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ULTRASOUND SCAN;
COUPLING GEL AS A POTENTIAL SOURCE OF INFECTION.

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ABSTRACT... Objective: To assess the infective potential of ultrasound gel and probes when used in a routine manner on ambulatory patients with intact skin. At our institute, ultrasound probes are wiped with a non-sterile absorbent paper towel after each patient. The probes become dry and clean in social terms but we were unsure if they also became bacteriologically decontaminated after wiping clean. We also wished to ascertain the intrinsic infective potential of ultrasound gel. **Materials and methods:** Bacteriological samples were taken from probe surface (after wiping it clean as per our protocol); gel dispensing bottles; and the gel jars that contain the gel in bulk. A total of 61 samples were cultured, out of these 13 were jar samples that were acquired daily on 13 days, 10 from gel bottles and 38 from probe surface (27 before beginning ultrasound, 11 after ending the day's work). Probe surface samples were collected on sterile cotton wipes dipped in sterile nutrient broth; bottle and jar samples were collected by sterile nickel loops and cultured on commercially available nutrient agar. Colonies were counted at 24 and 48 hours. **Results:** The results show bacterial contamination in all (10/10) gel bottle samples, 7% pre-scan probe surface wipes (2/27) and 27.3% (3/11) on post scan wipes. Gel Jar samples were sterile on the first 3 days and then progressively showed greater colony counts. This showed that the gel is initially sterile but is apparently contaminated from air and it serves as growth medium for bacteria. **Conclusion:** We conclude that the highest contamination is observed in gel bottle samples (100%). The lowest contamination was observed from wiped probe samples. This was probably due to repeated cleaning of probes by the operators. Gel jar samples have the second highest contamination but the initial samples showed no growth. The ultrasound gels probably contain no or little antibacterial agent and the gel serves as a growth medium for bacteria.

Key words: Ultrasound, Staphylococcus Aureus, Ultrasound Probe and Gel Contamination.

INTRODUCTION

Ultrasound gels and probes have been reported to cause nocosomial Infections[1]. The bacterial isolates identified in various studies have been E. coli, Staphylococcus aureus, Klebsiella pneumonia, Pseudomonas aeruginosa, Streptococcus group A and Burkholderia cepacia[2,3,4]. Of particular concern was methicillin-resistant

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staphylococcus found in one study[5].

Cross contamination and intrinsic contamination of medical gels are major sources of bacterial infection spreading through ultrasound probes. Thousands of patients undergo ultrasound investigations daily in our country in public and private hospitals. Ultrasound is considered to be safe because no radiation is involved; the potential for infections being transmitted is not a high consideration among operators.

This prospective study was conducted to assess the intrinsic contamination of ultrasound gel and probes. Probe surface, gel from ultrasound bottles and bulk containers was separately assessed for bacterial growth.

MATERIALS AND METHODS

Our institute has a fairly heavy ultrasound clinical load (about 20 patients per day, six days a week) that is predominantly abdomino-pelvic, obstetrical and cardiac. Most patients are adult and ambulatory. Those with open wounds are scanned in a manner that keeps the gel and probe away from the skin break as much as possible.

The study was designed to look at the intrinsic infective potential of ultrasound gel as well as the accumulation of varying bacterial populations on probe surface as the day wears on and different patients are scanned (cross contamination potential). We clean the probes between patients by wiping with dry, non-sterile tissue paper until no visible gel residue is present on the probe surface.

Adult patients who were ambulatory and had no skin wounds or ulcers were included in the study. Patients with open wounds, skin ulcers or neonates were excluded because for these we use commercially available alcohol swabs to clean the probes, and most of these patients are scanned with a different probe (Microconvex probe PVF 381 MT) than the one we used for this study. On patients with broken skin, we use sterile saline as a couplant.

All scans were done on a Toshiba SSA-550A ultrasound machine (Nemio 20, Toshiba inc. Japan), the convex abdominal probe (PVM 375 AT) that is used most commonly in our setting, was the one we used for taking the samples.

Gel is purchased in bulk, in 4 kg jars and then squeezed into 150ml bottles that are then used for patients. The jars are recapped after each bottle filling session and kept in a closed cupboard. The bottles are refilled as needed; these bottles are not washed prior to refilling. During ultrasound, the gel is squeezed onto the probe surface or the patients' skin to form an acoustic coupling medium between the probe and skin. The gel bottles are fitted with nozzles to control the squeezed gel flow; the nozzles are not capped between examinations so the gel is potentially exposed to air.

At the end of each examination, the probe surface is cleaned with a dry absorbent tissue paper and all visible traces of gel are removed. No special cleaning protocol is followed at the end of the day. As already mentioned, samples were taken from probe surfaces, gel bottles and gel jars.

38 probe surface samples were cultured over a period of one and a half months (August-September 2006). Two types of samples were taken for each probe, one before starting ultrasounds in the morning (the probes had been cleaned the day before at the end of session, N=27) and the other after ending ultrasound examinations and cleaning the probe as per our routine (N=11). For taking samples, sterilized cotton swab was first dipped in nutrient broth and rubbed over the entire surface of the probe twice. The swab was put into a sterilized test-tube and taken to the pathology laboratory for culture. The trip to the pathology lab took less than 5 minutes, and the

culture plate was inoculated within 30 minutes of acquiring the sample in every case.

13 serial samples of gel jar were taken over a period of 25 days and cultured. The samples were taken directly from gel after opening the cap of jar. The jar was immediately recapped after taking the sample. The gel jar was supplied by MEDILINES, diagnostic division, Pakistan under commercial name SONOGEL-0101 (4kg packing; expiry not mentioned). Sterilized nickel-chromium loop (0.1 µl, Made in Canada) was dipped into the gel and then taken to the pathology laboratory in a sterile test-tube where the sample was inoculated into nutrient agar containing lab-lemco powder, yeast extract, peptone, sodium chloride and agar and incubated for 24 hours at 37°C and aerobic conditions[6]. The inoculation took less than 30 minutes for all of our samples. Number of colonies was counted by direct method.

10 gel bottle samples were studied over a period of twenty days. The bottles were uncapped and gel in the bottle was sampled using the same procedures of sampling, inoculation and culture as described for gel jar samples.

RESULTS

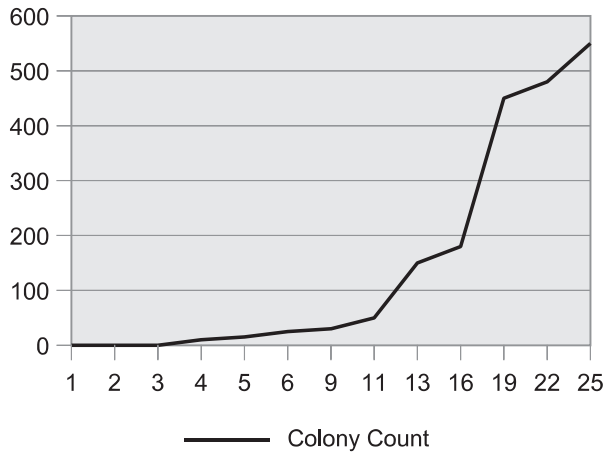
Only one organism, staphylococcus aureus (Coagulase positive) was grown in our positive samples.

There was bacterial growth in all (10/10) gel bottle samples with 100 to 1100 colonies on different days. There was bacterial growth in 7% pre-scan probe surface wipes (2/27) and 27.3% (3/11) on post scan wipes. Gel Jar samples were sterile on the first 3 days and then progressively showed greater colony counts Table I, fig 1.

Table-I. Number of colonies versus number of days after opening the seal of jar

Day	No of colonies
Day 1 (just after opening the seal)	0
Day 2	0
Day 3	0
Day 4	10
Day 5	15
Day 6	25
Day 9	30
Day 11	50
Day 13	150
Day 16	180
Day 19	450
Day 22	550
Day 25	480

Fig-1. Growth of colonies from Jar samples



DISCUSSION

Staphylococcus aureus is a common commensal carried in the nasal mucosa in up to 80% of the population[7]. Carriage is an important factor for invasive infections[7, 8]. Invasive infections from staphylococcus range from

folliculitis to MRSA (Methicillin Resistant Staphylococcus Aureus) Infection and toxic shock syndrome.

The infective potential of ultrasound examination has been explored in other studies too. Generally, such studies have demonstrated lapses in infection control and have cited reasons like re-using spatulas for spreading gel[9], with one study citing gel contamination at the manufacturing stage[4] but most studies raise concerns about cross contamination. The need for disinfection/sterilization depends upon the intended use of the material or instrument; three groups have been described[10]: a) critical; that come in contact with sterile tissue b) semi-critical; that come in contact with mucous membranes or broken skin and c) non-critical; that come in contact with intact skin.

Ultrasound gels are generally considered non-critical, needing minimal levels of disinfection similar to those found in cosmetics or shampoos. This might be adequate for the most common applications of ultrasound where the gel is used on unbroken skin in an otherwise healthy patient, but even this routine use of ultrasound has resulted in significant infections, especially in neonates[9]. With increasing frequency, ultrasound is used in endocavitary locations (trasnsvaginal, trasnsrectal) that is a semi critical application and needs more care with infection control.

Most studies, including ours when we designed it, assumed that the infective risk was mainly cross contamination from one patient to another.

This is due to the fact that although the gel has been shown to have no bactericidal or bacteristatic properties[1,2,] it has been found to be sterile on culture quite often[2,11] and the commonly cited studies on the topic focus on the ultrasound probe as the vector for transmitting infection from one patient to the other, specially those with post operative wounds[12]; But others have found the probes to have low potential for causing cross infection[1]. Despite its (initial) sterilized state, ultrasound gel will allow the growth of organisms if innoculated[1,12]. However, the possibility of gel itself being a source of possible infection has generally been discounted and in one study similar to ours, where serial cultures of gel were done, none of the 25 samples yielded any growth[11].

Ultrasound procedures do not carry radiation hazards and the safety statements are uniformly reassuring as long as the ALARA (As Low As Reasonably Achievable) principles are adhered to. These statements focus on the effects of energy deposition in tissues and the potential for spreading infection is not considered for inclusion[13,14,15].

This study highlights the potential of infection secondary to an every day ultrasound examination, especially in patients who are unusually susceptible, for example the immunocompromised or neonates.

This has prompted us to alter our scanning routine;
We have stopped using gel jars for bulk purchases, instead, we buy pre-filled gel bottles for one time use.
For patients at risk and invasive procedures we have started using Polymyxin B Sulphate skin ointment (Polyfax®) as the coupling medium instead of gel.

Differences have been pointed out in transmissibility of ultrasound using different material[16]. The special coupling gel has near ideal characteristics; other material can give up to a 20% loss in transmissibility. But most of this work has been done in the field of therapeutic ultrasound. Clinically the images acquired with the ointment appeared same as with the coupling gel on phantom studies as well as clinically so it appears that this can be used without any loss of clinical information.

CONCLUSION

We conclude that ultrasound gel has the potential to cause serious infection. This risk increases with the duration of use for a gel aliquot. This risk should be recognized and proper steps taken to minimize or avoid it. We would suggest:

Pre-filled gel bottles should be used instead of bulk jars. These should not be refilled with gel.

If pre-filled bottles cannot be used, it should be ensured that new gel jars are consumed within 3-4 days, at which time we first observed bacterial growth. This might mean an alteration in the way gel is used, and perhaps sharing the jar contents between several machines/departments to ensure rapid consumption of the quantity within the stipulated time.

For use on or near broken skin, neonates, immuno-compromised or for endocavitary use sterile gel or a commercially available skin ointment like polymyxin B (Polyfax®) should be used.

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