

ORIGINAL RESEARCH

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Comparison of ultrasound images obtained by different disinfection methods used

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Abstract

Ultrasonography-guided regional anesthesia (UGRA) applications are important in the practice of anesthesiology in the world. Despite the positive effect on patient care, there is concern that ultrasound (US) probes may be used repeatedly and assume a vector role in pathogen transport. There is no consensus on how to preserve US probes and use of gels against probing surface damage with pre-UGRA probe disinfection, agents used, and is still a research topic. Methods: Five different disinfection methods were compared via image quality by experienced anesthesiologists. Evaluators have been wanted to score the image that was recorded with using a defined disinfection method. Evaluators were blind while scoring the image. As a mean of 4,65 (US probe non-sterile stretch film coating and antiseptic spray(10% povidone-iodine) on the stretch film) Method 3 has been the most preferred one. The use of proven disinfection methods in UGRA interventions will be beneficial in terms of cost-effectiveness. According to study results, Method 3 (US probe non-sterile stretch film coating and antiseptic spray(10% povidone-iodine) on the stretch film) was observed to provide best image quality and cause the least cost for long-term use.

Keywords: Regional anesthesia, ultrasound-guided, antiseptic

Introduction

Ultrasonography-guided regional anesthesia (UGRA) applications are important in the practice of the anesthesiology in the world [1-5]. In addition, patient-centered ultrasonography (USG) methods have become a cornerstone in the diagnosis and treatment of patients in internal medicine, pediatrics, and emergency services. Despite the positive effect on patient care, there is concern that ultrasound (US) probes may be used repeatedly and assume a vector role in pathogen transport. The sterilization principles, which is a basic prerequisite for invasive interventional procedures, may not be respected sometimes during UGRA. For this reason, it has been reported that patients are exposed to ultrasound (US) probes that have been reused after UGRA and have not been adequately sterilized, may be a vector for pathogens [6]. However, there is no consensus on how to preserve US probes and use of gels against probing surface damage with pre-UGRA probe disinfection, agents used, and is still a research topic [7].

In the study, it was aimed to compare the image quality characteristics of the US images obtained from the axillary region with the proven disinfection methods used in the UGRA attempts

by the anesthesiologists with at least 5 years UGRA experience with the Likert scale method.

Material and Methods

Different disinfection techniques are available for UGRA initiatives. Each method has sufficient disinfection, with advantages and disadvantages, and sufficient image for the users is provided. The aim of our study is to evaluate US images obtained using five proven effluent disinfection methods by anesthesia specialists with more than 5 years UGRA experience. Evaluators have been wanted to score the image that was recorded using a defined disinfection method. Evaluators were blind while scoring the image.

The effects of the disinfectant agents to be used have been tested by the preliminary study. Our purpose in this preliminary study is; It is in vitro testing whether microorganisms that may be present the US probes are the cause of the infection during the interventions. (Povidone 10%), 70% 2-Propanol + Chlorhexidine digluconate (Steridin®) and 0.1% Octenidine Hydrochloride + 2% Phenoxyethanol (Octenidine®), respectively, after first obtaining a swab culture over the stretched film coated on the probe. After waiting for a while, individual swab cultures were taken. Cultures were evaluated after incubation for 24 hours on sheep blood agar media. A number of colony coagulase-negative Staphylococcus

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(S.) productions were detected in the culture from the stretch film, but no growth was detected using disinfectants. It was then aimed to test the effect of disinfectants by forming an infected probe. In this second phase of our study, gram-positive bacteria were used from multiple isolates of *S. aureus* from clinical isolates from institutional microbiology laboratory. Firstly, a suspension of *S. aureus* was prepared at a density of 0.5 McFarland. The suspension was then sown on a probe coated with a stretch film. Secondly, after taking the sample of the swab from the stretch film, all the disinfectants were applied separately and waited for the necessary time and then swab samples were taken. As in the first study, samples were seeded on sheep blood agar medium and incubated for 24 hours. When we evaluated after incubation, only *S. aureus* was observed in the swab culture which we made through the bag, but none of the swab cultures taken after the disinfectant application was produced. The same study was repeated with *Pseudomonas aeruginosa* in isolates common in intensive care units and the same results were obtained. There was no difference between the disinfectants.

Obtaining Image

The ESAOTE brand MyLabFive model (Esaote Europe BV Philipsweg 1 6227 AJ Maastricht The Netherlands) was used by an experienced expert with at least 5 years of experience to measure the ultrasonic device linear US probe at a supine position, 30 degrees counter-rotated to the lateral side, placed in the interscalene region at the level of the cervical 6th vertebra, and the nerve, muscle and vascular tissue images were taken about the 15 Mhz frequency. In this way, images obtained from the same anatomical region for each of the asepsis methods described below are recorded. Each image is numbered and transferred to the computer. It has been transferred with a resolution of 1152x864 pixels. In the name of objective evaluation, the evaluating anesthesiologists had not known that which number belongs to which asepsis technique used and they evaluated the images blindly. Totally 38 experienced anesthesiologists evaluated the images.

Evaluation of image quality

The obtained 5 different images were evaluated by a total of 38 anesthetists who were experienced in UGRA and who have more than 5 years experience. Likert scale was used for evaluation. (Score: 1: insufficient image, 2: reasonable image, 3: good image, 4: fairly good, 5: ideal/optimal image - Likert scale).

Disinfection methods were used;

Method 1: Placing the US probe inside a sterile glove

Method 2: Place the US probe inside the sheath/camera sheath

Method 3: US probe sterile non-stretch film coating and antiseptic spray(10% povidone-iodine) on stretch film

Method 4: US sterilization with a sterile sponge with antiseptic solution(10% povidone-iodine)

Method 5: US probe directly sprayed with 2% chlorhexidine, 70% isopropyl alcohol (Opacjel 2-70®) antiseptic solution

The antiseptic agents used for the applications were applied by spraying on the method used or casting on a sponge.

Agents used

Opakjel 2-70® (2% chlorhexidine, 70% isopropyl alcohol),

Povidone 10% (10% povidone iodine).

Pouring; 10 cm above the sponge directly from the package or swollen and in total 20 ml in bulk,

Spraying; For the US probe, the probe is placed at the right angle, with the probe being held upright, and the light-labeled portion of the probe at 12 o'clock in the clockwise direction at times 12, 3, 6, 9 with a right angle of 3 times and a probe angle of 45 degrees. Spraying will be applied 3 times from 15 cm. Spray 3 times 15 cm from the surface for each surface (5 ml per spray).

Disinfection with sterile sponge; 10 ml disinfectant applied sterile sponge will be wiped from the center of the application point to the periphery without wiping again from the same point.

Transmission gel to be used: NatuRel® 1 liter brand and packing, 2 ml for transmission gel application. The area to be applied shall be used by dropping at a distance of 10 cm. In the case of a sterile sheath (Medbar® Sterile Camera Sheath), the material to be used will be taken sterile by the applicator wearing sterile gloves and applied to the US probe.

Stretch film application; The Sera® brand 40 cm wide and 9 micrometers thick, 30 cm long piece will be placed on the full midpoint probe and will be folded towards the top of the stretch film probe and the other disinfecting applications will be applied as described.

Results

The mean values of the scores of the methods used by anesthesiologists;

Method 1: 4,02 (Placing the US probe inside a sterile glove)

Method 2: 3,57 (Place the US probe inside the sheath/camera sheath)

Method 3: 4,36 (US probe non-sterile stretch film coating and antiseptic spray(10% povidone-iodine) on the stretch film)

Method 4: 4,18 (US sterilization with sterile sponge with antiseptic solution(10% povidone-iodine))

Method 5: 4,26 (US probe directly sprayed with 2% chlorhexidine, 70% isopropyl alcohol (Opacjel 2-70®) antiseptic solution)

According to the results of the study, the least preferred method was method 2 and most preferred method 3. Method 2 is the least preferred method and that was statistically significant. There was no statistically significant difference in preference of other methods.

Statistical analyses have been performed with SPSS 15.0 software (SPSS Institute, Chicago, IL, USA). Continuous data have been tested for normality. Normally distributed data have been summarized using mean and standard deviation and have been compared using One-way Anova test. Bonferroni correction has been used. A P-value less than 0.05 have been considered statistically significant.

Discussion

As it was observed in the results, the worst choice is method 2 and the best is method 3 according to evaluators views, however, it should be emphasized that scores of method 1,3,4 and 5 are not very different from one another. Low image quality score of method 2 was thought to be because of the thickness of the sheath/camera sheath. It was reported that subcutaneous fat layer(s) and

poor transducer contact may cause low image quality [8-10]. The thickness of the camera sheath is not more than a sterile glove but it was thought that sterile glove provides a better contact surface and better image. As it was observed, the sterile camera sheath has more rigid structure than sterile gloves (more flexible), and these structural properties may cause the difference. On the other hand, the measured (measured via micrometric caliper) thickness

of sterile gloves is 100-150 micrometer (mcm), similarly camera sheet is in 100 mcm thickness nearly. However, the thickness of the stretch film coating is 9 mcm (producer asset).

According to evaluators views, scores of different methods seem to be similar except method 2, then it should be evaluated in term of cost of each method. Tabel 1 refers to institutional costs;

Table 1. Products used and prices invoiced to the institution (2017)

Povidone-iodine 1L 10% (containing 10% free iodine, 10% iodine complex)	0.04 \$/20 ml
Octenidine 1 L 0.1% Octenidine Hydrochloride, 2% Phenoxyethanol	0.57 \$/20 ml
US gel (non-steril) 1 L	0.01 \$/20 ml
US gel (steril 20 ml)	1 \$
stretch film coating	0.01 \$/meter
steril camera sheet	6.5 \$
steril surgical gloves	0.15 \$
steril sponge (steril package containing 5 pieces)	0.06 \$

(All costs were calculated with current exchange rate United States dollar (\$) : Turkish lira (TL) and the amount for single use)

As it was seen in table 1 sterile camera sheet is the most expensive and the least preferred method according to the evaluators of the study. Then the most cost-efficient method is method 4, according to scores of the evaluators. However, it should be emphasized that antiseptic solutions may harm the US probe with direct contact and lead to decrease in sonographic resolution [6,11,12]. It has been emphasized that an US probe cleaning method needs to be tailored to the clinical situation to achieve an appropriate cost-to-benefit ratio while applying UGRA [13]. The linear US probe that has been used in our clinic has a price more than 9000 \$, then the safety of US probe becomes significant. These findings make method 5 to have increased costs so, although method 5 provides high image quality according to evaluators scores, it is not the best method with real lowest-cost. Method 4 carries similar features, however, it carries the similar risks such as US probe damage and it has been emphasized that US probes have to be protected. It has been maintained that covering US probe also provides sterility of the interventional field, the un-sterile probe has to be covered with a sterile cover such as double layer probe cover [14,15] or sterile drape for ultrasound probe [16]. It should not be ignored that sterility of the interventional field was the first and indispensable point of UGRA. As a result, the methods which include a barrier such as method 1, method 2 and method 3 seem to have the advantage to prevent US probe from chemical damage and providing sterility of the interventional field. Then the method 3 becomes the real cost-effective disinfection choice that it is cheaper, easy to get, proved to prevent infection.

Conclusion

The study includes 38 experienced anesthesiologists, however, we believe that working in larger groups will give more inclusive results. In our country, we believe that the use of proven disinfection methods in UGRA interventions will be beneficial in terms of cost-effectiveness. According to study results, Method 3 (US probe non-sterile stretch film coating and antiseptic spray (10% povidone-iodine) on the stretch film) was observed to provide best image quality and cause the least cost for long-term use.

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Competing interests

The authors declare that they have no competing interest

Financial Disclosure

The financial support for this study was provided by the investigators themselves.

Ethical approval

Not applicable.

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