

# Bacteriology of Ultrasound Probes and the Antibacterial Efficacy of Decontaminants Used for Probes in a Tertiary Care Hospital

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## ABSTRACT

### BACKGROUND

Nosocomial infections are one of the leading causes of death with considerable economic costs in the form of prolonged stay, loss of work hours, increased use of drugs, need for isolation, and drugs. Diagnostic equipment is used for the diagnosis, risk assessment, monitoring of disease or response to treatment for outpatient or inpatient in emergency or as a routine procedure. Ultrasound (US) is one of the most commonly used diagnostic equipment from nearly half a century. With the increasing use of ultrasound in medical diagnosis, the risk of infections via the ultrasound probe, couch, or gel from one patient to another patient is on the rise. Ultrasound equipment has been investigated to determine its role in cross infection as these devices come into direct contact with patients and sonographers during scanning procedures. We wanted to assess the microbiological flora of the ultrasound equipment used for non-invasive examinations and assess the efficacy of decontamination regimes currently used for ultrasound equipment.

### METHODS

Swabs from 6 ultrasound machines were taken 15 times over a 3-month duration. Swabs were collected from the surface of the probe, keyboard, gel and probe holder using sterile swab soaked in thioglycolate broth. Swabs were inoculated on Blood agar and MacConkey agar at 37 °C for 24 hours. The isolated organisms were identified by standard microbiological techniques. The protocol of decontamination of the ultrasound equipment was noted. The data was then analysed as number and percentage.

### RESULTS

A total of 80 swabs were taken from four ultrasound machines. Sixty swabs (70%) did not grow any organisms out of the total 80 swabs. Twenty swabs (30%) grew 23 organisms, out of which 3 swabs grew two organisms. Swabs collected from the gel grew the most number of organisms. *Pseudomonas* species was the most common organism isolated followed by *Klebsiella* species.

### CONCLUSIONS

Due to increase in the patient load and ultrasound being used more commonly in day to day practice for diagnosis as well as prognosis, a routine methodology needs to be followed for the patient safety. Protocol for ultrasound equipment decontamination as well as regular swab culture has to be framed to prevent nosocomial infections.

### KEYWORDS

Gel, Nosocomial Infections, Probe, Ultrasound

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**BACKGROUND**

Diagnostic equipment is used for the diagnosis, risk assessment, monitoring of disease or response to treatment for outpatient or inpatient in emergency or as a routine procedure. Ultrasound (US) is one of the most commonly used diagnostic equipment from nearly half a century.<sup>1</sup> Now a day's ultrasound is the most widely used imaging technologies to investigate the internal organs pathology or to help the surgeons for biopsies as it is inexpensive, portable and with minimal radiation risk. Nosocomial infections are the infections transmitted from patient to patient within the hospital. Diagnostic equipment can be one of the factors which can act as a vector in the transmission of infections. Surveillance studies have shown this evidence.<sup>2</sup> Equipment used in invasive interventions, such as ventilator and catheter are known to cause nosocomial infections but other instruments like sphygmomanometers, thermometer and stethoscope can also transmit infections.<sup>3</sup> Nosocomial infections are one of the leading causes of death<sup>4</sup> with considerable economic costs for prolonged stay, loss of work hours, increased use of drugs, need for isolation, and drugs.<sup>5</sup> The increased length of hospitalization for infected patients is the greatest contributor to cost.<sup>6,7,8</sup> Coella et al.<sup>9</sup> observed an overall increase in the duration of hospitalization for patients with surgical wound infections to be 8.2 days, ranging from 3 days for gynaecology to 9.9 for general surgery and 19.8 for orthopaedic surgery.

With the increasing use of ultrasound in medical diagnosis, the risk of infections via the ultrasound probe, couch, or gel from one patient to other patient. Ultrasound equipment have been investigated to determine its role in cross infection as these devices comes into direct contact with patients and sonographers during scanning procedures. There is a risk of cross-contamination from the equipment to the patient, whenever any part of ultrasound equipment is contaminated, be it the transducer or the coupling gel.<sup>2</sup> Infection prevention plays an important role in the prevention of cross-contamination. The non-adherence to infection control practices or guidelines in the ultrasound room or chamber can be the probable reason of transmission of organisms between the doctor, ultrasound and the patient. The users of the ultrasound machine may not comply with the basic infection control practices like regular hand hygiene as demonstrated by world health organization, regular cleaning of the ultrasound probes, keyboard or probe holders, cleaning of the ultrasound probe between the patients, nor taking proper care to empty the ultrasound gel bottle completely before refilling it which can cause cross-contamination. Individual countries have their own best practice guidelines for the disinfection of ultrasound and infection control practices. World Federation of Ultrasound in Medicine and Biology (WFUMB) has formulated guidelines by a team of expert collaborations, amongst others.<sup>10-13</sup> So this study was done to assess the microbiological contamination of the ultrasound equipment used for non-invasive examinations and the efficacy of decontamination regimes used for ultrasound equipment.

**METHODS**

This prospective study was conducted in the department of Radiodiagnosis and Microbiology at Rajarajeswari Medical College & Hospital, Bangalore from July 2018 and September 2018. The study protocol was approved by the Institutional Scientific and Ethics Committee. Six ultrasound machines were used in total - Four present in the radiology department each with three probes and two bedside machines with two probes in each machine. The machines were sampled randomly on different days of the week and at different times over a period of three months to ensure a variety of practitioners. Documentation about the ultrasound machine and cleanliness was documented. All ultrasound machines were sampled 15 times from the probe, probe holder, keyboard and gel. The sampling was performed with the sampler wearing sterile gloves, moistening a dry swab with thioglycollate broth and rubbing over the sample area. The collected two swabs were transported immediately to the laboratory for processing. Cultures were performed on blood agar and MacConkey agar at 37°C for 24 hours. The isolated organisms were identified by standard microbiological techniques. The data was analysed as number and percentage.

**RESULTS**

A total of 80 swabs were taken from four ultrasound machines. Sixty swabs (70%) did not grow any organisms out of the total 80 swabs. Twenty swabs (30%) grew 23 organisms, out of which 3 swabs grew two organisms. The positivity seen in each area are showed in the bar diagram (Figure 1). The organisms isolated are shown in Table 1. Gel swabs grew the maximum number of organisms when compared to other areas in our study. Figure 2 shows technician taking the swab from ultrasound gel.

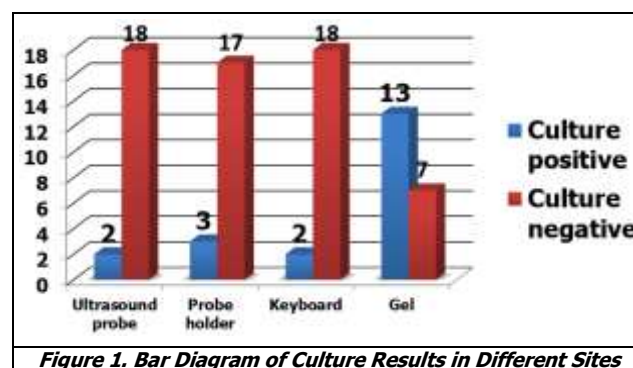
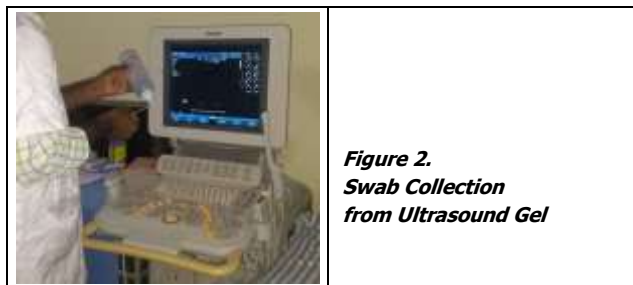


Figure 1. Bar Diagram of Culture Results in Different Sites

Site	Organisms Isolated (No Isolated)
Probe	<i>Bacillus</i> species (1), <i>Pseudomonas</i> species (2)
Probe holder	<i>Bacillus</i> species (2), <i>Pseudomonas</i> species (1)
Keyboard	<i>Bacillus</i> species (2)
Gel	<i>Klebsiella pneumoniae</i> (4), <i>Escherichia coli</i> (3) Coagulase Negative <i>Staphylococcus</i> (2), <i>Pseudomonas</i> species (3), <i>Bacillus</i> species (2)

Table 1. Sites and the Organisms Isolated



**Figure 2.**  
**Swab Collection**  
**from Ultrasound Gel**

## DISCUSSION

Nosocomial infections are infections caused during the stay in the hospital after 48 hours of admission to the hospital. Contamination of ultrasound equipment with organisms known to cause infection in immunocompetent individuals and commensals which can be pathogens in immunocompromised individuals is a threat to cause nosocomial infections. Swabs have shown 30% positivity for culture in our study which suggests that approximately 1 in every 4 to 5 patients may acquire organisms from the ultrasound equipment. A study by Chu K et al.<sup>14</sup> showed 22.6% positivity from the swabs of ultrasound which correlates to our study but study by Skyes A et al.<sup>15</sup> showed 64.5% positivity for skin commensals and 7.7% positivity for pathogens and Velvizhi G et al.<sup>16</sup> showed 72% positivity which was higher than our study. Velvizhi G et al.<sup>16</sup> also showed that the average CFU transmitted by the unclean probes was 74.56, for probes cleaned by single paper wipe was 6.71 and for the probes cleaned by double paper wipe was 0.76. There was a statistical significant difference ( $P < 0.001$ ) between unclean probes and after single and double paper wipe cleaning procedure. The findings of the study done by Stephen T. Odonkor et al.<sup>17</sup> showed that the Trans-abdominal ultrasound probes, - probe, and ultrasound couch were all contaminated with microorganisms. *Staphylococcus aureus* was the most frequent and most common organisms found (27%). This was followed by *Staphylococcus epidermidis* and *Candida albicans* both with 15.4% each. The least bacteria isolate (2) was *Enterococcus faecalis*, representing 7.7%. The following microbes: *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Enterococcus faecalis* and *Candida albicans* were not isolated from the ultrasound couch/bed. Generally more microbes were isolated from the trans-abdominal probe (15) than the Trans-vaginal probe (8). Seven of 31 (22.6%) probes were positive for bacterial growth- none of which were endocavity probes (0/4). Four of 14 visibly soiled probes (28.6%) showed bacterial growth, and four of seven probes positive for bacteria (57.1%) were visibly soiled. No MRSA grew after seeding probes with MRSA and then disinfecting with 0.5% accelerated hydrogen peroxide. Sonography guidelines and general disinfecting guidelines were reviewed by Kelly Chu et al.<sup>14</sup>

Decontamination of ultrasound probes or probe holder is a necessary step in the prevention of Infection control or prevention of cross contamination. There are wide ranges of

decontamination procedures which are referred in the articles among which the most commonly used methods are usage of paper towels, alcohol wipes, or soap and water or clean cloth.<sup>18</sup> Studies by Fowler C et al,<sup>19</sup> Ohara T et al,<sup>20</sup> Mattar EH et al,<sup>21</sup> Hayark S et al.<sup>22</sup> Karadenz YM et al.<sup>23</sup>, and Mirza et al.<sup>24</sup> have showed that alcohol-soaked wipes of the ultrasound probes were better than plain paper towel wipes. Some of these authors have recommended the usage of alcohol wipes only in case of patients with clinical disease rather than for the physiological conditions as the alcohol degrades the life span of the ultrasound probes. The manufacturer instructions also says that solutions that contain more than 70% alcohol can cause damage to the probes and instrument.<sup>25</sup> Alcohol can also degrade the probe brightness after usage of 80% solution as demonstrated by Bello TO et al.<sup>26</sup>

In our study the ultrasound probes were cleaned with clean cloth only which shows that the decontamination method was not sufficient to clear all the organisms as well as produce sterile environment for the patients. Gel used for scanning was of standard quality in our hospital. Gel collected from the nozzle of the bottle showed the highest growth in our study. This finding is correlating with the studies by Fowler C et al.<sup>19</sup> and Bello TO et al.<sup>26</sup> This indirectly gives us an interpretation to use a gel which has an antibacterial property to prevent infections or cross-contamination. Interference of residual organic and inorganic materials with the effectiveness of the disinfection or sterilization process is a well-known fact which has to be cleaned of the visible soil after manual cleaning as demonstrated in a study.<sup>27,28</sup> The time of exposure and the dilutions of the disinfectants are to be provided by the manufacturers.<sup>27,29</sup> Wooltorton E<sup>30</sup> has given the recommended practices for minimizing the risk of serious infection from ultrasound and medical gels which needs to be practiced in routine day to day practice as the number of organisms isolated is more in gel in our study.

### Limitations

Limitations of our study is the number of samples taken is less so no conclusive remark could be given as well as no correlation with the patients were made. A single microbiologist has interpreted the results. It is a single centre study.

## CONCLUSIONS

Due to the increase in the patient load and ultrasound being used more commonly in day to day practice for diagnosis as well as prognosis, a routine methodology needs to be followed for the patient safety. Protocol for ultrasound equipment decontamination as well as regular swab culture has to be framed to prevent nosocomial infections. Use of antibacterial gel will be an alternative to reduce the microbial load. A motto to reduce the nosocomial infections should be a primary concern for the radiologists as well as the management.

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