The Journal of Arthroplasty 30 (2015) 1410–1413

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Bacterial Contamination in Tips of Electrocautery Devices During Total Hip Arthroplasty

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ARTICLE INFO

Article history:
Received 20 October 2014
Accepted 11 March 2015

Keywords:
total hip replacement
electrocautery
contamination
equipment
bovie

ABSTRACT

Surgical equipment can become contaminated during surgery. It is unknown if electrocautery tips can become contaminated in clean orthopedic procedures despite the produced heat. Therefore, we conducted a prospective study to address this concern. The tips from 25 primary and 25 aseptic revision THAs were collected and an additional 5 sterile tips served as negative controls. Aerobic and anaerobic cultures were incubated for a minimum of 3 days. There were 3 positive cultures (6%); one in primary THA (4%) with *Lactobacillus* and *Enterococcus faecalis*; two among revisions (8%), one with *E. faecalis* and another one with alpha hemolytic streptococci and coagulase negative *Staphylococcus*. The mean exposure time of the contaminated tips was 132.3 minutes. Patients were followed for 90 days postoperatively and none of them developed surgical site infection. This is the first study to demonstrate that electrosurgical devices can become contaminated during THA in laminar flow equipped operating rooms.

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Total hip arthroplasty (THA) is one of the most successful procedures in modern medicine [1]. It is projected that by the year 2030, the number of primary THA procedures will increase by 174% to 572,000 annually in the United States. Accordingly, the number of revision arthroplasties is forecasted to increase [2].

Periprosthetic joint infection (PJI) after THA is one of the most devastating complications and is associated with significant morbidity and mortality [3,4]. The essential principles to reduce the risk of PJI consist of sterile surgical technique and equipment, timely and appropriate antimicrobial prophylaxis, and perioperative skin antisepsis [5]. Several studies have focused on the contamination of sterilized equipment during surgery [6,7]. Davis et al [8] reported a contamination rate of 28.7% in surgical gloves, 17% in gown swabs, 14.5% in light handles, and 10.1% in needles for deep closure during elective primary total hip and knee arthroplasty. Suction catheters have also shown to be a reservoir for microorganisms both in conventional and ultraclean air operating rooms [9,10]. The contamination rate for suction tips is reported to be as high as 16%–55% during orthopedic procedures [7,11,12]. Electrosurgical devices have been commonly used to control bleeding and dissect tissues since they were introduced by *William T. Bovie*[13]. They are used commonly in orthopedic procedures and could be a potential reservoir for bacteria, despite the fact that tips that can be superheated to a temperature of greater than 200 °C during surgery [14].

In 2013, the International Consensus Meeting (ICM) on PJI was held to establish standards, developed by global experts, for the prevention, diagnosis and treatment of PJI [15]. One of the recommendations was to change suction tips every 60 minutes. However, the workgroup made no specific comment regarding electrosurgical devices due to paucity of evidence [16].

While the contamination risks using suction catheters have been well studied, it is unknown whether electrosurgical tips become contaminated. Therefore, we conducted a study to investigate the contamination rate of electrosurgical tips during THA.

Materials and Methods

A prospective study was conducted at our institution and the tip of the electrocautery device from 25 consecutive primary THAs and 25 aseptic revision THAs was collected between March and June, 2014. The rationale behind choosing THA procedures was that they are carried out without the use of tourniquets and therefore, electerocautery devices are used more often. We assumed that the more the device was used, the higher likelihood of contamination and capturing positive cultures. Furthermore, by choosing one specific procedure, operative room conditions were unified as much as possible to avoid potential bias. The mean age of the patients was 63.2 ± 13.3 years (range; 37–87 years)

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2015.03.011.

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http://dx.doi.org/10.1016/j.arth.2015.03.011
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Table 1
Demographics.

	Primary THA (N = 25)	Revision THA (N = 25)	Total (N = 50)
Age[a] (year)	58.4 ± 13.0 (20.6–85.3)	68.0 ± 11.0 (36.9–86.5)	63.2 ± 13.3 (36.9–86.5)
Sex	14 Females, 11 Males	13 Females, 12 Males	27 Females, 23 Males
BMI[a] (kg/m^2)	28.7 ± 4.4 (20.7–38.4)	30.9 ± 6.2 (21.3–49.0)	29.8 ± 5.5 (20.9–49.0)
Side	10 Left, 15 Right	13 Left, 12 Right	23 Left, 27 Right

[a] Numbers are given as mean ± SD (range).

and consisted of 27 females and 23 males (Table 1). This study had institutional review board exemption since all patient information was de-identified.

A standard, disposable electrosurgical device was used in all cases (Covidien Ltd., Dublin, Ireland). According to the manufacturer, these devices are sterilized by ethylene oxide. The tip is stainless steel and coated with a silicone-based elastomer. The heat produced at the tip depends on factors such as tissue resistance and alternating current frequency [17]. The electrosurgical unit frequency was set at 60 KHz for coagulation and dissection for all cases. The tip can reach temperatures of up to 200 °C at this setting. The tips were collected at the conclusion of each case, using sterile transfer technique, and then transferred to the microbiology lab in Amies transport medium (ESwab™, COPAN Diagnostics Inc., CA, USA). Eswab™ is a multipurpose liquid-based sample collection and transport system. The container is filled with 1 ml of Liquid Amies transport medium, which is tested for pH stability and bio-burden [18].

Cultures were performed by inoculating 100 μL of each specimen onto a BBL Trypticase soy agar with 5% sheep blood (TSA II) (BAP) (Becton, Dickinson and Company); a BBL Chocolate II Agar (CHOC) plate (Becton, Dickinson and Company); a BBL MacConkey (MAC) II agar plate (Becton, Dickinson and Company); and onto a BBL CDC anaerobe (CDC-ANA) 5% sheep blood agar plate (Becton, Dickinson and Company). All plates were incubated in 5% CO_2 at 35 °C except the CDC-ANA plate, which was incubated under anaerobic environmental conditions created by the Anoxomat system (Advanced Instruments, Inc.). Aerobically-incubated plates were visibly observed 24–120 hours post-incubation for the presence or absence of growth. The anaerobically-incubated CDC-ANA plates were observed 48–120 hours post-incubation for the presence or absence of growth. In positive cultures, the organisms were identified with the use of MALDI-TOF Biotyper system (Bruker Corporation, Fremont, California, USA). In order to account for false positive cultures generated from transfer of the tip to the ESwab or from the ESwab to the culture media, 5 sterile tips were also cultured as negative controls.

All surgeries were performed in a laminar flow operating room. The laminar flow protocols in our institution follow the stated recommendations of the National Institute of Occupational Safety and Health [19] and also meet the standards of the American Society of Heating, Refrigerating and Air-conditioning Engineers [20]. The minimum difference of the positive pressure in the operative room was +0.0125 pa. Additionally, high efficiency particulate air filters with the filtration rate of 99.97% are used in all the operating rooms.

Preoperative intravenous prophylactic antibiotics were administered in accordance with the Surgical Care Improvement Project (SCIP) criteria [21] and skin preparation was performed for all the patients according to the protocols of the ICM 2013 [22,23] and adhesive incision drapes (Ioban, 3M, Saint Paul, MN) were also utilized.

The following data were collected: demographics (age, gender, body mass index (BMI)), laterality, operative duration, number of people present in the operating room, number of scrubbed personnel, American Society of Anesthesiologists (ASA) score, estimated blood loss, and the tip exposure time. The tip exposure duration was defined as the time from opening of the device, approximately 30 minutes prior to incision, to the time that the tip was collected for culture at the conclusion of the case. All patients were followed for at least 90 days after the surgery. In positive culture cases, a microbiologist and musculoskeletal infectious disease specialist were consulted to review the microbiology results.

Statistical Analysis

In the absence of previously published data on the rate of contamination of the electrocautery tips in orthopedic procedures, the main goal of our study was to prove or refute the probability of contamination of these devices. Based on data reported in multiple studies [6–10], the minimum reported contamination rate in orthopedic procedures was for skin blades; present in about 3.2% of the cases [8]. Assuming that the true rate of contamination for electrocautery tips was within 1%–2% to be clinically significant, 50 samples would provide an adequately powered study to capture contaminated samples, using a 1-tailed binomial test, alpha of 0.05, and 80% power. Descriptive statistics were used to report all the results. Mann–Whitney and Fisher's exact tests were used to compare continuous and categorical variables respectively. All statistical analyses were performed with the use of R 2.15.1 (R Foundation for Statistical Computing, Vienna, Austria).

Results

There were positive cultures in 6% (3/50) of electrosurgical tips. Of the primary THA patients, 4% (1/25) of the tips were contaminated with *Lactobacillus* and *E. faecalis*. 8% (2/25) of tips from revision THA procedures were contaminated. One tip was positive for *E. faecalis* and the other with both alpha hemolytic streptococci and coagulase negative *Staphylococcus* (Table 2). The cultures for all 5 controls were negative. None of the patients developed subsequent PJI within 90 days (range, 98–150 days).

The mean on-field duration of the tips was 81.6 ± 20.0 (range, 52–120) minutes in primary THA and 154.2 ± 58.1 (range, 83–340) minutes in revision THA. The average on-field duration was 132.3 ± 79.0 (52, 135, 210) minutes for the contaminated tips compared to 117.4 ± 56.5 (range 57–340) in non-contaminated ones ($P = 0.66$) (Table 2).

The overall estimated blood loss (EBL) was 258.0 ± 183.13 mL (range 50–800). Blood loss was 158.0 ± 39.2 mL (range 50–200) for primary and 358.0 ± 213.4 mL (range 100–800) for revision THA, respectively ($P < 0.0001$). The median ASA score was 2 in both groups. Of non-contaminated electrocautery tips, 5 operations were performed with direct anterior approach, 17 with direct lateral approach, and the rest of the study cohort were operated with anterolateral (Modified Hardinge) approach. There was no significant difference in laterality, EBL, tip exposure time, type of the procedure, number of people in the operating room, and number of people that scrubbed between those contaminated and not contaminated (Table 3).

Discussion

Operative room environment and surgical equipment can be a source of intraoperative contamination and potential subsequent infection. Studies reported contamination in surgical gloves, syringe bags, gown swabs, base of light handles, body of light handles, sieve swabs, needles for deep closure, skin blades, inside blades, and suction tips [8,24–27]. Our results are the first, to the authors' knowledge, to demonstrate that electrosurgical tips are not an exception and can become contaminated during THA in laminar flow equipped operating rooms.

It is a misconception that the electrical current at the tip of the electrosurgical device produces heat that can subsequently sterilize it [28].

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