



Original Article

## Bacterial contamination in physical therapy departments in the State of Kuwait

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**Abstract.** [Purpose] Interferential therapy and electrical stimulation are electrophysical modalities commonly used in physical therapy departments to treat patients with musculoskeletal problems. These machines are applied directly to the patient's skin via a medium or electrodes, which can facilitate the transmission of microorganisms from one patient to another. The purpose of this study was to determine the extent of microorganism contamination in the machines sponges at physical therapy departments in Kuwait hospitals. [Subjects and Methods] Sixty samples comprising sponges from interferential therapy and electrical stimulation machines, and water from hot pack units were collected from 5 physical therapy departments in 5 different hospitals. The samples were analyzed at a Medical Laboratory to explore the extent and type of microorganisms present. [Results] Forty-one of the 60 samples (68.3%) were positive for microorganism contamination. Of the 41 contaminated samples, 28 (68.3%) were sponges and 13 (31.7%) were water samples. The major microorganisms found were *Acinetobacter baumannii* (21.9%), *Serratia marcescens* (12.2%), and *Staphylococcus lentus* (7.3%). [Conclusion] Interferential therapy and electrical stimulation in physical therapy departments have a high probability of causing cross contamination between patients. Physical therapists are encouraged to adhere to safety guidelines, such as disinfection management, disposal of used sponges, and regular sponge replacement.

**Key words:** Bacterial contamination, Kuwait, Physical therapy

(This article was submitted Feb. 1, 2017, and was accepted Mar. 11, 2017)

### INTRODUCTION

Electrotherapy is a common term that refers to a wide group of therapeutic modalities used to apply different forms of energy to the body, and is commonly used in physical therapy departments for rehabilitation<sup>1</sup>). These modalities include heat, cold, pressure, sound, electromagnetic radiation, and electrical current<sup>1</sup>). The numerous electrotherapy machines in existence include ultrasound, interferential (IF) therapy, transcutaneous electrical nerve stimulation, and electrical stimulation (ES)<sup>2</sup>). Most of these machines provide direct contact via electrodes through a medium such as gel and wet sponges<sup>2</sup>). Medical devices applied directly to the patient's skin such as stethoscopes, welsh cup electrodes, ultrasound probes, electrography leads, electrography wires, and IF machines may facilitate the transmission of microorganisms from one patient to another<sup>2-4</sup>). Contamination of electrotherapy machines with microorganisms may transmit infection from one patient to another during treatment<sup>2-4</sup>).

ES is broadly used for the process of controlling pain, decreasing muscle edema, and facilitating the healing of chronic

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wounds<sup>5</sup>). When used for wound healing, ES induces a low-level therapeutic dose of electricity that is immediately transmitted to the wound<sup>5</sup>). In such circumstances, there may be a greater risk of bacterial transmission and other pathogenic microorganisms to the skin in contact with the device<sup>5</sup>). Clinicians should follow disinfection protocols to avoid further complications to the patients' health<sup>5</sup>).

IF therapy is used to treat and relieve skeletal muscle pain alternating electric currents with a medium frequency applied via the skin<sup>2</sup>). Direct contact is achieved with the painful area through electrodes cups covered with wet sponges<sup>2</sup>). Diadynamic current therapy and ES are other modalities frequently used in physical therapy departments, with similar applications<sup>1</sup>). A previous study revealed a major increase in microbial infection of sponges and suction cups following IF treatment sessions<sup>2</sup>). Recent studies have reported the presence of approximately 25 bacterial *Phyla* on IF sponges<sup>6</sup>). Additionally, a study revealed that methicillin and tobramycin-resistant *Staphylococcus aureus* (MRSA) were discovered more often in patients who had received physical therapy treatment<sup>6, 7</sup>). The water reservoir of IF therapy machines was also reported to be contaminated with a large number of *Pseudomonas aeruginosa*. Transmission of this bacterium may occur through the sponge to the skin of the patient during treatment<sup>2</sup>).

Physical therapy departments in Kuwait hospitals frequently employ electrophysical modalities. A recent report from the Ministry of Health in Kuwait revealed that the number of ES sessions in 2013 alone was 15,149, while IF treatments reached 95,545. Observation of several hospitals in Kuwait showed that some physical therapists do not adhere to the guidelines of the infection control unit, instead immersing the sponges in a hot pack water container, which maximizes the incidence of infection. There is a great need for a study to determine the degree of contamination associated with the use of IF and ES machines and the possibility of cross contamination between patients treated in the physical therapy department. The purpose of the current study is to determine the extent of microorganism contamination in IF and ES machine sponges and the water in hot pack units at physical therapy departments in Kuwait hospitals.

## SUBJECTS AND METHODS

To identify the microorganisms inhabiting the equipment being used, a total of 60 samples, 30 (50%) from water and 30 (50%) from sponges, were collected from 5 different hospitals. For the sake of confidentiality, the hospitals will be termed A, B, C, D, and E. Twelve specimens were collected from each hospital, 6 sponge and 6 water samples, the latter from hot pack units. To test the microbiological growth of the bacteria, all specimens were incubated in 9 ml of sterile nutrient broth at 37 °C for 24 hours and were cultured in growth media that included Blood agar plates (2% of human packed cells, oxoid), Mannitol Salt agar (Becton and Dickinson company), and MacConkey's agar (MAC, HIMEDIA). These were then incubated at 37 °C for 24 hours, under aerobic conditions<sup>1</sup>). The isolated bacteria were stained with Gram stain, and identified using Vitek 2 GNI (for Gram-negative bacteria) or Vitek 2 GPI (for Gram-positive bacteria) (Biomerieux) kits<sup>8</sup>).

Antibiotic sensitivity tests were performed for the isolates using Vitek AST-P592 (for Gram-positive bacteria) and AST-N232 (for Gram-negative bacteria) kits (Biomerieux). In addition, manual antibiotic sensitivity testing was conducted using the disc diffusion method for some of the isolates that could not be tested with the Vitek 2 machine. The bacteria were dissolved in saline to create a bacterial suspension with turbidity of 0.5 MacFarland<sup>8</sup>). The suspensions were evenly smeared on Muller Hinton media using a swab and the antibiotic discs were placed above the bacteria<sup>8</sup>).

The bacteria were cultured for 24 hours at 37 °C and their resistance to the antibiotics was determined by measuring the diameter of the inhibition zone around the disc<sup>8</sup>). The study procedures was approved by the Ethical Review Board of Health Science Center at Kuwait University (FOAHS Project No. 6).

## RESULTS

In this study, 60 different specimens (30 sponge and 30 water samples) from 5 different physical therapy departments in Kuwait were inspected to identify the microorganisms inhabiting healthcare equipment. Forty-one of the 60 specimens (68%) were contaminated with microorganisms. More specifically, 28 of the 30 (93.2%) sponges were contaminated, whereas 13 of the 30 (43.2%) water samples were contaminated.

The percentage of contamination in each hospital was calculated for each sample, as shown in Table 1. With regard to the total percentage of water sample contamination (43.2%), contamination was most predominant in hospitals A and B (13.3%).

**Table 1.** The percentage of contamination found in each hospital

Hospital	Water (%)	Sponges (%)	Total (%)
A	13.3	20	33.3
B	13.3	16.6	29.9
C	10	20	30
D	6.6	20	26.6
E	0	16.6	16.6

Additionally, hospital D had 6.6% water contamination, and hospital C had 10% water contamination. Hospital E showed no contamination in their water reservoirs. As for the percentage of positive sponge contamination (93.2%), hospitals A, C, and D had the highest percentage of contamination (20%) compared to hospitals B and E (16.6%). The total percentage of contamination for both water and sponges in each hospital was as follows: hospital A (16.6%), hospital B (15%), hospital C (15%), hospital D (13.3%), and hospital E (8.3%).

According to the results for the identification of microorganisms inhabiting these samples, *Acinetobacter baumannii* (21.9%), *Serratia marcescens* (12.2%), *Staphylococcus lentus* (7.3%), and *Aeromonas salmonicida* (7.3%) were the most predominant bacteria. The other bacteria found were *Gardnerella vaginalis*, *Dermacoccus nishinomiyaensis*, *Kocuria kristinae*, *Acinetobacter lwoffii*, *Staphylococci epidermidis*, and *Stenotrophomonas maltophilia*, with a total percentage of 4.9%. *Staphylococcus aureus*, *Enterobacter cloacae* (2.4%), *Rhizobium radiobacter* (2.4%), *Comamonas testosteroni* (2.4%), *Pseudomonas aeruginosa* (2.4%), *Staphylococcus vitulinus* (2.4%), *Ewingella americana* (2.4%), *Staphylococcus intermedius* (2.4%), and *Aerococcus viridans* (2.4%) were also found. The types and percentages of all bacteria found in each hospital are shown in Table 2. In addition, antibiotic sensitivity testing showed that the majority of the bacteria were sensitive to most of the antibiotics tested.

## DISCUSSION

In this study, hospital A was found to have the highest percentage of infection (16.6%) in physical therapy departments. The second most infected hospitals were B and C (15%), followed by hospital D (13.3%), and finally hospital E (8.3%). According to the statistical results for the treatment of patients and therapeutic methods used in Kuwait physical therapy departments in 2014, hospital A had the highest usage of IF and ES machines (28,099). Hospital B, with 24,298 applications of IF and ES machines, is considered to be the second highest. In this study, contamination by several microorganisms including *Acinetobacter baumannii*, *Serratia marcescens*, *Staphylococcus lentus*, and *Aeromonas salmonicida* was detected in the samples taken from IF and ES sponges, and from water samples collected from hot pack containers.

*Acinetobacter baumannii* was found to be the most predominant species in this study. It is considered an opportunistic bacterial pathogen primarily associated with hospital-acquired infections, with a high incidence among immunocompromised individuals. This bacterium is commonly found in aquatic environments, but can colonize the skin, and can be isolated from respiratory secretions from infected individuals. Recently, it was designated a serious human pathogen due to its extensive antibiotic resistance, which is alarming in the medical field<sup>9</sup>.

The second most predominant species was *Serratia marcescens*, an important nosocomial pathogen that can cause a range of infections, most notably of the urinary tract and bloodstream. It is usually found in many environmental niches, and is capable of infecting plants and animals. The emergence and spread of multidrug-resistant strains producing extended-spectrum

**Table 2.** Type and prevalence of bacteria found in each hospital

Name of the bacteria	Hospital A (%)	Hospital B (%)	Hospital C (%)	Hospital D (%)	Hospital E (%)
<i>Acinetobacter baumannii</i>	10	-	55.5	12.5	40
<i>Stenotrophomonas maltophilia</i>	-	11.1	-	-	20
<i>Dermacoccus nishinomiyaensis</i>	-	-	11.1	-	20
<i>Serratia marcescens</i>	30	-	-	25	-
<i>Aeromonas salmonicida</i>	20	-	11.1	-	-
<i>Kocuria kristinae</i>	10	-	11.1	-	-
<i>Gardnerella vaginalis</i>	10	11.1	-	-	-
<i>Staphylococcus lentus</i>	-	33.3	-	-	-
<i>Staphylococcus epidermidis</i>	-	22.2	-	-	-
<i>Staphylococcus aureus</i>	-	11.1	-	-	-
<i>Enterobacter cloacae</i>	-	11.1	-	-	-
<i>Rhizobium radiobacter</i>	-	-	-	-	20
<i>Aerococcus viridans</i>	-	-	11.1	-	-
<i>Acinetobacter lwoffii</i>	10	-	-	-	-
<i>Comamonas testosteroni</i>	10	-	-	-	-
<i>Pseudomonas aeruginosa</i>	-	-	-	12.5	-
<i>Staphylococcus vitulinus</i>	-	-	-	12.5	-
<i>Ewingella americana</i>	-	-	-	12.5	-
<i>Staphylococcus intermedius</i>	-	-	-	12.5	-

or metallo beta-lactamases now pose a threat to public health worldwide<sup>10</sup>).

One of the other important bacteria found among the specimens is *Staphylococcus aureus*, which is considered a commensal bacterium<sup>11</sup>). Although it was found at a low percentage in this study, it can cause both superficial and invasive, potentially life-threatening infections such as sepsis, endocarditis, and pneumonia<sup>11</sup>). Antibiotic treatment is often ineffective owing to the development of antibiotic-resistant strains, such as MRSA<sup>3, 11</sup>). MRSA is prevalent in hospitals, and hypervirulent MRSA strains have recently spread throughout the community<sup>3, 11</sup>). In addition, *Ewingella americana* was found at a low percentage in this study. Clinical infections due to *E. americana* have been determined to cause peritonitis, conjunctivitis, bacteremia, pneumonia, sepsis, and even death from Waterhouse-Friderichsen syndrome. More importantly, this bacterium can infect individuals who are immunocompromised due to diabetes mellitus, bone marrow transplantation, and chemotherapy. In addition, osteomyelitis and septic arthritis caused by *E. americana* infection has been reported. Based on this observation, clinicians may want to consider *Ewingella americana* as an emerging true pathogen<sup>12</sup>). *Gardnerella vaginalis* is also an important bacterium identified in this study. It is an opportunistic pathogen that can spread through the blood stream following trauma to the tissues of the genital tract. It has been reported as a cause of urinary tract infection, post-operative infections, and in particular, obstetric complications such as preterm labor and chorioamnionitis<sup>13</sup>).

These bacteria may transfer from one patient to another during treatment using medical equipment with direct contact to the patient's skin, and can pose a threat to public health. The results of this study were consistent with previous studies that investigated stethoscopes, sponges, electrograph leads, electrograph wires, and suction cups for IF machines<sup>2, 3, 6, 7, 14, 15</sup>). This issue also poses a concern in radiological departments where the surfaces of equipment could serve as a reservoir for pathological agents that can cross infect patients undergoing treatment as well as healthcare professionals providing the treatment<sup>16</sup>).

In conclusion, physical therapy departments have a high risk of compromising patient safety through spreading infections via electrophysical modalities, especially at physical therapy departments that do not adhere to the guidelines of the infection control unit. Therefore, the disinfection management should be established with close supervision, sponges should be changed on regular basis, and damaged sponges should be discarded. Moreover random water samples from the hot pack unit should be checked regularly to ensure the cleanness of the water. Additional recommendations should be enforced by members in the PT departments to minimize the chance of spreading infection, physical therapists should be aware and follow the manufacturer recommended disinfection procedures before applying any modality. The manufacturer was found to be efficient and in disinfecting both the suction cups and sponges as well as preventing microbial transfer from the skin of one patient to another<sup>2</sup>). Furthermore, immunocompromised patients should be treated with cautious in the PT department, and disinfection dispensers should be available and accessible in all treatment rooms.

This study contains some limitations, specifically related to time and the small size of the samples. Nevertheless, further studies are needed to explore factors behind the high levels of infection in some departments compared to others, and to compare the presence of bacteria pre and post treatment.

The results of this study makes a significant contribution to the literature because hospitals in Kuwait frequently employ electrophysical modalities and these devices can serve as vectors for the transmission of infection between patients. Knowledge of the extent and type of contamination can aid in the implementation of measures to improve adherence to infection management guidelines and to reduce the spread of infection.

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