbreaks of central line-associated-bloodstream infections owing to contamination of infusate in open infusion system have been reported in several countries (Rosenthal & Maki, 2004; Rosenthal et al., 2006).

Contamination due to extrinsic factors or during use plays very significant role in bacterial contamination of the central line (Macias et al., 2008). Substituting open, semi-rigid plastic infusion containers to closed, wholly collapsible plastic infusion containers in Argentina resulted in cost effectiveness and 64% reduction in the rate of central line-associated bloodstream infections.

Whereas study of open containers was limited to semi rigid plastic containers only and time to central line-associated-bloodstream infections was not studied as well (Rosenthal & Maki, 2004).

Few drugs formulated in the form of intravenous infusions have the inherent ability to sustain the growth of microorganisms which are responsible for serious infections and complications. Although intrinsic contamination from the manufacturer is rare, extrinsic contamination during use in hospitals with poor nursing techniques and standards are very common. Nevertheless, extrinsic infusate contamination has also been reported in settings with good nursing standards. Consequently, identifying the frequency of such contaminations and method used to identify their sources emerged to be a significant area of research (Moore et al., 2005).

Therefore, the current study was conducted in a tertiary care hospital of Quetta city Pakistan where all types of open infusion containers are utilized. We aimed to evaluate the probability of developing central line-associated-bloodstream infections, the type of bacteria involved in contamination of infustae and practice of the health care professionals in terms of maintaining central line.

METHODS

Study setting

Present study was conducted in Centre for Advanced Studies in Vaccinology and Biotechnology (CASVAB), University of Baluchistan, Quetta for the isolation and identification of pathogenic bacteria from pierced IV infusions during the drug administration by nurses. The samples were taken from tertiary care hospital i.e., Sandeman Provincial Hospital of Quetta city of Pakistan. The hospital has more than 45 departments however, the samples were collected from Trauma centre, Causality, Medicine, Paediatric, Gynecology, Surgery and Intensive care unit. Biochemical tests were performed in vitro to identify the pathogenic bacteria (Shahzad et al., 2018).

Sampling size and sampling procedure

In the selected time frame of 6 months, two hundred and ten IV infusate samples were collected from selected departments as mentioned above. Systematically, thirty samples were taken from each department as reference samples and two Petri dishes as standard. The samples were taken to the laboratory in the cold chain condition within a half hour of selection.

Preparation of Media

According to the manufacturers' instructions, the commercially available media was reconstructed in distilled water and pH was adjusted with one Molar HCl and one Molar NaOH accordingly. The media was autoclaved at 15 lb/in pressure per square inch (PSI) for 15 minutes at 121℃ and was then allowed to cool down up to 50℃. Liquid media was dispensed in clean pre-sterile test tubes having cotton wool plugs. The solid media were aseptically poured into Petri plates and were allowed to solidify. The agar medium was also dispensed in clean pre-sterile tubes in 5 ml quantities and was allowed to solidify in slant position for preparation of slants. The plates, slants and tubes of liquid media were incubated at 37°C for 24 hours to confirm sterility of the media. Any media showing bacterial or fungal growth was discarded and not used. Sterile media were stored at 4°C till further use.

Bacteriological analysis

For the bacteriological analysis, membrane filtration technique was used. The selected samples were filtered by the cellulose nitrate sterile membrane filter which contains 0.45µm pour size. For the sterile filtration the assembly was placed in the BSL-II cabinet. To avoid the contamination all the apparatus i.e. funnel, flask and membrane filter were autoclaved before filtration. Filtered membranes were transferred on the selective media agar plates with the help of sterile and smooth tip of the forceps to obtain the pure colonies of bacteria.

Isolation and identification of Pathogenic bacteria

After the filtration process the cellulose nitrate membrane filter contained suspected bacteria on the surface of membrane. The membrane was transferred on the MacConkey agar plate with the help of forceps carefully. MacConkey agar was spread on the filtered membrane and incubated for 24 hours at 37C. After incubation the membrane filters were examined. Pink color colonies were obtained. To get more purified colonies once again their colonies were streaked on the MacConkey agar plates.

RESULTS

As shown in Table 1, the total number of standards was 14 and total references were 210 which included dextrose and ringer infusion.

Table 1: Distribution of samples and standards in different areas of hospital.

S. No	Departments	Standard Petri dishes	Reference Selected IV Fluids	Reference Petri dishes
1	Trauma unit	2	Dextrose 5%	10
			Dextrose 10%	10
			Ringer	10
2	Causality unit	2	Dextrose 5%	10
			Dextrose 10%	10
			Ringer	10
3	Medicine unit	2	Dextrose 5%	10
			Dextrose 10%	10
			Ringer	10
4	Peads unit	2	Dextrose 5%	10
			Dextrose 10%	10
			Ringer	10
5	Gynea unit	2	Dextrose 5%	10
			Dextrose 10%	10
			Ringer	10
6	Surgery unit	2	Dextrose 5%	10
			Dextrose 10%	10
			Ringer	10
7	IC unit	2	Dextrose 5%	10
			Dextrose 10%	10
			Ringer	10
		14	210	

As described in Table 2, different bacteria were identified in the standard and reference Petri dishes. Klebsiella, Enterococcus, E.coli, Staphylococcus aureus were the major bacteria which were identified in the Reference Petri dishes.

Table 2: Bacteria identified in the Standard and Reference Petri dishes.

S. No	Departments	Standard Petri dishes	Reference Selected IV Fluids	Reference Petri dishes
1	Trauma unit	Enterobacteriaceae Enterococcus, staphylococcus aureus, Pseudomonas, proteus, Klebsiella, E.coli	Dextrose 5%	Enterococcus, E.coli
			Dextrose 10%	Klebsiella, E.coli
			Ringer	E.coli
2	Causality unit	staphylococcus aureus Enterobacteriaceae, E.coli, Klebsiella, Citrobacter	Dextrose 5%	Klebsiella
			Dextrose 10%	Klebsiella, E.coli, Enterococcus
			Ringer	E.coli, Citrobacter
3	Medicine unit	Enterobacteriaceae, E.coli	Dextrose 5%	
			Dextrose 10%	Enterococcus
			Ringer	E.coli
4	Peads unit	Enterobacteriaceae, E.coli, Klebsiella	Dextrose 5%	Klebsiella
			Dextrose 10%	Klebsiella
			Ringer	Klebsiella,E.coli
5	Gynea unit	staphylococcus aureus Enterococcus, Citrobacter, Pseudomonas, E.coli, Klebsiella, and Candida	Dextrose 5%	E.coli
			Dextrose 10%	Enterococcus, Citrobacter
			Ringer	Klebsiella, Enterococcus, E.coli
6	Surgery unit	Enterococcus, Klebsiella, Pseudomonas, E.coli, Klebsiella, and Candida Citrobacter	Dextrose 5%	E.coli
			Dextrose 10%	Klebsiella, Enterococcus,E.coli
			Ringer	Klebsiella
7	IC unit	candida spp E.coli, Enterococcus Enterococcus	Dextrose 5%	
			Dextrose 10%	Enterococcus
			Ringer	E.coli
Total		14	210	

The data showed that the positive infusate sampling ratio was more in gynecology unit (6.19%) followed by trauma (5.23%) and causality unit (4.76%) as shown in the table no 3.

Table 3: Section wise number of positive and negative result.

Departments	No of samples	Negative	Negative %age	Positive	Positive %age
Trauma unit	30	19	9.04%	11	5.23%
Causality unit	30	20	9.52%	10	4.76%
Medicine unit	30	28	13.33%	02	0.95%
Peads unit	30	22	10.47%	08	3.80%
Gynea unit	30	17	8.09%	13	6.19%
Surgery unit	30	22	10.47%	08	3.80%
IC unit	30	28	13.33%	02	0.95%
Total	**210**	**156**	**74.25%**	**54**	**25.68%**

DISCUSSION

Patients with critical illness commonly need maintenance of central line and administration of large volumes of medication, fluids, and blood products. This carries a higher risk for development of central line-associated-bloodstream infections (Madani et al., 2009; Moreno et al., 2006). In addition the most commonly IV fluids used in these wards were selected for sampling which included 5% dextrose, 10% dextrose and ringer lactate solutions (Shahzad et al., 2018).

Findings of our study revealed that contamination of infusate must not be undermined as a source of bacteraemia. It was found that 28.68% samples were positive for the presence of bacteria in the infusate. Similar results were also found in other studies where nosocomial bacteraemia was found in the IV admixtures at National Institute of Medical Sciences and Nutrition‘‘Salvador Zubira´n’’ (INNSZ) in Mexico City (Macias et al., 2008; Macias et al., 2010). Currently in Pakistan there is no policy to detect microbial contamination or analyse IV admixtures from the wards. Although these analyses are very exhaustive and infusate culturing can be completed on selected number of patients but still it is very important to estimate the risk and look for proper solution.

According to results of our study percentage of positive cases were more in gynaecology ward (6.19%) followed by Trauma Unit (5.23%). Identical results were reported in other studies where paediatric wards remained at top for positive cases 20% in Mexico, and rate of 2-5% in various other hospitals (Hernández-Ramos et al., 2000). It is recommended to change intravenous administration sets after 24 hours to decrease the danger of extrinsic contamination. But increase in cost and non-availability of comparative data the sets are still being used up to 48 hours. However, it is believed that before changing the intravenous infusion set it shall be made obvious that there is negligible contamination of infusate (Gillies et al., 2004).

In the current study it was observed that the nursing staff had a unique practice of puncturing the plastic drip set to remove entrapped air and speed up the transfer of liquid. This practice resulted in opening of container which increases potential contamination risk and development of central line-associated-bloodstream infections because this practice allows the air to enter the system, therefore serves to facilitate the entry of microorganisms. When open infusion containers are used by the health care providers, the chances of acquiring infections increase. Whereas if the closed type of infusion containers are employed the chances of acquiring infections decreases. In patients who need long term intravenous therapy due to nature of their illness closed infusion containers will have more benefit as compared to the open containers. In a study conducted by Munoz et al, in teaching hospital at Mexico where infusion was cultured at secondary level 29.6% contamination ratio was found in the baseline. Similarly, 2% contamination ratio was also reported by Macias et al in a cross-sectional multicentre study where deficiencies in the technique of administration resulted in in-use contamination (Macias et al., 2010; Munoz et al., 1999).

In order to prevent infusate contamination and to obtain additional benefits it is necessary to decrease manipulation of intravenous drugs and drip sets as much as is feasible. In addition, by restricting the use of those fluids which serve as culture media for microorganisms such as Dextrose solutions and Ringer lactate solution (Macías et al., 2000). The advisory committee for health care infection control practices recommends decreasing manipulation in running infusion. Furthermore, the person responsible for administering infusion should adopt all infection control measures and should strictly adhere with aseptic techniques.

CONCLUSION

It was concluded that chances of infusate contamination were higher in the areas where nursing staff was responsible to compound intravenous admixtures. The nursing staff used to vent the container by spiking the container with needle so as to deliver the solution to patient, consequently providing an opportunity for contamination. To lessen the danger of infection from contaminated infusate in-line filters can be used but these filters are susceptible for blockage in addition to being expensive. Mechanical devices like infusion pumps are

also encouraged to be utilized during extreme usage conditions. To prevent bacteraemia in a practical way we recommend improving pharmacy services in the hospitals which will diminish the compounding of intravenous admixtures in nursing units. Standards to prepare and compound sterile preparations should be imposed on pharmacies, physician, and nursing practices. Meanwhile it is also recommended that infusate should be cultured routinely to estimate contamination especially in those patients where there is no clinically proven source of infection.

Limitations

Our study has a limitation of being single centred therefore our interpretation may not be pertinent to other hospitals in the province having established pharmacy services.

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