



Nasal Carriage of Staphylococci among Health Care Workers and Impact of Conventional Decolonisation Methods

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ABSTRACT

Introduction

Staphylococci are one of the most common causes of nosocomial infections. The principal route of transmission of Staphylococci is the contaminated hands of health care workers (HCWs). Staphylococci can also be found as part of the nasal microbiota without causing overt disease. So we undertake the present study to estimate the prevalence of asymptomatic nasal carriage of Staphylococci among HCWs and impact of conventional decolonisation methods in a tertiary care hospital in West Bengal.

Materials and Methods

Nasal swabs were collected from anterior nares of HCWs for culture and antibiotic sensitivity test on day one. HCWs who were found to be carriers of Staphylococci were advised to apply mupirocin ointment to anterior nares twice daily along with chlorhexidine gluconate bath once daily for five days. All HCWs were also advised to practice standard hygiene protocol. All of them were re-tested for nasal swab culture and antibiotic sensitivity on day seven and day twenty eight.

Results

Nasal carriage of Staphylococci in the first, second and third culture report was found to be 64.28%, 7.14% and 24.49% respectively. Cefotaxime, cotrimoxazole and erythromycin were least effective against Staphylococci. There was variable sensitivity to clindamycin, gentamycin and ciprofloxacin. All strains of Staphylococci were highly sensitive to linezolid. All strains of Staphylococci except MRSA were highly sensitive to vancomycin.

Conclusion

The present study re-establishes the fact that HCWs carry Staphylococci in their nose in significantly high proportion. So different measures should be undertaken to minimise Staphylococci related nosocomial infections.

Keywords

Staphylococci; Nosocomial Infection; Health Care Workers; Nasal Carriage; Decolonisation

Nosocomial infections represent an important health problem in terms of morbidity, mortality and cost of treatment. Prevention of these infections is a key priority. Staphylococci are one of the most common causes of nosocomial infections.¹ The

principal route of transmission of Staphylococci in the hospital is from patient to patient via the contaminated hands of health care workers (HCWs).² Staphylococci can also be found as part of the nasal microbiota without causing overt disease.

This carrier state is an important factor for dissemination from HCWs to patients and vice-versa.^{3,4} Another challenge associated with Staphylococci is the development of multidrug resistant strains to various available antibiotics.⁵ So we undertake the present study to estimate the prevalence of asymptomatic nasal carriage of Staphylococci among HCWs and impact of conventional decolonisation methods in a tertiary care hospital in West Bengal.

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Materials and Methods

We conducted a prospective study among HCWs over a period of one month from 1st July 2019 to 31st July 2019 in a tertiary care hospital in the northern part of West Bengal. Institutional Ethical Committee clearance and informed consent from each participant were taken. HCWs from medicine ward, surgery ward and critical care unit (CCU) were recruited in the study. HCWs comprised of doctors, nurses and group-D staff. HCWs suffering from fever, upper respiratory tract infection, impetigo, skin and subcutaneous infections, diabetes mellitus, immunocompromisation, were excluded from the present study. HCWs with history of recent nasal surgery, use of nasal antiseptics, or antimicrobial therapy, an MRSA decolonization attempt in the previous 6 months, allergy to mupirocin or chlorhexidine, were also excluded from the study. HCWs who were pregnant, breast feeding, or did not turn up in the follow up were also excluded.

Nasal swabs were collected from anterior nares of the participants using sterile cotton swabs moistened with sterile normal saline on day one. The swabs were then immediately transported with aseptic precautions to the Microbiology laboratory. Specimens were inoculated on 10% sheep blood agar, Nutrient agar and MacConkey's agar plates and incubated overnight at 37°C. Samples were identified by standard methods based on colony morphology, pigment production, Gram staining, catalase test, slide coagulase test, modified Hugh and Leifson (O/F) test and fermentation of mannitol. All of the isolated Staphylococci strains were tested against different antimicrobial agents by the modified Kirby Bauer disc diffusion method on Mueller Hinton agar following Clinical and Laboratory Standards Institute guidelines. The antibiotic discs used were clindamycin (CLIND) 2mcg, gentamicin (GEN) 10mcg, cefotaxime (CEFO) 30mcg, ciprofloxacin (CIPRO) 10mcg, cotrimoxazole (COTRI) 25mcg, erythromycin (ERY) 15mcg, linezolid (LIN) 30mcg, and vancomycin (VAN) 30mcg. Methicillin resistant Staphylococci were detected by using cefoxitin 30mcg discs.

HCWs who were found to be carriers of Staphylococci in the first culture were advised to apply mupirocin ointment to anterior nares twice daily along with

chlorhexidine gluconate bath once daily for five days. All HCWs were also advised to practice standard hygiene protocol including hand washing before and after patient examination, use of sterile aprons, gloves and masks, and avoiding touching one's nose during work. All of them were re-tested for nasal swab culture and antibiotic sensitivity on day seven and day twenty eight.

Results

Total 98 participants were included in the present study. Distribution of methicillin sensitive Staphylococcus aureus (MSSA), methicillin resistant Staphylococcus aureus (MRSA), methicillin sensitive coagulase negative Staphylococci (MS CoNS), and methicillin resistant CoNS (MR CoNS) in the nasal swab culture on day one, seven and twenty eight are shown in Table I. In the first, second and third culture report nasal carriage of Staphylococci was found to be 64.28%, 7.14% and 24.49% respectively.

Comparative distribution of nasal carriage of Staphylococci among the different HCWs in different wards on day one, seven, and twenty eight are depicted in Tables II, III and IV respectively. There were 27 doctors, 58 nurses and 13 group-D staffs in the present study. Nasal carriage of Staphylococci in doctors on day one, seven and twenty eight was 66.67%, 3.70% and 22.22% respectively. Nasal carriage of Staphylococci in nurses on day one, seven and twenty eight was 67.24%, 8.62% and 27.59% respectively. Nasal carriage of Staphylococci in group-D staff on day one, seven and twenty eight was 46.15%, 7.69% and 15.38% respectively. Nasal carriage of Staphylococci among HCWs in medicine ward on day one, seven and twenty eight was 51.22%, 2.44% and 12.20% respectively. Nasal carriage of Staphylococci among HCWs in surgery ward on day one, seven and twenty eight was 72.5%, 7.5% and 35% respectively. Nasal carriage of Staphylococci among HCWs in CCU on day one, seven and twenty eight was 76.47%, 17.65% and 29.41% respectively.

Antibiotic sensitivity of MSSA, MRSA, MS CoNS, and MR CoNS on day one, seven and twenty eight are shown in Tables V, VI and VII respectively.

Table I: Distribution of samples according to culture report on day one, seven and twenty eight

ISOLATE	NUMBER (PERCENTAGE)		
	DAY 1	DAY 7	DAY 28
MSSA	19 (19.38)	0 (0)	2 (2.04)
MRSA	5 (5.1)	1 (1.02)	5 (5.1)
MS CoNS	37 (37.76)	5 (5.1)	15 (15.31)
MR CoNS	2 (2.04)	1 (1.02)	2 (2.04)
Others	14 (14.29)	2 (2.04)	4 (4.08)
No growth	21 (21.43)	89 (90.82)	70 (71.43)

MSSA:methicillin sensitive *Staphylococcus aureus*, MRSA:methicillin resistant *Staphylococcus aureus*, MS CoNS:methicillin sensitive coagulase negative *Staphylococci*, MR CoNS:methicillin resistant coagulase negative *Staphylococci*

Table II: Distribution of nasal carriage of Staphylococci among the different HCWs in different wards on day one

ISOLATE	NUMBER (PERCENTAGE)							
	DOCTORS		NURSES			GROUP-D STAFF		
	(N=27)		(N=58)			(N=13)		
	MEDICINE WARD (N=14)	SURGERY WARD (N=13)	MEDICINE WARD (N=22)	SURGERY WARD (N=22)	CCU (N=14)	MEDICINE WARD (N=5)	SURGERY WARD (N=5)	CCU (N=3)
MSSA	3	3	3	4	3	1	2	0
MRSA	1	1	0	1	1	0	0	1
MS CoNS	4	6	9	11	5	0	1	1
MR CoNS	0	0	0	0	2	0	0	0

MSSA:methicillin sensitive *Staphylococcus aureus*, MRSA:methicillin resistant *Staphylococcus aureus*, MS CoNS:methicillin sensitive coagulase negative *Staphylococci*, MR CoNS:methicillin resistant coagulase negative *Staphylococci*

Table III: Distribution of nasal carriage of Staphylococci among the different HCWs in different wards on day seven

ISOLATE	NUMBER (PERCENTAGE)							
	DOCTORS		NURSES			GROUP-D STAFF		
	(N=27)		(N=58)			(N=13)		
	MEDICINE WARD (N=14)	SURGERY WARD (N=13)	MEDICINE WARD (N=22)	SURGERY WARD (N=22)	CCU (N=14)	MEDICINE WARD (N=5)	SURGERY WARD (N=5)	CCU (N=3)
MSSA	0	0	0	0	0	0	0	0
MRSA	0	0	0	1	0	0	0	0
MS CoNS	0	1	1	1	1	0	0	1
MR CoNS	0	0	0	0	1	0	0	0

MSSA:methicillin sensitive *Staphylococcus aureus*, MRSA:methicillin resistant *Staphylococcus aureus*, MS CoNS:methicillin sensitive coagulase negative *Staphylococci*, MR CoNS:methicillin resistant coagulase negative *Staphylococci*

Table IV: Distribution of nasal carriage of Staphylococci among the different HCWs in different wards on day twenty eight

ISOLATE	NUMBER (PERCENTAGE)							
	DOCTORS		NURSES			GROUP-D STAFF		
	(N=27)		(N=58)			(N=13)		
	MEDICINE WARD (N=14)	SURGERY WARD (N=13)	MEDICINE WARD (N=22)	SURGERY WARD (N=22)	CCU (N=14)	MEDICINE WARD (N=5)	SURGERY WARD (N=5)	CCU (N=3)
MSSA	0	1	0	0	1	0	0	0
MRSA	0	1	1	2	0	0	1	0
MS CoNS	1	3	3	5	2	0	0	1
MR CoNS	0	0	0	1	1	0	0	0

MSSA:methicillin sensitive *Staphylococcus aureus*, MRSA:methicillin resistant *Staphylococcus aureus*, MS CoNS:methicillin sensitive coagulase negative *Staphylococci*, MR CoNS:methicillin resistant coagulase negative *Staphylococci*

Clindamycin and gentamycin were only effective against MS CoNS. Ciprofloxacin was effective against all strains of Staphylococci except MRSA. All strains of Staphylococci were highly sensitive to linezolid. All strains of Staphylococci except MRSA were highly sensitive to vancomycin. Cefotaxime, cotrimoxazole and erythromycin were least effective against Staphylococci.

There was no adverse effect of the topical decolonisation agents among the participants.

Discussion

Worldwide, most of the literature focuses on carriage of Staphylococcus aureus and impact of decolonisation methods among patients. Other Staphylococci such as (CoNS) are also pathogenic. Methicillin resistant CoNS (MRCoNS) have also been found worldwide. Moreover, CoNS may transfer its resistance to MRSA^{6,7}. HCWs are at the interface between hospitals and communities⁸. So periodic screening of HCWs to identify carrier state and measures taken to decolonise them is crucial in prevention of Staphylococci associated nosocomial infection.

Nasal carriage of Staphylococci among HCWs was 64.28% in the present study. It comprised of 24.48% Staphylococcus aureus and 39.8% CoNS. In a similar study by Nadia. E. Al-Abdli et al, nasal carriage of Staphylococci was 83.9%, comprising of 47.5% Staphylococcus aureus and 36.4% CoNS.⁹ Staphylococcus aureus and MRSA carriage rate among HCWs in the present study are similar to the internationally reported range which are 19.80% to 48% and 5.8% to 17.8% respectively.^{10,11} This wide range can be attributed to variations in sampling technique, culture and method of MRSA identification, local infection control standards and the local prevalence of MRSA.

In the present study nasal carriage of Staphylococci was highest among nurses (67.24%) and doctors (66.67%) followed by group-D staffs (46.15%). Nasal carriage of Staphylococci was highest among HCWs of CCU (76.47%) and surgery ward (72.5%) followed by medicine ward (51.22%). Similar findings were noted in other studies also.¹² Higher rate of nasal carriage of Staphylococci in specific groups of HCWs can be due to frequent contact with infected wounds in specific wards.

Table V: Antibiotic sensitivity of Staphylococci on day one

ORGANISM	ANTIBIOTIC SENSITIVITY (IN PERCENTAGE)							
	CLIND	GEN	CEFO	CIPRO	COTRI	ERY	LIN	VAN
MSSA	57.89	52.63	52.63	73.68	36.84	46.37	100	94.74
MRSA	40	20	0	40	20	0	100	60
MS CoNS	83.78	75.68	59.46	67.57	54.05	48.65	100	100
MR CoNS	50	50	0	100	50	50	100	100

CEFO:cefotaxime, COTRI:cotrimoxazole, ERY:erythromycin CLIND:Clindamycin, GEN:gentamycin, CIPRO:ciprofloxacin, LIN:linezolid, VAN:vancomycin, MSSA:methicillin sensitive Staphylococcus aureus, MRSA:methicillin resistant Staphylococcus aureus, MS CoNS:methicillin sensitive coagulase negative Staphylococci, MR CoNS:methicillin resistant coagulase negative Staphylococci

Table VI: Antibiotic sensitivity of Staphylococci on day seven

ORGANISM	ANTIBIOTIC SENSITIVITY (IN PERCENTAGE)							
	CLIND	GEN	CEFO	CIPRO		ERY	LIN	VAN
MRSA	0	0	0	0	0	0	100	0
MS CoNS	80	48	60	80	60	60	100	100
MR CoNS	0	0	0	100	0	0	100	100

CEFO:cefotaxime, COTRI:cotrimoxazole, ERY:erythromycin CLIND:Clindamycin, GEN:gentamycin, CIPRO:ciprofloxacin, LIN:linezolid, VAN:vancomycin, MSSA:methicillin sensitive Staphylococcus aureus, MRSA:methicillin resistant Staphylococcus aureus, MS CoNS:methicillin sensitive coagulase negative Staphylococci, MR CoNS:methicillin resistant coagulase negative Staphylococci

Table VII: Antibiotic sensitivity of Staphylococci on day twenty eight

ORGANISM	ANTIBIOTIC SENSITIVITY (IN PERCENTAGE)							
	CLIND	GEN	CEFO	CIPRO		ERY	LIN	VAN
MSSA	50	50	0	50	0	0	100	100
MRSA	40	60	0	60	20	20	100	60
MS CoNS	66.67	73.33	53.33	73.33	40	46.67	100	100
MR CoNS	100	50	0	100	0	0	100	100

CEFO:cefotaxime, COTRI:cotrimoxazole, ERY:erythromycin CLIND:Clindamycin, GEN:gentamycin, CIPRO:ciprofloxacin, LIN:linezolid, VAN:vancomycin, MSSA:methicillin sensitive Staphylococcus aureus, MRSA:methicillin resistant Staphylococcus aureus, MS CoNS:methicillin sensitive coagulase negative Staphylococci, MR CoNS:methicillin resistant coagulase negative Staphylococci

United States Food and Drug Administration approved mupirocin for decolonization of the anterior nares.¹³ It is a topical anti-staphylococcal antibiotic. Nasal carriers of Staphylococci may also harbour the organism at various extra-nasal sites.¹⁴ It is unlikely that nasal application of mupirocin will have any effect on these sites. Decolonization of the skin can be achieved by washing with chlorhexidine gluconate.¹⁵ The combination of nasal mupirocin ointment along with chlorhexidine bath was preferred over other alternative agents due to strong evidences generated in favour of this combination for reduction of MRSA burden and decolonization of MRSA carriers in Cochrane review,¹⁶ and meta-

analysis¹⁷ in recent times. Moreover, education about both hygiene and regular environmental disinfection measures has also been included to reduce carriage and prevent infection. Simple preventive measures like hand washing before and after patient examination, use of sterile aprons, gloves and masks, awareness during the examination of immunocompromised patients, and avoiding touching one's nose during work, can reduce transmission of Staphylococci considerably.

In the present study, HCWs found to carry nasal Staphylococci on first culture report were advised to apply mupirocin ointment to anterior nares twice daily and chlorhexidine gluconate bath once daily for five days

along with maintenance of standard hygiene protocol. After seven days nasal carriage of Staphylococci were found to decrease from 64.28% to 7.14%. After twenty eight days, it was found to increase to 24.49%. This increase may be due to various factors. The HCWs might be re-exposed and become colonized with the same or a new strain of Staphylococci. There is also possibility that some HCWs did not follow the hygiene protocol strictly.

Another major issue is the emergence of multi-drug resistant Staphylococci.¹⁸ This is due to misuse of cheap and easily available over-the-counter antibiotics. This causes infections which are difficult to treat which in turn prolongs hospitalization and cost of treatment. In the present study cefotaxime, cotrimoxazole and erythromycin were least effective against Staphylococcus. Clindamycin, gentamycin and ciprofloxacin were effective against limited number of samples. Even vancomycin was not effective against all MRSA. Only linezolid was effective against all samples.

Conclusion

The present study re-establishes the fact that HCWs carry Staphylococci in their nose in significantly high proportion. So periodic screening of HCWs for their carrier state should be done for their own sake, as well as for patients and community as a whole. Decolonisation measures should be taken for carriers of Staphylococci. But this doesn't eliminate the chance of re-infection. HCWs should be periodically educated and trained about the maintenance of personal hygiene measures to be followed within hospital premises. Community awareness programmes on the effects of use or rather the misuse of antibiotics should be held from time to time. Apart from this, time to time disinfection of the healthcare setting may be carried out as per the institutional protocol, to prevent re-colonization by Staphylococci among HCWs.

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