Incidence of nosocomial infections associated with surgical procedures

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Abstract

Nosocomial infections are referred to as healthcare associated infections (HAI'S), are infections acquired during the process of receiving health care. The study's main goal is to determine the prevalence of nosocomial infections in patients through various surgical procedures. In order to find out the risks associated with surgical procedures, a total of 180 samples were collected twice a day on different days of a week for two months immediately before and after surgery was performed. Samples were collected using wet swabs and were taken from operation table, endotracheal tube, anaesthesia-ventilator inlet and analysed for the presence of pathogens such *Salmonella spp, Escherichia coli and Staphylococcus spp* as well as the total viable count. Serial dilutions were made for each sample for further analysis. Colonies were counted using digital colony counter and each plate appear to have colonies ranging from 30-300. The results showed that the total viable count in samples collected both before and after performing surgery in a veterinary hospital operation theatre table were significantly ($P<0.001$) lower when compared with endotracheal tube and anaesthesia-ventilator inlet. *Salmonella spp* were more commonly noticed before and after surgery than *Escherichia coli* and *Staphylococcus spp.* Proper managemental practices and surveillance could reduce the incidence of nosocomial infection in surgery.

Keywords: Nosocomial Infections; Operation theatre; anaesthetic equipment; Veterinary Surgery; Veterinary Practice-Evaluation

Introduction

Nosocomial, or hospital-acquired infections are defined by the US Centres for Disease Control and Prevention (CDC) as any localized or systemic condition that occurs in a patient as a result of the presence of an infectious agent or its toxin that was not present or incubated at the time of hospital admission (Horan *et al.,* 2008). The most common type of Nosocomial Infections (NI) contracted in critical care are ventilator -associated pneumonia (VAP), Central line-associated blood stream infections (CLABSI) and catheter associated urinary tract infections (CAUTI) and surgical site infections (SSI).

The incidence of nosocomial infections that occur in veterinary hospitals has not been established (Boerlin *et al.,* 2001). The patients which underwent surgeries have more chances of acquiring NI due to many reasons viz. perioperative bacterial load at the site of incision, increased blood loss during surgery, prolonged labour etc. Responsible pathogens originate from different sources and are represented by different types of NI. Among bacterial pathogens common Gram-positive organisms include coagulase-negative *Staphylococci, Staphylococcus aureus, Streptococcus* species, and *Enterococcus* species (e.g., *faecalis*, *faecium*). Common Gram-negative organisms include species of *Enterobacteriaceae* family, including *Klebsiella pneumoniae, Proteus mirabilias, Escherichia coli*. *Acinetobacter baumanii* is associated with high mortality within the intensive care setting owing to its inherent multi-drug resistant properties (Vincent *et al.,* 2009). Multidrug-resistant bacteria are commonly seen in NI and are associated with significant mortality (Jernigan *et al*., 2020). Candida species make up the fourth most common pathogen across all types of Hospital Acquired Infections (Spivak *et al.,* 2018).

Materials and methods

Sample collection

A total of 180 samples were collected aseptically using wet swabs from Operation table, endotracheal tube, Anaesthesia-ventilator inlet before and after surgery was performed from surgery department of Veterinary Clinical Complex, College of Veterinary Sciences, P V Narasimha Rao Telangana Veterinary University, Hyderabad, Telangana. Samples were taken on three days of a week based on the number of surgeries performed on those days. For further analysis, the collected samples were carried to laboratory.

Preparation of Agar media

Plate count agar, Eosin Methylene Blue Agar, Mannitol Salt Agar, Brilliant Green Agar for estimation of total viable count, *Escherichia coli, staphylococcus spp* and *salmonella spp* respectively. Agar media were prepared based on the directions and measurements labelled on the media as per the instructions of the manufacturer labelled on the pack. For further analysis Serial dilutions were conducted on each sample.

Procedure

Collected samples were incubated for 24 hours. Each test tube was filled with nine ml of distilled water and one ml of the collected sample which makes 1:10 dilution and so on up to 10^7 dilutions. Fifth dilution was taken for enumeration of total viable count (TVC). One ml of aliquot was taken and spread on the Petri dish and respective media was poured and spread uniformly. Incubation of plates was done at 37^0 for 24 to 48 hours.

Microbiological analysis

By using a digital colony counter colonies were counted and each plate appeared to have colonies ranging from 30-300. For specific pathogen interpretation colonies were picked from the culture media and sub cultured on the selective media for the presence of *E. coli, Staphylococcus spp* and *Salmonella spp*. For further identification and confirmation Gram staining and common biochemical tests such as IMViC tests (Indole, Methyl Red, Voges Proskauer and Citrate tests), urease test, oxidase test, catalase test, nitrate reduction test and triple sugar iron test were performed.

Statistical analysis

The results were subjected to analysis through (Version, 16; SPSS) by applying one way ANOVA. The treatment means were ranked using Duncan's multiple range test with significance at 5% level (Duncan, 1955). All the statistical procedures were done as per Snedecor and Cochran (1994).

Results

The results of the current study are presented in Table 1 and 2. Total viable count before performing surgery on OTT, ETT and Anaesthesia ventilator-inlet are 128.6, 211.57, 155.23 respectively and after performing surgery values are 175.5, 231.37 and 188.4 respectively.

The total viable count in samples collected both before and after performing surgery in a veterinary hospital operation theatre table were significantly ($P<0.001$) lower when compared with endotracheal tube and anesthesia-ventilator inlet.

Total Viable Count (TVC) of samples collected before and after performing surgery from veterinary hospital are depicted in Table1. The number of Pathogenic bacteria present in the samples collected from the three locations of veterinary hospital before and after performing surgery are presented in the Table 2. Out of 180 samples collected it was found that 80, 90 and 50 samples were positive for *Escherichia coli*, *Salmonella* and *Staphylococcus* respectively before surgery and 60, 90 and 60 samples were positive for the same pathogens respectively after performing surgery (Table 3). In the present study, the most commonly found organisms in the samples before and after surgery are *Salmonella* followed by *E. coli* and *Staphylococcus.*

Table 1: Total Viable Count in samples before and after surgery

Time	OTT	ETT	Anaesthesia-ventilator inlet	SEM	P	N
Before (Mean±SE)	128.6^{c}±4.52	211.57^{a}±4.13	155.23^{b}±0.39	4.61	0.001	90
After (Mean±SE)	175.5^{c}±4.65	231.37^{a}±2.58	188.4^{b}±3.61	4.50	0.001	90

OTT- Operation table, ETT- endotracheal tube, *The values obtained are from the 3rd serial ten-fold dilution of sample

Table 2: No. of pathogenic bacteria in samples before and after surgery

Sample type	Before surgery			After surgery		
	E Coli	Salmonella	Staphylococcus	E Coli	Salmonella	Staphylococcus
Operation table	30	30	20	20	30	20
Endotracheal tube	20	30	10	10	30	10
Anaesthesia ventilator	30	30	20	30	30	30

Table 3. Biochemical confirmation tests for pathogenic bacteria

Name of the organism	Biochemical tests								
	Indole	**MR**	**VP**	**Citrate**	**Urease**	**Oxidase**	**Catalase**	**Nitrate reduction**	**TSI**
Before surgery									
E. Coli (80)	+	+	-	-	-	-	+	+	Acid/Acid, Gas +ve
Salmonella (90)	-	+	-	-	-	-	+	+	Alkali/Acid Gas +ve
Staphylococcus (50)	-	+	+	+	+	-	+	+	Gas -ve
After surgery									
E. Coli (60)	+	+	-	-	-	-	+	+	Acid/Acid, Gas +ve
Salmonella (90)	-	+	-	-	-	-	+	+	Alkali/Acid Gas +ve
Staphylococcus (60)	-	+	+	+	+	-	+	+	Gas -ve

Discussion

Eugster *et al* (2004) has described surgical site infections (SSI) within the range of 0.8% to 18.1% in small animal surgical procedure with significant variation associated with surgery type which is comparatively low with the present study which is about 33.3% to 66.6%. This difference might be due to increased duration of hospitalization which is associated with increased risk of infection (Ogeer-Gyles *et al.*, 2006) and also due to the bacterial species that can also be found both in healthy dogs as a part of normal skin microbiota in various canine infections including SSIs (Nelson 2011; Weese, 2013 and Gortel, 2013) and lack of consistent diagnostic criteria has made studies of SSI in veterinary patients difficult to compare (Beal *et al.*, 2000).

The higher TVC and bacterial pathogens count in present study might be due to several risk factors associated with nosocomial events which are categorised as specific and non-specific indicators. Any surgical

procedure, medications, urinary catheter and intravenous catheter are the specific indicators whereas length of hospitalization, age and gender are the non-specific indicators of health.

Conclusion

Nosocomial infections are life threatening problems for veterinary patients, especially surgical patients. Majority of the infections can be prevented by the preoperative, intraoperative and postoperative care. Proper sterilization of surgical equipments, regular surveillance and ongoing sensitization programmes for all categories of health care workers and hygienic practices could help in reducing the risk of getting nosocomial infections.

Further scope of research: Molecular examination of pathogens for identification of different strains and antimicrobial resistance of the organisms.

Conflict of interest: The authors declare that they have no conflicts of interest.

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