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Original Research Article

Outbreak investigation of surgical site infections caused by Methicillin Resistant *Staphylococcus aureus* in patients undergoing total abdominal hysterectomy at tertiary care center

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Abstract

Introduction: This report details surgical site infections (SSIs) due to Methicillin resistant staphylococcus aureus. SSIs was observed among patients undergoing Total abdominal hysterectomy procedures performed in between 15 days of time frame.
Aim: The investigation aimed to identify the source of the SSI, contributing factors, and implement control measures to prevent further infections.
Materials and Methods: A case was defined as any patient who underwent the specified surgery during the designated timeframe and developed an SSI within 30 days of the procedure, as defined by the Centres for Disease Control and Prevention criteria. Medical records were reviewed to identify patients meeting the case definition. Demographic information, surgical details, laboratory results, and infection control practices were collected for each case. Swab samples were collected from the operating room environment, including surgical equipment, surfaces, and air. Clinical and environmental samples were analysed in the hospital laboratory to identify the causative organisms.
Results: A total of 5 patients were identified as meeting the case definition for SSI in between 15 days. Microbiologically MRSA isolated from all five patients. Nasal and hand swabs collected from healthcare workers of obstetrics & gynaecology unit and surgical service department of OT to detect MRSA. Among the 25 health care workers, 14 (56%) were MRSA carrier (6 hand carrier (24%) and 8 (32%) nasal carrier).
Conclusion: The investigation findings were used to propose specific control measures to prevent future outbreaks and improve patient safety.

Keywords: Surgical site infections, Methicillin resistant staphylococcus aureus, Centre of disease control, Total abdominal hysterectomy.

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1. Introduction

According to the CDC's, around 1,10,800 SSIs were linked to inpatient surgeries in 2015.[1] In 2022, HAI revealed a 4% increase in the standardized infection ratio (SIR) for surgical site infections (SSIs) across all NHSN operative procedures in comparison to the previous year.[2] SSIs generally result from microorganisms, either external (exogenous) or internal (endogenous) that invade the surgical wound during or after the procedure. If the infection occurs during the operation, it is classified as a primary infection, whereas infections developing post-surgery are considered secondary.[3] Primary SSIs are typically more severe and tend to emerge within 5 to 7 days following the surgery.[4] Among the various pathogens responsible for SSIs, *S. aureus* remains the most frequently identified.[5,6] Around 25% of the general adult population naturally carries *S. aureus* in their nasal passages, and preoperative carriers face a higher likelihood of developing SSIs, as they are often infected by their own bacterial strains.[7,8] This bacterium is commonly found on the skin and within the nasal mucosa[2]. Additionally, nasal and hand carriage are closely linked, with hands serving as a primary means of bacterial transmission from the anterior nares (nose-picking area) to other surfaces.[2,4] Healthcare workers (HCWs) who are asymptomatic nasal carriers of *S. aureus* are at an increased risk of subsequent infection and are also believed to play a key role in the spread of MRSA.[9,10] We recently uncovered a concerning trend: a cluster of patients

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undergoing total abdominal hysterectomy developed serious MRSA infections. Our investigation aimed to pinpoint the source of these infections and take steps to protect future patients.

2. Materials and Methods

2.1. Case identification

This report details of surgical site infections (SSIs) that occurred at tertiary care hospital. Five patients developed SSIs following surgery, with four undergoing total abdominal hysterectomy (TAH) and one undergoing surgery for a haemorrhagic ovarian cyst. All patients were between 28 and 42 years old. A consistent sequence of events was observed in all five cases: Initial dressing check (post-surgery) revealed healthy wounds. Second dressing check identified serous discharge and purulent pus, indicating infection. All cases met the criteria for SSIs.

Following were the chronological Events: (**Table 1**)

Table 1: Chronological Events during SSI among the patients.

Case No.	Event	Day	Description
Patient 1	Surgery	1	Total Abdominal hysterectomy
	First Dressing Check	3	Serous discharge present, No bleeding on margins
	Second Dressing Check	6	Purulent Pus Discharge
	Diagnosis	3	SSI Confirmed
Patient 2	Surgery	1	Total Abdominal hysterectomy
	First Dressing Check	3	Wound Healthy
	Second Dressing Check	6	Purulent discharge
	Diagnosis	6	SSI Confirmed
Patient 3	Surgery	1	Total Abdominal Hysterectomy
	First Dressing Check	3	Wound Healthy
	Second Day Dressing	6	Purulent discharge
	Diagnosis	6	SSI Confirmed
Patient 4	Surgery	1	Total Abdominal hysterectomy
	First Dressing Check	3	Wound Healthy
	Second Day Dressing	6	Purulent discharge, redness, pain
	Diagnosis	6	SSI Confirmed
Patient 5	Surgery	1	Total abdominal hysterectomy
	First Dressing Check	3	Wound Healthy
	Second Day Dressing	6	Purulent discharge, redness, pain
	Diagnosis	6	SSI confirmed

Table 2: MRSA carriers among different types of HCWs.

Department	Profession	Total	MRSA hand Carrier (%)	MRSA Nose carrier (%)
Obstetrics and Gynaecology	Doctor	5	2 (40)	1 (20)
	Nurse	4	2 (50)	0 (0)
	Attendant	3	0 (0)	1 (33.3)
	Total	12	4 (33.3)	2 (16.6)
Surgical service department	OT Technician	10	2 (20)	5 (50)
	Housekeeping Staff	3	0 (0%)	1 (33.3)
	Total	13	2 (15.3)	6 (46.1)

2.2. Control measures

A meeting was held to address the surgical site infection (SSI) outbreak. As a precautionary measure, the unit was temporarily closed to new admissions, and all elective surgeries were suspended. To assess the extent of the issue, comprehensive screening was conducted for all current inpatients and staff, including nasal, hand, and wound swabs. Additionally, the patient ward underwent thorough disinfection and cleaning to mitigate the risk of further contamination. During the meeting, specific concerns were raised regarding a nursing staff member working in the ward who had an existing skin condition, prompting further investigation into their potential role in bacterial transmission.

2.3. Investigation

A cross-sectional study was performed to conduct a thorough investigation to identify the source of the surgical site infections. This may include: Reviewing surgical procedures and protocols for TAH and ovarian cyst surgery. Evaluating practices for sterile technique in the operating room and during dressing changes. Collecting cultures from patients, surgical staff, and the environment to identify the causative organism.

2.4. Laboratory methods

Environmental Surface Sampling: Environmental surface samples were collected for every patient enrolled in the research, operating room environment and surgical equipment. Utilizing nylon-flocked swabs, each sampling point, covering roughly 25 cm^2, was swabbed using a crosswise technique. Within each patient's room, four distinct areas were targeted for sampling: area 1 (the handle on the inside of the ward door, the bed's metal frame and adjustment buttons), area 2 (the surfaces of overbed tables and the curtains used to divide beds), area 3 (light operating switches), and area 4 (toilet flush and faucet handles, as well as both sides of the bathroom door handles). Samples were also collected from patients and healthcare workers in the obstetrics and gynaecology unit and the surgical service department of the operating theater in a tertiary care hospital. Sterile, non-absorbent cotton swabs were used to collect samples from wounds, nasal cavities, and hands. For nasal sampling, a swab was carefully inserted 2 to 3cm into the anterior nares and rotated four times in both directions before being smoothly removed. Hand swabs were collected by swabbing the web spaces using a sterile cotton swab moistened with brain heart infusion (BHI) broth. Similarly, wound swabs were obtained by rotating a swab over the wound surface after moistening it with sterile BHI broth. The presumptive S. aureus colonies were confirmed by coagulase production and mannitol fermentation. The cefoxitin disc method was used to determine methicillin resistance for *S. aureus* in accordance with the Clinical Laboratory Standards Institute document M100-S20.[11] Colonies that exhibited a golden-yellow appearance on NA, consisted of Gram-positive cocci in clusters, and tested positive for catalase and coagulase were confirmed as *S. aureus*.

3. Results

During the outbreak investigation of surgical site infections (SSIs) environmental, equipment and patient room sampling was conducted. Swab samples were collected from various surfaces within the operating room environment, including walls, floors, and equipment surfaces. Additionally, swabs were taken from surgical instruments that were utilized during the procedures of the affected patients and patient room. Analysis of the swab samples obtained from the operating theatre environment and patient room revealed no presence of Methicillin-Resistant *Staphylococcus aureus*. Specifically, MRSA was not isolated from any of the sampled surfaces or the surgical instruments processed and used during the total abdominal hysterectomy procedures associated with the identified cluster of SSIs. In contrast to the environmental and equipment findings, screening of the surgical team involved in the procedures of the affected patients identified carriage of MRSA in personnel.

3.1. Screening

Five inpatients were screened and all were found to carry MRSA. Twenty-five healthcare workers were screened. Six healthcare workers were identified as MRSA hand carriers, all of whom had not adhered to the WHO handwashing guidelines. Additionally, eight healthcare workers were found to be nasal carriers of MRSA. Despite following proper hand hygiene protocols, these individuals had a habit of nose-picking, which may have contributed to bacterial transmission. **Table 2** shows majority of carrier were from surgical service department of OT followed by Obstetrics and Gynaecology Department. OT technicians had the highest prevalence followed by doctors and nurses.

A total of eight individuals identified as *S. aureus* nasal carriers underwent decolonization therapy using a 2% mupirocin nasal ointment. The treatment achieved complete success, with follow-up testing conducted one month later showing no traces of *S. aureus* in any of the carriers.

4. Discussion

Although SSIs are among the preventable causes of HAIs, they continue to be a major global health concern.[12] Despite advancements in surgical procedures and a deeper understanding of wound infection mechanisms, managing SSIs remains a challenge for healthcare professionals. Patients with SSIs are further exposed to the hospital environment, which is often rich in pathogenic microorganisms, increasing the risk of additional infections. The growing resistance to commonly used antimicrobials only worsen the situation, making treatment increasingly difficult.[13]

Studies indicate that approximately 80% of healthy individuals worldwide carry *Staphylococcus aureus* on their skin or in their nasal passages. If the skin barrier is compromised during surgery, this bacterium can frequently lead to skin and soft tissue infections.[14] These factors contribute to *S. aureus* being the most commonly identified pathogen in SSIs.

In this study, *S. aureus* emerged as the most frequently identified Gram +ve bacterial isolate. Its significance in SSIs is heightened due to its major role in HAIs and the emergence of MRSA strains. MR develops when the *mecA* gene is acquired, leading to the production of a specialized penicillin-binding protein called PBP2a. This protein has a low binding affinity for β-lactam antibiotics, allowing the bacterium to continue synthesizing its cell wall despite exposure to penicillin's including anti-staphylococcal variants as well as carbapenems & cephalosporins.[15] As a result, treatment options for MRSA infections are significantly limited.

SSIs, the second most prevalent type of HAI can largely be prevented by following stringent infection control protocols. Effective prevention strategies include proper hand hygiene, minimizing traffic in the operating room, decolonization & screening of *S. aureus* carriers, and ensuring the correct timing and selection of prophylactic antibiotics.[16]

5. Conclusion

Effective infection control measures are critical in preventing surgical site infections (SSIs). Key strategies include active surveillance, standardized checklists, monitoring compliance, implementing screening and decolonization protocols for *Staphylococcus aureus*, and maintaining strict hand hygiene. To improve patient safety and surgical outcomes, Indian hospital management must prioritize regular collaboration between surgical teams, microbiologists, and infection control specialists. Strengthening this multidisciplinary approach will enhance the quality of surgical care and reduce the burden of SSIs.

6. Conflict of Interest

None.

7. Source of Funding

None.

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