Risk of nosocomial bacteria transmission: evaluation of cleaning methods of probes used for routine ultrasonography

*T. O. Bello[1], S. S. Taiwo[2], D. P. Oparinde[3], W. O. Hassan[2] and J. O. Amure[2]
Department of Radiology[1], Medical Microbiology[2] and Chemical Pathology[3], Ladoke Akintola University Teaching Hospital, Osogbo, Nigeria

E-mail: bellotope@hotmail.com

Summary

Background: **There exists a small but definite risk of nosocomial infection transmission attributable to ultrasonography probes and coupling gels.**

Objective: **Our objective was to ascertain whether the current method of probe disinfection in between patients is adequate to prevent cross infection, and to determine the best and safest method of probe disinfection applicable during routine ultrasonography in our institution.**

Materials and method: **Forty consecutive patients sent for routine ultrasonography at the Radiology Department of our institution in the month of January 2004 were studied. Each patient had a standardized ultrasound scan of the abdomen, after which swabs were taken from the surface of the unclean probe and after probe disinfection by single and double paper wipe cleaning method. The swabs were cultured on Blood agar to determine the characteristics of the colony forming units (CFU).**

Result: **Forty four bacterial isolates were recovered from 37 patients who cultured positive, with MRSA constituting 36.4%, MRCONS 22.7%, MSSA 13.6%, MSCONS 13.6%, *Klebsiella spp* 9.1% and *Proteus mirabilis* 4.6%. The average CFU transmitted by the unclean probe was significantly higher (P<0.05) than that transmitted by the probe after single or double paper wipe. Also, the average CFU transmitted following single and double paper wipe, in the inpatients was significantly higher (P<0.05) than in the outpatients.**

Conclusion: **Single paper wipe is adequate for outpatients, but for inpatients, especially those with high risk of cross infection, double paper wipe is preferred with probe thoroughly wiped until visibly clean.**

Key-words: ***Nosocomial infection, US probes.***

Résumé

Introduction: Un petit mais un risque bien arrêté existe à propos de la transmission d'infection attribuable aux sondes ultrasonographies et coloide d'accouplement.

Objectif: Notre but était de déterminer si la méthode actuelle de désinfection des sonde entre les patients est adéquat d'éviter l'infection croisée, et de décider la meilleur méthode sans danger de désinfection des sondes applicable pendant l'ultrasonographie d'usage dans notre hôpital.

Matériels et méthode: Quarante patients consécutifs envoiés pour l'ultrasonographie d'usage au service de la radiologie de notre hôpital en janvier 2004 ont été étudies. Chaque patient a subi l'ultrason uniformisé dans l'abdomen, aprés, on avait enlevé les tampons sur la surface de sonde souille et après la désinfection du sonde à travers la méthode d'une seule et double papier de nettoyer. On avait mis les tampons sur la gelose du sang afin de décider les traits caractéristiques des unités de la formation de la cononie (UFC).

Résultats: Quarante quatre bactériens isolates ont été repris aux 37 patients qui étaient possitifs, le MRSA constitue 36,4%, MRCONS 22,7% MSSA 13,6%, MSCON 13,6%, Klebsiella spp 9,1% et protéine mirabilis 4,6%. Le CFU moyen transmis par le sonde souillé était sensiblement élevé (P<0,05) plus que celui transmis par le sonde après papier de nettoyer seul ou double. Egalement, le CFU moyen transmis à la suite de papier de nettoyer seul ou double, chez des patients hospitalisés était sensiblement élevé (P,0,05) plus que chez les malades qui viennent consulter à l'hôpital.

Conclusion: Papier de nettoyer seul est propre pour les malades qui viennent consulter à l'hôpital, mais pour des patients hospitalisés ceux à haut risque d'infection croisée, papier de nettoyer double est préférable avec la sonde parfaitement essuyée jusqu'au manifestement propre.

Introduction

Nosocomial outbreaks of infection originating from ultrasound (US) probes and contaminated coupling gels have been reported in a French hospital[1]. In our institution, US probes are wiped with a clean, dry, soft absorbent paper after each procedure as a basic standard of probe disinfection. Some studies [2,3] have however shown this single paper wipe procedure to be inadequate in preventing cross infection especially among high-risk patients such as those with unhealed wounds, burns and those in intensive therapy units. Some others have used single paper wipe followed by alcohol or glyoxal treatment. Although, this method appears the most effective in preventing cross infection, frequent use of alcohol can lead to degradation of the rubber seal and shorten the working life of the probe[4].

Our objective was to ascertain whether the current

*Correspondence

method of probe disinfection in our institution is adequate to prevent cross contamination or infection in all categories of patients seen at the Radiology Department of our institution and to determine the best and safest method of probe disinfection applicable for routine ultrasonography.

Materials and methods

Forty consecutive patients sent for routine ultrasonography at the Radiology Department of Ladoke Akintola University Teaching Hospital in the month of January 2004, were included in the study. Each patient had a standardized ultrasound (Siemens sonoline SL1, Germany) scan of the abdomen and other body parts performed by one of us (BTO) using a linear probe (3.5 MHZ linear probe) and sterile gel. From the unclean probe after each scan, a sterile cotton swab was used to collect specimen across the entire scanning surface of the probe. The swab was immediately placed in a bottle of Brain Heart Infusion (BHI) broth. The probe was then wiped dry with a soft, clean but non-sterile absorbent paper and the swab collection repeated the same way. The probe was for the second time wiped dry and the process repeated the same way. The bottles of BHI broths were immediately transported to the Medical Microbiology laboratory close by, within 10 minutes of collection. From each of the bottle, the broth was poured onto Blood agar plate, with excess broth decanted. The palates were incubated aerobically at 37°C for 24 hours[5]. The number, identity and antibiotic susceptibility pattern of the colony forming units (CFU) were established after 24 hours according to the recommended standard techniques [6,7].

Data analysis was done using EPI-INFO version 5.0 statistical package[8]. The level of significance was estimated using Student's t-test with significant value set at 0.05.

Table 2 Number of colony forming units (CFU) transmitted by unclean and cleaned probes among outpatients (n = 28)

Patient's Serial No	Unclean	Single paper wipe	Double paper wipe
1	500	19	0
2	490	14	3
7	146	28	6
8	140	38	10
9	52	28	2
10	52	25	1
13	54	2	1
14	60	3	1
15	78	6	4
16	72	5	4
17	1	0	0
18	11	0	0
21	28	8	0
22	30	6	0
23	9	1	0
24	7	3	0
25	304	35	5
26	300	30	4
27	7	0	0
28	11	5	1
29	7	2	0
30	7	1	0
35	0	0	0
36	1	0	0
37	0	0	0
38	0	0	0
39	5	1	0
40	5	1	0
Total CFU	**2377**	**261**	**42**
Average CFU	**84.9**	**9.3**	**1.5**
	84.9 ± 162.2	**9.32 ± 14.35**	**1.5 ± 1.22**

Result

Of the 40 patients studied, 28 (70%) were outpatients while 12 (30%) were inpatients; 37 (92.5%) were culture positive and 3 (7.5%) were bacteriologically sterile. A total of 44 bacterial isolates were recovered

Table 1 Types and distribution of bacterial isolates in the patients

Organism	Outpatients (%) n = 28	Inpatients (%) n = 12	Total (%) n = 40
Staphylococcus aureus			
i. MRSA	12(27.3)	4(9.1)	16(36.4)
ii. MSSA	5(11.4)	1(9.1)	6(13.6)
CONS			
i. MRCONS	6(13.6)	4(9.1)	10(22.7)
ii. MSCONS	2(4.6)	4(9.1)	6(13.6)
Klebsiella spp	0(0)	4(9.1)	4(9.1)
Proteus mirabilis	0(0)	2(4.6)	2(4.6)
Total	**25(56.8)**	**19(43.2)**	**44 (100)**

Key
MRSA– Methicillin-resistant Staphylococcus aureus, MSSA – Methicillin-sensitive Staphylococcus aureus
CONS – Coagulase negative staphylococci
MRCONS – Methicillin-resistant CONS
MSCONS- Methicillin-sensitive CONS

Table 3 Number of colony forming units (CFU) transmitted by unclean and cleaned probes among inpatients (n = 12)

Patient's Serial No	Unclean probe	Single paper wipe	Double paper wipe
3	60	14	5
4	70	19	6
5	312	96	36
6	318	86	32
11	40	13	3
12	40	16	0
19	42	1	1
20	32	1	1
31	150	4	2
32	150	5	2
33	5	0	0
34	4	0	0
Total CFU	**1223**	**255**	**88**
Average CFU	**101.9**	**21.5**	**7.3**
	101.9 ± 139.01	**21.5 ± 38.34**	**7.3 ± 14.13**

from the 37 culture positive patients; 25 (56.8%) from outpatients and 19 (43.2%) from inpatients (Table 1). All the 25 culture positive outpatients yielded one organism each, 7 of the inpatients also yielded one organism each, 3 yielded 2 organisms each while 2 yielded 3 organisms each (Table 1). Of the 44 isolates, methicillin-resistant *Staphylococcus aureus* (MRSA) constituted 36.4%, methicillin-resistant coagulase negative staphylococci (MRCONS) 22.7%, methicillin sensitive *Staphylococcus aureus* (MSSA) 13.6%, methicillin sensitive coagulase negative staphylococci (MSCONS) 13.6%, *Klebsiella spp* 9.1% and *Proteus mirabilis* 4.6%. The MRSA and Gram negative bacilli were multiply resistant to antibiotics.

The average CFU transmitted by the unclean probes was 90, for probes cleaned by single paper wipe 12.9 and for probes cleaned by double paper wipe 3.3. There is a statistical significant difference ($P < 0.05$) between unclean probes and after single or double paper wipe cleaning procedure. Among the inpatients, the average CFU transmitted was 101.9 for the unclean probe, 21.3 for probe cleaned by single paper wipe and 7.3 for probe cleaned by double paper wipe (Table 2). For outpatients, the average CFU transmitted was 84.9, 9.3 and 1.5 for unclean probes, single wipe and double wipes respectively (Table 3). The average CFU transmitted following single and double paper wipe cleaning method between inpatients and outpatients showed a significant difference ($P < 0.05$). The Gram-negative bacilli, recovered exclusively from inpatients, were completely removed from the probes only after double paper wipe.

Discussion

There is a limited literature on the propensity of ultrasound probe as a source of cross infection. An outbreak of *Klebsiella pneumoniae* infection in a French hospital was traced to ultrasonography coupling gel[1]. Ultrasound machine may therefore serve as a vector for cross infection particularly in vulnerable patients such as neonates, patients with unhealed wounds, burns and those with haematological malignancies or renal diseases.

Although, studies of nosocomial outbreaks of infections in our environment have been reported from contaminated intravenous infusion[9], disinfectants[10], instrumentation and personnel[11], none has considered ultrasonography probe or coupling gel as a possible source of cross infections. Our study appears to be the first of its kind in this environment to evaluate the possibility of cross infection from ultrasonography.

This study showed that single paper wipe cleaning method of ultrasound probes significantly reduced the numbers of bacteria pathogen transmitted but still transmit large number of CFU including Gram negative bacilli. Double paper wipe cleaning method reduced greatly the number of CFU transmitted by a factor of about 50 and none of the Gram-negative bacilli was transmitted. These findings agree with reports of Spencer and Spencer[2], Tesch and Froschle[3], and Fowler and McCracken[4] but disagree with that of Muradeli *et al*[12] who concluded that US probes that are wiped once with a paper towel do not contribute to nosocomial infections but stressed that probes must be thoroughly wiped dry until they are visibly clean.

This study also demonstrated a significant difference in the single and double paper wipe cleaning methods between outpatients and inpatients. The average CFU transmitted after single paper wipe among inpatients was 21.3 compared to 9.3 among outpatients and for double paper wipe, it was 7.3 to 1.5 ($P < 0.05$). Although the reason for this may not be readily explained, it implies that US probes used for inpatients should be

more rigorously cleaned. We did not use alcohol in our study because of the identified risk of alcohol to the probe. In a developing country like ours, we can not afford to try a procedure with an established risk, as a damaged probe may take a long time to replace.

A total of 44 bacterial isolates were recovered from 37 patients that were culture positive after scanning. The organisms recovered were mainly *Staphylococcus aureus*, coagulase negative staphylococci, *Klebsiella spp* and *Proteus mirabilis*, with methicillin resistant *Staphylococcus aureus* constituting 36.4% of all isolates and multiply resistant. The Gram negative bacilli were recovered exclusively from inpatients and were resistant to more than three antibiotics. They were removed completely from the probe only after double paper wipe cleaning procedure.

Conclusion

Single paper wipe is an adequate cleaning method for outpatients but for inpatients, especially the vulnerable groups, double paper wipe cleaning method is preferred and probe must be thoroughly wiped until visibly clean.

References

1. Galliot O, Maruejouls C, Abachin E, Lecure F, Arlet G, Simonet M, Berchel P. Nosocomial outbreak of *Klebsiella pneumoniae* producing SHV-5 extended spectrum â lactamase originating from a contaminated ultrasonography coupling gel. *J. Clin. Microbiol.* 1998; 36: 1357-1360

2. Spencer P, Spencer RC. Ultrasound scanning of post operative wound; the risk of cross infection. *Clin. Radiol.* 1998; 39: 245-246.

3. Tesch C, Froschle G. Sonography machine as a source of infection. *A.J.R.* 1997; 168: 567-568.

4. Fowler D, McCracken D. US probes; risks of cross infection and ways to reduce it: Comparison of cleaning methods. *Radiology.* 1999; 213: 299-300.

5. Cheesborough M. Medical Laboratory Manual for Tropical Countries. Vol. II. Microbiology, Cambridge University Press, 2000.

6. Barrow GI, Feltham RKA. Cowan and Steel Manual for the Identification of Medical Bacteria. Third edition, Cambridge University Press, 1993.

7. Bauer AW, Kirby WMM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. *Am. J. Clin. Path.* 1966; 45: 493-496.

8. Dean AD, Dean JA, Burton JH, Dicker RC. EPI-INFO version 5: a word processing, database and statistics program for epidemiology on microcomputers. Centre for Disease Control and Prevention, Atlanta, Georgia, USA, 1990.

9. Egri-Okwaji MTC, Kesah CN, Iroha EO, Odugbemi TO. Intravenous infusions potential sources of neonatal septicaemia; A Lagos experience. *Nig. Qt. J. Hosp. Med.* 1996; 6: 96-100.

10. Olayemi AB, Obayan Y. Contaminated disinfectants in health clinics in Ilorin, Nigeria. *Infect. Contr. Hosp. Epidemiol.* 1994; 15: 581-582.

11. Montefiore DG, Alausa K, Cooke AR, *et al.* Epidemiological surveillance of hospital acquired wound infections. *Nig. Med. J.* 1979; 9: 289-293.

12. Muradeli D, Gold WL, Philips A, Wilson S. Can ultrasound probes and coupling gel be a source of nosocomial infections in patients undergoing Sonography? An *in vivo* and *in vitro* study. *A. J. R.* 1995; 164: 1521-1524.