LETTERS TO THE EDITOR

A Response to the Validity of an Article Reporting Contrary Cleaning Efficacy Results for Robotic Surgical Instruments

To the Editor—The article by Saito et al[1] makes unsupported assertions and reports cleaning efficacy results of robotic surgical instruments that are contrary to published data using validated methods.

REVIEW OF EXPERIMENTAL INCONSISTENCIES

The results of this study are unreliable due to several inconsistencies in the application of scientific best practices, including different treatments of the reference and test groups of instruments, the absence of experimental controls, and the use of an unvalidated residual protein extraction method.

In this study, reference instruments (ie, common handheld surgical instruments) were reprocessed in an automated washer disinfector using an alkaline detergent, whereas the test instruments (ie, robotic surgical instruments) were reprocessed manually using a pH-neutral detergent. Correspondingly, thermal disinfection was performed on the reference instruments at 93°C for 10 minutes. Protein is denatured and becomes fixed (covalently bound) to surfaces at temperatures >55°C,[2] making them unavailable to extraction using standardized methods. For this reason, thermal disinfection is not allowed during a test of cleaning efficacy according to the International Standards Organization specifications for washer-disinfectors (ISO 15883–1).[3] Unless the extraction method using water and ultrasonic energy has been validated to solubilize protein fixed at high temperatures, it can be assumed that residual protein on the reference devices is not extracted.

A negative control was not employed in this study, but a negative control is required to quantify potential interfering effects to the testing methodology.[4] It is important to clarify that the bicinchoninic acid (BCA) test does not measure protein directly but measures the ability of certain amino acids and the peptide bond (at elevated temperature) to reduce copper in the reagent from Cu(II) to Cu(I). Reduced copper is then chelated by 2 BCA molecules, resulting in a shift in absorbance at 562 nm proportional to the amount of protein in the sample.[5] Consequently, any compound that can reduce Cu(II) under the conditions of the assay will also generate a proportional signal. Due to the harsh nature of the ultrasound extraction process used for the robotic instruments, the possibility of releasing interfering substances cannot be ruled out without the use of negative controls (ie, devices that are reprocessed and extracted but not soiled). The authors neither cited nor provided evidence for the validation of their ultrasonic protein extraction method, even though validated methods have been published.[6,7] The publications of the AG da Vinci Working Group provide methods for the destructive and nondestructive evaluation of robotic instruments that have been validated by controlled experimentation including recovery efficacy and blind testing at certified laboratories.

Extraction in an ultrasonic bath for 30 minutes is harsh and can result in instrument damage and the release of iron and tungsten particles that interfere with the BCA protein test by reducing Cu(II) according to their relative positions in the electrochemical series. If surgical soil were present on the devices, ultrasonic energy would typically liberate the soil in particles (rather than solubilizing), which would lead to turbidity in the extract and to false-positive results in the spectrophotometric measurement. Entire robotic instruments were extracted in a large volume of water (200 mL) rather than only extracting the patient contact portions of the devices. This creates an analytical issue because the BCA test gives results in μg/mL, which are then multiplied by the extract volume to give total protein in micrograms. Multiplying the result by a large number leads to an amplification of both the signal from the protein and the signal from interfering substances (and turbidity) and increases the limit of detection for the method by the same factor.

STUDY RESULTS COMPARED TO PUBLISHED EVIDENCE OF CLEANING EFFICACY

The results reported by Saito et al show a ~2-log reduction in surgical soil after cleaning both the reference and robotic instruments. After serial extractions of the cleaned robotic instruments, however, an expected log reduction in residual protein in robotic instruments is not seen, as is claimed by the authors. Figure 1 shows the results with actual lines in place of trend lines. The elevated flat response after the serial extractions of cleaned robotic instruments can be indicative of a high interference signal in the BCA results.

In contrast, 223 clinically used robotic instruments were tested using the validated method of the Working Group by certified laboratories as part of ISO 15883–1[3] cleaning process qualifications at 28 hospitals in Germany.[8] Hospital staff were trained and monitored to follow the manufacturer's instructions during the first year of the study; in the subsequent 2 years, the average total residual protein results for robotic instruments were 72.7 μg ($n = 89$) in 2013 and 35.1 μg ($n = 73$) in 2014. Over these 2 years, only 4 values were reported to be >200 μg. The high residual protein results for robotic instruments reported by Saito et al do not match the cleaning performance established in the German study in which hospitals were compliant with the reprocessing instructions and validated testing methods were used.

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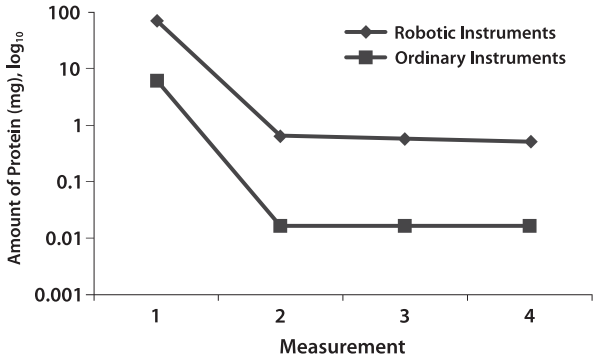

FIGURE 1. Results of Saito et al[1] redrawn with connecting lines. Measurement 1 represents residual protein on a set of instruments prior to cleaning. Measurements 2–4 represent residual protein from serial extractions on a different set of cleaned instruments. The results for robotic instruments indicate a possible high-level background signal.

DISCUSSION

Scientific best practices and controlled experimentation are not evident in the execution of the Saito et al study and published cleaning efficacy data refute the results. Additionally, the safety of robotic-assisted surgery has been extensively reported in the clinical literature; numerous multisite studies have reported statistically significant lower infection rates for robotic-assisted surgery compared to other surgical methods.[9,10] Thus, the assertions and assumptions of the article are without merit.

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Emergency Evacuation of Immunocompromised Patients From a Hematology Unit Following Flooding of High-Efficiency Particulate Air (HEPA) Filtration

To the Editor—To reduce the risk of developing nosocomial fungal infections, patients with hematological malignancies are placed in protected areas during intensive chemotherapy or during bone marrow transplant.[1,2] Patients admitted to these units often stay several weeks to be treated. Guidelines recommend placing high-risk patients in rooms with high-efficiency particulate air (HEPA) filtration systems.[3] The beds are located under laminar airflow and environmental samples (air and surface samples under laminar airflow and from the bathroom) are regularly taken from the patient rooms to detect air fungal contamination.[4]

The hematopoietic stem cell transplantation center of Brest University Hospital has been accredited for the quality management system by the Joint Accreditation Committee of the International Society for Cellular Therapy (ISCT) and the European Society for Bone Marrow Transplantation (EBMT) known as JACIE since 2008.[5,6] JACIE is equivalent to its US counterpart, the Foundation for the Accreditation of Cellular Therapy, FACT, which is an ongoing quality management system that pertains to clinical, collection, and processing activities. The configuration of the Hematology