

Innovation in the Central Sterile Supply Department: support for robotic graspers with wastewater drainage as a safety and standardization tool

Innovación en el Departamento Central de Suministros Estériles: soporte para fórceps robóticos con drenaje de aguas residuales como herramienta de seguridad y estandarización

Inovação no Centro de Material e Esterilização: suporte para pinças robóticas com escoamento de água residual como ferramenta de segurança e padronização

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Abstract

The safe preparation of robotic graspers is essential to ensure efficiency and patient safety in highly complex procedures. This innovation report describes the design, implementation, and standardization of a specific support for robotic graspers, developed with a wastewater drainage system, to facilitate the cleaning and preparation of these instruments in the central sterile supply department. The support allows for the safe organization of instruments, reduces the risk of contamination, and standardizes the workflow of the nursing team. It is expected that this tool will increase operational efficiency, promote patient safety, and serve as a replicable model for other hospital units.

Descriptors: Perioperative Nursing; Innovation in Healthcare; Robotic Graspers; Standardization; Patient Safety.

Resumén

La preparación segura de fórceps robóticos es fundamental para garantizar la eficiencia y la seguridad del paciente en procedimientos de alta complejidad. Este informe de innovación describe el diseño, la implementación y la estandarización de un soporte específico para fórceps robóticos, desarrollado con un sistema de drenaje de aguas residuales, para facilitar la limpieza y preparación de estos instrumentos en la central de esterilización. El soporte permite la organización segura de los instrumentos, reduce el riesgo de contaminación y estandariza el flujo de trabajo del equipo de enfermería. Se espera que esta herramienta aumente la eficiencia operativa, promueva la seguridad del paciente y sirva como modelo replicable para otras unidades hospitalarias.

Descriptoros: Enfermería Perioperatoria; Innovación en la Atención Médica; Fórceps Robóticos; Estandarización; Seguridad del Paciente.

Resumo

O preparo seguro das pinças robóticas é essencial para garantir a eficiência e a segurança do paciente em procedimentos de alta complexidade. Este relato de inovação descreve a concepção, implementação e padronização de um suporte específico para pinças robóticas, desenvolvido com sistema de escoamento de água residual, visando facilitar a limpeza e o preparo desses instrumentais no centro de material e esterilização. O suporte permite a organização segura dos instrumentos, reduz riscos de contaminação e padroniza o fluxo de trabalho da equipe de enfermagem. Espera-se que esta ferramenta aumente a eficiência operacional, promova a segurança do paciente e sirva como modelo replicável para outras unidades hospitalares.

Descriptoros: Enfermagem Perioperatória; Inovação em Saúde; Pinças Robóticas; Padronização; Segurança do Paciente.



Introduction

Robotic surgeries demand complex and highly sensitive instruments, such as robotic graspers, whose proper handling and preparation are critical for patient safety. During cleaning and preparation, the drainage of residual water presents a challenge, potentially compromising the efficiency of the process or increasing the risk of contamination. In this context, perioperative nursing plays a strategic role, being responsible for the organization, sterilization, and traceability of instruments. The innovation presented consists of the creation of standardized support that organizes robotic graspers and allows for the safe drainage of residual water, aligning safety, efficiency, and institutional standardization^{1,2}.

With the advancement of surgical technologies, especially in the field of robotics, the complexity of materials and preparation processes has increased significantly. Nurses, as professionals who work directly at the interface between technology and care, need to develop specific skills to handle high-cost and sensitive instruments, ensuring their integrity and functionality throughout the entire life cycle. Safe and efficient practice depends on the standardization of processes, continuous training of the team, and the adoption of innovative solutions that optimize workflow^{2,3}.

Furthermore, the traceability of robotic materials is an essential component for patient safety and compliance with regulatory standards. Detailed inspection of instruments, correct identification of components, and application of sterilization methods compatible with each manufacturer require rigorous attention and specialized technical knowledge. The creation of devices and strategies that facilitate these steps contributes to reducing errors, increasing efficiency, and strengthening the safety culture in the surgical environment³⁻⁶.

Given the above, this study aims to present an account of the experience of a technological innovation focused on the organization and safe flow of robotic graspers during the cleaning process, as a strategy to promote safety, standardization, and efficiency in perioperative nursing practice.

Methodology

This study is characterized as an experience report with a qualitative approach, developed in a large hospital institution, a reference in robotic surgical procedures. The experience was built over a period of approximately one year, between August 2022 and September 2023, during the monitoring of the routines for preparation, cleaning, and management of instruments dedicated to robotic surgery.

The population involved includes professionals from the perioperative nursing team, technicians from the Central Sterile Supply Department, and other collaborators who work directly in the organization and processing of robotic materials. The observed situation arose from the high surgical demand, which required agility and precision from the team in performing activities, often under conditions of overload. Observations made by collaborators revealed recurring difficulties, especially related to the drainage of residual water from robotic f graspers, the

identification of instruments, and the maintenance of the functionality of the devices.

The motivation for this study stemmed from the need to develop practical and safe solutions that would optimize workflow, reduce risks, and ensure the traceability of materials. The proposed technological innovation - the creation of standardized support for robotic grippers - emerged as a response to these demands, seeking to integrate safety, efficiency, and institutional standardization.

To support the theoretical and practical discussion of the lived experience, Patricia Benner's model was adopted as a reference⁷, which recognizes the development of clinical competence through practice and accumulated experience. The nurse's role, in this context, is understood as a dynamic process of knowledge construction, where critical observation and creativity are fundamental to transforming daily challenges into effective solutions.

The concept and design of the robotic gripper support for wastewater drainage were developed exclusively by the author of this report. The technical design and construction of the prototype were carried out by a responsible and specialized company, following the author's specifications and recommendations.

Experience Report

The intervention was developed in a large private hospital located in the city of São Paulo, in the Central Sterile Supply Department, in response to the growing demand for robotic procedures and the need to optimize the preparation of instruments. The experience was built over a year, through continuous observation of the scenario and the difficulties reported by employees, especially those related to the drainage of residual water from robotic graspers and the organization of materials during the cleaning process.

Support design

The idea arose from the need to ensure the efficient drainage of residual water from robotic graspers after the cleaning stage, preventing moisture buildup that could compromise sterilization or damage the components. The support was designed to accommodate the graspers in a vertical or slightly inclined position, allowing the water to drain naturally by gravity. This structure also facilitates the visualization of the graspers during inspection, contributing to the traceability and safety of the process.

Materials and dimensions

For the construction of the support, materials resistant to chemicals used in hospital cleaning were selected, such as polypropylene and stainless steel, ensuring durability and compatibility with the instruments. The dimensions were adjusted according to the grasper models used in the institution's robotic platforms, such as the da Vinci X/Xi and Hugo RAS System, respecting contact limits and avoiding deformation. The design was conceived to be functional, safe, and easy to clean⁴⁻⁶.



Standardization of use

Following the prototype validation, an institutional protocol was developed that defines the correct positioning of the graspers in the holder, the minimum drainage time set at 20 minutes, the hygiene procedures for the structure, and the recording of the steps in the computerized system of the central sterile supply department. This standardization and observed time allowed for greater control over the process, promoting uniformity of practices across shifts and teams.

Team training

The final stage consisted of training nursing professionals and technicians from the central sterile supply department on the use of the support. Topics covered included patient safety, instrument traceability, care of sensitive materials, and operational efficiency.

Success indicators and evaluation

The intervention was evaluated using operational and qualitative indicators, with the aim of measuring the effectiveness of the standardized support for robotic graspers. One of the main indicators was the percentage of graspers prepared following the established protocol. After implementation, it was observed that more than 90% of the instruments were organized and disposed of according to the guidelines of the new support, demonstrating team adherence and the effectiveness of the standardization.

Another aspect evaluated was the average preparation time of robotic instruments, comparing the periods before and after the implementation of the support. Before the intervention, the average preparation time was approximately 35 minutes per set of graspers. After adopting the support, the time was reduced to about 25 minutes, representing a significant improvement in process efficiency without compromising quality or safety. Monitoring of non-conformities related to the cleaning and handling of instruments was also carried out. The records showed a significant reduction in reported failures, especially regarding the presence of residual moisture and inadequate organization of the graspers during preparation. This decrease reinforces the positive impact of the intervention on the safety and traceability of materials.

Figure 1. Support for robotic graspers. São Paulo, SP, Brazil, 2023



Source: Author's collection.

Finally, feedback was collected from the team involved in the process through informal conversations. The professionals reported greater ease in handling the instruments, better visualization during inspection, and greater confidence in performing the steps. The playful approach used in the training was also highlighted as a differentiating factor that contributed to engagement and understanding of standardized practices.

Figure 2. Support for robotic graspers. São Paulo, SP, Brazil, 2023



Source: Author's collection.

The implementation of standardized support for robotic graspers aims to achieve significant results in the context of perioperative nursing and materials management in the central sterile supply department. It is expected to reduce the risk of cross-contamination during instrument cleaning and preparation through efficient drainage of wastewater. The proposal also seeks to standardize workflow, promoting greater uniformity between shifts and teams. By optimizing positioning and drainage time, it is anticipated that the time required for instrument preparation will be reduced, contributing to faster processes. Furthermore, the support facilitates the training of new team members through a visual and practical approach and is a replicable solution for other hospital units facing similar challenges in robotic materials management.

Discussion

The implementation of standardized support for robotic graspers demonstrates the innovative capacity of nursing to develop practical solutions for complex challenges

in high-tech environments. Nursing, historically recognized for its adaptability and systemic vision, has expanded its role beyond direct care, taking a leading role in process management and the incorporation of technologies that promote safety and efficiency. According to a study⁷, the practical knowledge gained through experience is essential for clinical decision-making, especially in contexts that demand technical judgment and situational sensitivity, as is the case with robotic surgery.

Tools such as the developed support can be classified as process innovations, as they integrate into the institutional routine with a direct impact on patient safety. The literature indicates that the standardization of practices in the Central Sterile Supply Department contributes to the reduction of variability, rework, and errors. By allowing for the proper drainage of wastewater and organizing instruments safely, the support acts as a quality facilitator, promoting greater control over the preparation of materials and reducing the risk of cross-contamination².

Furthermore, the support proved effective as an educational tool, especially during the training of new employees. The playful approach, combined with visual standardization, favors learning and information retention, as argued by author⁸, who highlights the importance of meaningful and contextualized education. The ease of use reported by the team reinforces the tool's potential as a

pedagogical resource, capable of stimulating the engagement and autonomy of professionals.

It is noted that the initiative contributes to a culture of continuous improvement within the material and sterilization center, aligning with the principles of quality management and patient safety. The replicability of the model in other hospital units reinforces its strategic value, allowing good practices to be shared and adapted according to local needs. Thus, the experience demonstrates how the creativity and technical knowledge of nursing can generate sustainable and innovative solutions, with a direct impact on the care and management of health services.

Conclusion

The creation and standardization of robotic grasper support with wastewater drainage represents a significant innovation in perioperative nursing practice, integrating safety, efficiency, and standardization into a single device. This initiative demonstrates the nursing profession's ability to propose practical solutions to technological challenges, reinforcing its role as a key player in managing complex processes. In addition to contributing to improved quality of care and reduced risks, the developed support is a replicable model with potential application in other hospital centers that use robotic instruments, strengthening the culture of safety and continuous improvement in healthcare services.

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