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Can ultrasound probes and open coupling gel in Obstetrics and Gynecology Departments be capable of bacterial infections?

Kadın Hastalıkları ve Doğum Kliniğinde ultrason probları ve açık jel bakteriyel enfeksiyonların kaynağı olabilir mi?

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ÖZ

Amaç: Bu çalışmanın amacı, ultrasonografi problarının (UP) ve jellerinin bakteriyel kontaminasyon oranlarını ve bunlarla ilişkili hastane enfeksiyonu riskini değerlendirmektir. Bu şekilde, hastane genelinde enfeksiyon riskini azaltmak için UP dezenfeksiyonu protokollerimizin yeterliliğinin değerlendirmesi amaçlanmıştır.

Gereçler ve Yöntem: Transabdominal (TAP) ve transvajinal ultrason (TVP) prob yüzeyleri ve ultrasonografi jellerinden (UJ) toplam 48 sürüntü örneği alınmış ve mikrobiyoloji laboratuvarında kültüre edilmiştir. Karşılaştırma için, jinekoloji odaları kapı kollarındaki bakteriyel kontaminasyon (12 sürüntü kültürü) analiz edilmiştir. Bu ölçümler, bir ay boyunca her hafta uygulanmış ve her bir probdan, çalışma süresi boyunca 4 kez kültür alınmıştır.

Bulgular: Prob kültürlerinden insan deri florasında ve çevrede yaygın olan, cilt florasında ve çevrede sık bulunmasına rağmen nadiren patojen olabilen sekiz mikroorganizma (Staphylococcus epidermidis, Staphylococcus. hominins, Staphylococcus haemolyticus, Staphylococcus lugdunensis, Corynebacterium amycolatum, Corynebacterium aurimucosum) ve iki önemli patojen mikroorganizma (Enterobacter cloacae, Escherichia coli) izole edildi. Metisilin dirençli Staphylococcus aureus izole edilmedi. Jel kültürlerinden ise patojenik olmayan organizmalar (Staphylococcus epidermidis, Staphylococcus cohnii) izole edildi. Hasta muayene sayısı ve acil değerlendirme durumu açısından kontaminasyon oranlarında da gruplar arasında anlamlı bir fark bulunmadı (p >0.05).

Sonuç: Kadın Hastalıkları ve Doğum kliniklerinde UP ve jellerinde bakteriyel kontaminasyon tespit edildi. Çoğunlukla patojen olmayan mikroorganizmalar (Staphylococcus epidermidis, S Staphylococcus hominis, Staphylococcus haemolyticus, Staphylococcus lugdinensis) saptanmasına rağmen, patojenik iki mikroorganizma da tanımlandı (Enterobacter cloacae, Escherichia coli). Hastane personeli, UP'lerin bakteriyel kontaminasyon için bir araç olabileceğini ve infeksiyöz komplikasyonlara yol açabileceğini unutmamalıdır. Probların kuru, steril olmayan kağıt havlu kullanılarak dekontaminasyonu, cihaza zarar vermeyen, bakteri yükünü de azaltabilen ucuz, basit ve etkili bir yöntemdir.

Anahtar Kelimeler: bakteriyel kontaminasyon jel, metisiline dirençli Staphylococcus aureus, jinekoloji ve doğum kliniği ultrason probları, jel

ABSTRACT

Background: The aim was to evaluate the bacterial contamination rate of ultrasound probes and gels and the associated nosocomial infection risk. In this way, we aimed to assess whether our ultrasound probe disinfection protocols were effective in reducing the risk of hospital-wide infection.

Material and Methods: Forty-eight swab samples were collected from the surfaces of transabdominal (TAP) and transvaginal ultrasound (TVP) probes and adhered to gel bottles, which were then cultured in the microbiology laboratory. In comparison, bacterial contamination of gynecology room door handles (12 swab cultures) was analyzed. These measurements were repeated every week for one month, so that each probe was cultured four times during the study period.

Results: Eight microorganism species (Staphylococcus epidermidis, Staphylococcus hominis, Staphylococcus haemolyticus, Staphylococcus lugdunensis, Corynebacterium amycolatum, Corynebacterium aurimucosum) although they present common in human skin flora and the environment, can be rarely pathogenic, were isolated, and two notable pathogens (Enterobacter cloacae, Escherichia coli) were isolated from the probe cultures. Non-pathogenic organisms (Staphylococcus epidermidis, Staphylococcus cohnii) were isolated from gel cultures. Also, no significant differences were also found between groups in contamination rates during various patient examinations and emergencies (p >0.05).

Conclusion: Bacterial contamination was found on ultrasound probes/gels in the ob&gyn departments. Although the majority were non-pathogenic microorganisms, two pathogenic microorganisms were also identified. Hospital staff should remember that ultrasound probes can be a tool for bacterial infection and can lead to infectious complications. Decontamination of probes with dry, nonsterile paper towels is a cheap, simple, and effective method that does not damage the device and can also reduce bacterial exposure.

Keywords: bacterial contamination gel, methicillin-resistant Staphylococcus aureus, gynecology and obstetrics clinic ultrasound probe, gel

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INTRODUCTION

Ultrasound probes (UP) are widely used in the obstetrics and gynecology *Ob&Gyn* departments to detect pathologies and are in direct contact with the skin and endocavitary mucous membranes. Therefore, they may play a role in bacterial contamination during routine examinations1. Though the cases of clinical infection due to cross-infection by UP are rare, it is critical to prevent such iatrogenic events2-4. Transvaginal probes (TVP) carry a low risk of infection, and sterilization is neither necessary nor feasible. To further minimize risk, the TVP is covered with a disposable condom after a gel to improve image quality3. However, condoms can rupture and the TVP can become contaminated with pathogens that can be present in bodily secretions and can cause healthcare-associated infections3. Studies have shown that UPs and ultrasound jelly (UJ) that are not decontaminated by appropriate methods can transmit infections from patient to patient by various microorganisms, especially Coagulase-negative Staphylococci, Corynebacterium species, Bacillus species, Staphylococcus aureus, and Methicillin-resistant Staphylococcus aureus (MRSA)5-7. In particular, Staphylococcus and Corynebacterium species are prevalent in the skin microbiota8 and can cause critical infectious diseases, especially in immunocompromised patients2. In addition, pyoderma due to cross-infection with Staphylococcus aureus associated with contaminated UJ9 and an outbreak of hospital-acquired K. pneumonia due to contaminated UP have been detected. Measures to prevent bacterial contamination of UP include analysis of bacterial contamination of UP and the influence of UJ on this contamination, and determination of best procedures for decontamination of ultrasound probes2.

In this study, we aim to determine the contamination rate of transvaginal (TVP), transabdominal probes (TAP) and UJ from 3 ultrasound machines in our department. In addition to the effectiveness of disinfection measures for these devices, we want to determine whether the number of patients or emergency conditions affect the contamination rate.

MATERIALS AND METHODS

In this descriptive cross-sectional study, UPs in the inpatient and outpatient Dep. of Ob&Gyn of Ankara Training and Research Hospital were enrolled between March 1, 2022 and April 1, 2022. The approval of the Local Ethics Committee (No: 22-909) was obtained. No patient data were collected in this study and no human samples were examined. Therefore, patient consent was not required. The study included three full-time ultrasound units in the *Ob&Gyn* departments with an average of 1500 births per year. The first ultrasound unit is used in the *Ob&Gyn* inpatient and emergency departments with an average of 80 patients per day. The second ultrasound machine is located in the reproductive endocrinology outpatient department (OPD), where the examination is performed on 50 patients per day. The third is used for ultrasound examination of less than 10 patients per day in the gynecologic oncology OPD. We compared the contamination of TAP, TVP and UJs for three ultrasound devices. The swab samples were collected from the surfaces of TAP, TVP and from their own gel bottles in the *Ob&Gyn* departments and cultured in the microbiology laboratory. For comparison, bacterial contamination was analyzed on room door handles (12 swab cultures). These measurements were repeated every week for one month, so that each probe was cultured 4 times during the study period. A total of 1906 patients underwent ultrasonography in the ob&gyn department during the study period, 982 patients in the reproductive endocrinology OPD, and 212 patients in the gynecologic oncology OPD. The results in this descriptive study are given as numbers and percentages.

Standard disinfection procedures of clinical UPs

The cleaning and disinfection procedure of UP is performed by clinicians (obstetricians and residents) after the use of the probe for each patient. The TVP is covered with a disposable condom prior to the examination and the cover is taken out after the examination. After using the surface of all probes is wiped with a non-sterile paper towel to clean the applied gel. The Infection Committee has recommended that the UP be mechanically cleaned and wiped with a high potency disinfectant after use.

Microbiological Samples and Cultivation

Samples are collected with sterile swabs and sent to the laboratory in tryptic soy broth. Samples in Tryptic soy broth were inoculated onto 5% sheep blood agar and eosin methylene blue (EMB) agar in the laboratory. The colonized plates and samples in tryptic soy broth were incubated for 24-48 hours under appropriate conditions. Plates with growth at the end of the appropriate incubation period were evaluated qualitatively. Samples from non-growing plates in tryptic soy broth were re-evaluated and re-cultured in appropriate media, whether or not they formed turbidity, and incubated again for 24-48 hours. All colonies grown on the media were identified using classical conventional methods and the system VITEK MS, MALDI-TOF

(Biomerieux). Microorganisms were identified and tested for antimicrobial susceptibility using standard procedures. The microbiologist reading the culture plates did not know the origin of the sample.

RESULTS

A total of 48 cultures were obtained, 24 from the UPs, 12 from the UJs, and 12 from the door handle. The colonization rate was 63% in the UPs, 17% in the UJs, and 17% in the door handles (Table 1).

Table 1: Microorganisms isolated by culture sites

Location		1.week	2. week	3. week	4. week
Dep. of Ob&Gyn	Ultrasound gel	-	-	-	-
	Tranvaginal USG Probe	-	-	*S. hominis*	-
	Transabdominal USG Probe	*S. epidermidis*	*S. hominis*	-	***Enterobacter cloacae**** *Corynebacterium amycolatum* *S. hominis*
	Door handle	-	-	-	*S. hominis*
OPD of Reproductive Endocrinology	Ultrasound gel	-	*S. epidermidis*	-	*S.cohnii*
	Transvaginal USG probe	*S.haemolyticus*	*S. epidermidis*	*S. hominis*	*Corynebacterium aurimucosum*
	Transabdominal USG probe	*S. epidermidis*	*S.lugdinensis*	*S.haemolyticus*	*S. epidermidis*
	Door handle	-	-	-	-
OPD of Gynecologic Oncology	Ultrasound gel	-	-	-	-
	Transvaginal USG Probe	*S. epidermidis* ***Escherichia coli****	*S. epidermidis*	-	*S. hominis*
	Transabdominal Probe	-	-	-	-
	Door handle	-	-	-	*S.hominis*

*** Showed pathogenic microorganisms**

Overall, 18 microorganisms grew in 15 (63%) of 24 cultures taken from UPs. Sixteen of the 18 growing microorganisms (Staphylococcus epidermidis (n=6), Staphylococcus hominis (n=5), Staphylococcus haemolyticus (n=2), Staphylococcus lugdunensis (n=1), Corynebacterium amycolatum (n=1), Corynebacterium aurimucosum (n=1)) (89%) were non-pathogenic microorganisms commonly found in human skin flora and environment, while two (Enterobacter cloacae, E. coli) (11%) were pathogenic microorganisms. Enterobacter cloacae, one of the pathogenic microorganisms, grew on TAP in the ob&gyn department and Escherichia coli grew on TVP in the gynecologic oncology OPD. The colonization rate was 50% (4/8) in the UPs of the ob&gyn departments 100% (8/8) in the UPs of the reproductive endocrinology OPD, and 38% (3/8) in the UPs of the gynecologic oncology OPD.

Non-pathogenic microorganisms (Staphylococcus hominins (n=2)) (17%) grew in two of a total of 12 cultures taken from the door handles. One of these microorganisms grew on the door handle of the *Ob&Gyn* department and the other on the door handle of the gynecologic oncology OPD, where a colonization rate of 25% (1/4) was observed, whereas no colonization was observed on the door handle of the reproductive endocrinology

OPD. Staphylococcus aureus was not isolated in any culture.

The UJ and UP colonization rates of the reproductive endocrinology OPD were higher than the UJ and UP colonization rates of both service and gynecologic oncology OPD (Table 1).

Non-pathogenic microorganisms (Staphylococcus epidermis and Staphylococcus cohnii) grew in two (17%) of 12 cultures from the UJs. Evaluation of colonization rates in the UJs shows that there is no colonization in the UJs of the inpatient department of ob&gyn and the gynecologic oncology OPD. Two non-pathogenic microorganisms (Staphylococcus epidermitis and Staphylococcus cohnii) grew in the culture taken from the UJ used in the reproductive endocrinology OPD and the colonization rate was reported as %50.

DISCUSSION

To the best of our knowledge, this study is the first to investigate bacterial contamination of UPs in *Ob&Gyn* departments in Turkey. We isolated non-pathogenic microorganisms (Staphylococcus epidermidis, Staphylococcus hominis, Staphylococcus haemolyticus, Staphylococcus lugdunensis, Corynebacterium amycolatum, Corynebacterium aurimucosum) and two important pathogens (Enterobacter cloacae, E. coli) on the TAP and TVP probe surfaces. No pathogenic microorganisms were isolated from gel cultures and door handle cultures. Moreover, no significant differences were observed between the contamination rates of the groups as a function of patient density.

Clinical investigation of bacterial transmission and prevention of transmission are critical for reducing morbidity, mortality, and costs, especially in patients affected by nosocomial infections11,12. Uncleaned UP can potentially transmit pathogens to other patients. Therefore, disinfection of probes between patient examinations is essential. Transthoracic and transabdominal probes are considered low-risk infection procedures because they contact only the patient's skin. It is well known that TVPs that are in frequent contact with the endocavitary area are at extreme risk for transmission of transmitting infection(7).Kac et al. studied 183 UP specimens and found that bacterial contamination was significantly lower in TAP than in arterial UP performed in the cervical and inguinal areas (p = 0.047. However, in their study of MRSA carriers hospitalized in the ICU, Fowler et al. found MRSA transmission through the use of TAP in 41% of patients, even though no endocavitary probe was used13.

Because of the potential risk of cross-contamination between patients during ultrasound examinations, disposable covers for ultrasound probes can be used13. However, there is no guideline for the management of TVP disinfection. The infection prevention committees recommend that TVP disinfection be performed on every patient, even if condom covers are used14. Zali et al. showed that in 300 TVP samples3, commensal and/or environmental bacterial flora was detected in 86% of samples, occasionally in mixed cultures and in varying amounts (10-3000 CFU/sample). Staphylococcus aureus grew in 4% (10-560 CFU/probe) of the cultures. PCR detected HPV DNA positivity in 13% of the samples and Chlamydia trachomatis DNA in 20% of the primary samples. Fungi were not isolated in any of the UP cultures in the study. Furthermore, it was highlighted that the probes were significantly contaminated with clinically important microorganisms, including HPV, Chlamydia trachomatis, mycoplasmas, and Gram-positive and Gram-negative bacterias7,15,16. Furthermore, the disinfectants used may chemically damage to the mucous membranes of patients, especially TVPs, have a deleterious reaction on germ cells and embryos, prolong the duration of the procedure, and damage the UP, which may lead to imaging degradation 2,3

In addition, the possibility of UP contamination in routine practice may differ between emergency and outpatients. In their study of 110 specimens in the emergency department, Sanz et al.17 reported that UPs in the outpatient department, trauma department, and pediatric department were 65%, 33%, and 70% clean on inspection, respectively (p <0.001). They also noted that ultrasound gel or blood was detected on the surface of UPs, but there was no MRSA development in a UP culture. In our study, emergency patients admitted to our hospital were evaluated in our gynecology and obstetrics departments. Most patients underwent ultrasonography in this clinic. Subsequently, patients were examined in the menopause and infertility department and at least in the oncology outpatient clinic. Bacterial contamination was found in 50% (4/8) of UPs in the gynecology and obstetrics outpatient clinic, in 100% (8/8) of UPs in the reproductive endocrinology OPD, and in 38% (3/8) of UPs in the gynecologic oncology OPD. No significant differences were also found between groups in contamination rates for various patient examinations and emergencies (p >0.05).

Various methods have been used for UP disinfection, such as. wiping the probe with a soft, nonsterile paper towel, wiping with single and double paper (low-level disinfection methods), wiping with alcohol or antiseptic solutions (dimethylammoni-

um chloride, glutaraldehyde, hydrogen peroxide, or peracetic acid, polyhexamethylene biguanide, glycolic acid), wiping with a towel impregnated with disinfectant spray (high-level disinfection methods), or decontamination with ultraviolet irradiation, which is also one of the high-level disinfection methods. However, mixed results have been obtained regarding the effectiveness of the ideal UP cleaning methods(7). Fowler et al.13 found that single-paper wiping was not sufficient to prevent bacterial cross-transmission in UPs. Karadeniz et al.1(18).tated that it is sufficient to wipe the TAP, used in the abdomen, with dry paper only after use, because fewer bacteria are generated there than in moist and hairy areas such as the inguinal and axillary region, and that it is more useful to clean inguinal and axillary region with alcohol (7)efore using TAP. On the other hand, Kac et al (7). found that the success of cleaning with dry paper towels was 4%, while that of disinfectants was 16%. They found no significant difference between cleaning with dry paper or disinfectants. When they compared the UV method with other methods, the UV method was the most successful with 88%. In our study, UPs were cleaned more frequently in the ob&gyn departments because of the high number of patients. However, Enterobacter cloacae, one of the two pathogens in our study, was detected on the TAP ob&gyn departments, and E. coli, the other pathogen, was isolated on the TVP of gynecologic oncology OPD. In addition, studies have investigated the culture methods and susceptibility of microorganisms in microbiological examinations of specimens from the UP19. Several methods were used to examine the samples: 1) “probe swab method” -application of UP directly to blood agar plates with 5% surface-; 2) “swab method” -sterile cotton swabs moistened with sterile physiological saline and then applied to a UP surface, followed by swabbing directly onto blood agar plates-; 3) “smear suspension method” -sterile cotton swabs moistened with sterile physiological saline and applied to a UP surface and then placed in screw-cap tubes containin saline and then cultured in culture medium-. Koibuchi have shown that the most suitable impression method is direct compression of the agar surface with UPs. The reason could be that in the direct impression method, the bacterial detection rate was closer to the actual contamination rate of the probes. In addition, the microorganisms are picked up by the swab enclosed in the cotton fiber matrix, so bacterial contamination is detected with lower sensitivity(20). In our study, samples were collected with sterile swabs and sent to the laboratory in a liquid broth (tryptic soy broth). Samples are cultured in the laboratory on 5% sheep blood agar and eosin methylene blue agar (EMB). Plates with growth at the end of the appropriate incubation period were evaluated qualitatively. There was no comparison of sampling methods in our study.

This study has some notable limitations. The data were obtained from a single clinical study center rather than from multiple clinical study centers. In addition, probe contamination sampling methods were not compared. In addition, the plate-specific incubation was not evaluated quantitatively, so we only determine the proliferation of microorganisms. Based on the qualitative evaluation, we cannot determine the number of colonies.

Conclusion

Essentially, the goal is to raise awareness among gynecologic and obstetric clinicians about bacterial transmission through UPs. In addition, identifying the most appropriate methods for cleaning and disinfecting probes is critical to preventing bacterial contamination. UPs can serve as a reservoir for bacterial pathogens if the probe is not properly cleaned after use. Wiping probes with a simple paper towel is an appropriate cleaning method. If a patient has a potential source of infection (MRSA positive or ICU patient), paper towels must still be used with antiseptic solutions. Clinicians should remember to reevaluate the disinfection process for UPs to avoid risks.

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