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Relevant actions in the control of surgical site infections in neurosurgery: an integrative review

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ABSTRACT

Aim: to identify the knowledge produced and published regarding the most relevant actions in the control of surgical site infections (SSI) in neurosurgery amenable to intervention. **Method:** integrative review of articles published in Portuguese, English and Spanish in MEDLINE, CINAHL, LILACS, through the VHL, CAPES and PUBMED portals. **Results:** 23 publications were selected and analyzed, grouped into categories focusing on actions taken before, during and after surgery and surgical surveillance. **Discussion:** the non-operation of trichotomy, correct antibiotic prophylaxis, rigid aseptic technique in surgery, care with ventricular derivations, curative and postoperative surgical surveillance were considered relevant in the control of SSI in neurosurgery in the studies found. **Conclusion:** The evidence found will help to direct the actions of HICC nurses in the control of SSI in neurosurgery.

Descriptors: Neurosurgery; Surgical Wound Infection; Infection Control Services; Prevention & Control.

INTRODUCTION

Surgical site infections (SSI) occur at the site of surgical procedures and can affect the surface and deep layers of the incision, and the organs or spaces that have been manipulated or traumatized⁽¹⁾. Thus, by definition, SSIs are divided into superficial, deep, and organ/cavities⁽²⁾. The importance of this problem is that it is associated with increased morbidity, mortality, and an increase in hospital costs. SSIs also lead to an average increase of four to seven days in the length of hospital stay and these patients have twice the risk of dying, are twice as likely to be admitted to an intensive care unit, and have five times more chance of being readmitted after discharge^(3,4,5). In addition, there is the emotional and physical suffering of the affected patient due to prolonged illness and hospitalization, which causes more time away from their usual activities, social life and family disruption due to the worsening of their status and uncertainty concerning the health problem.

SSIs in neurosurgery are important infections in terms of their clinical severity. They are often associated with poor prognosis, high mortality and a large number of sequelae among survivors. These infections are subdivided into superficial wound infection, shunt infection or ventricular shunts, intraparenchymal abscess and meningitis⁽⁶⁾.

In neurosurgery, most procedures are considered "clean" in terms of the manipulation of sterile tissues. Failures in the processes involved in neurosurgery may be particularly important, and the implementation of strict procedures and monitoring by the Hospital Infection Control Commission (HICC) is essential. However, there are controversies as to the measures for controlling and preventing SSIs, and for the effective prophylaxis and management of these infections, with many recommendations and varying

degrees of scientific evidence. It has become necessary to seek the best evidence so that the HICC can effectively justify its operations and ensure effective results with regard to preventing these infections. The search will allow comparison, grouping and integration of information in order to support decisions on the operational focus of HICC. In this context, this study aims to identify the knowledge produced and published in national and international literature on the actions of greatest importance in the control of SSIs in neurosurgery that are amenable to intervention on the part of HICC nurses.

METHOD

This is an integrative literature review, which aims to synthesize multiple studies published on an issue and to identify gaps that need to be filled with new studies, and seek the best evidence for the chosen subject⁽⁷⁾.

To operationalize the review, the following steps were used:

- 1- Theme identification and selection of the research question;
- 2- Establishment of criteria for inclusion and exclusion of studies/sampling;
- 3- Definition of the information to be extracted from selected studies/categorization of studies;
- 4- Assessment of included studies;
- 5- Interpretation of results;
- 6- Presentation of review/knowledge synthesis⁽⁷⁾.

Online search for articles was conducted in order to answer the following research question: *What are the most relevant actions in terms of the control and reduction of SSI in neurosurgery that are susceptible to intervention on the part of HICC nurses?*

The search was conducted in the following databases: Latin American and Caribbean Health

Sciences (LILACS), Cumulative Index to Nursing and Allied Health Literature (CINAHL) and US National Library of Medicine (PUBMED) using the descriptors in health science (DeCS) *neurosurgery*, *Surgical Wound Infection* and *Infection Control*, with their translations standardized at the Medical Subject Heading (MESH) - *neurosurgery*, *Surgical Wound Infection* and *Infection Control* - and in Spanish - *neurocirugía*, *infección de la Herida* and *Control de infección*. Due to the specific characteristics of each database, search strategies were adapted according to the purpose and criteria for inclusion in this study. The search was conducted from January 15 to February 15, 2015. 2004 was established as the starting year for searches, and these continued through to 2015. The choice of this period is justified as 2004 was the year of release of the World Alliance for Patient Safety by the World Health Organization and one of the campaigns focused on was the surgical safety, including the reduction of infections related to surgery^(8,9).

Studies were selected using the following inclusion criteria: scientific articles, theses or dissertations published in English, Portuguese or Spanish that addressed measures for SSI control, prevention and surveillance in neurosurgery, and which are available in full on the selected databases through contact with authors or virtual viewing. They considered only studies involving brain surgery, with or without devices, and that exposed action with some influence on the incidence of SSI, subject to implementation, enforcement or monitoring by HICC. The excluded articles were those that addressed technical or surgical procedures, trauma surgery and emergencies, and which brought intrinsic risk factors for SSI, such as comorbidities and surgery time or independent factors of HICC actions such as pre and post operative hospital stay. Many texts with the SSI theme were found to relate to *S. aureus*, with protocols for control and surveillance of this

pathogen. However, we opted for their exclusion because of the specificity of the topic. Reports of informal cases, book chapters, reflection papers, news reports, newspaper editorials without a scientific character, and systematic and integrative reviews were also excluded.

The work was initiated by the PUBMED database, using the advanced form with combinations of descriptors. Sequentially, consultations were performed in the CINAHL, LILACS, CAPES, and VHL databases. The search was conducted by the descriptors individually, then the crosses were made using the Boolean operator and between the descriptors. A data collection instrument was used for evaluation of the selected publications. In it, items related to the article were placed, such as identification of the methodological characteristics as well as those related to the content, objectives, methods, interventions, and measured results found. After reading the full text of the selected articles, the items used to complete the assessment tool were extracted. Data were entered into a spreadsheet in Microsoft Excel 2007 format for descriptive analysis. For the evaluation of the scientific evidence level, the seven levels classification was used according to the categorization of the Agency for Healthcare Research and Quality (AHRQ)⁽¹⁰⁾.

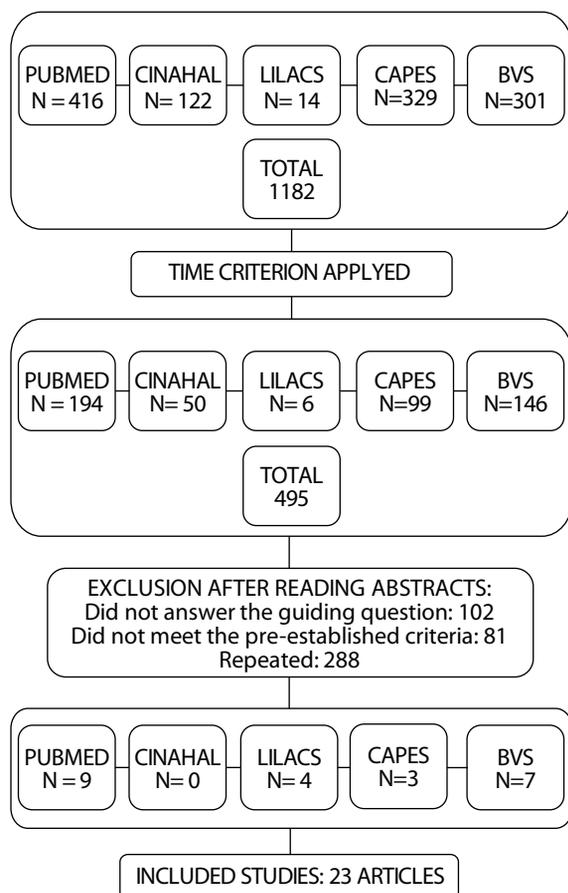
- Level 1 - systematic review or meta-analysis of relevant randomized controlled clinical trials or derived from clinical guidelines based on systematic reviews of randomized controlled trials;
- Level 2 - publications derived from at least one randomized controlled clinical trial clearly delineated;
- Level 3 - well-designed clinical trials without randomization;
- Level 4 - cohort studies and well-designed case-control studies;
- Level 5 - systematic review of descriptive and qualitative studies;

- Level 6 - descriptive or qualitative studies;
- Level 7 - the opinions of authorities and/or reports of expert committees.

RESULTS

After the crossings, 1,182 publications were found. At the end of the first stage (using the time criterion), 495 articles remained for analysis. Of these, 302 were selected for reading in full in accordance with the proposed objective. At this stage, the articles that failed to correspond to the research question or which did not meet the predetermined criteria were removed. At the end of the search, 23 articles were found. The selection process is shown in Figure 1.

Figure 1: Flowchart of study selection. Rio de Janeiro, 2015.



Source: prepared by the authors

The highest concentration of publications was in the US (N=6) and in Europe (N=8). Brazil was responsible for three publications. Most of the journals were developed by medical professionals. Nurses were responsible for the publication of five articles. Publications of other categories of professionals were not found. As to type of publication, all papers were scientific articles.

The Qualis-Periodicals is the set of procedures used by the *Comissão de Aperfeiçoamento de Pessoal do Nível Superior* (Capes) (Higher Level Personnel Improvement Commission) for stratifying the quality of the intellectual production of graduate programs. As a result, a list of the classification of vehicles used by graduate programs for the dissemination of its production is available. The classification of journals by Capes is performed for the areas of evaluation and is updated annually. These journals are classified in strata indicative of quality - A1 (the highest); A2; B1; B2; B3, B4; B5; C (with zero weight)⁽¹¹⁾. For journals that did not have the specified area "Nursing", we used the "Medical" area.

Table 1 shows the characteristics of the articles in terms of the name of the journal in which they were published, the year and the Qualis Capes grade, and the degree of evidence according to AHRQ.

Most of the articles were published in 2007 (N=9), with publications in almost every year of the period considered for this research. The articles were published in 16 journals. Of these, ten have a Capes Qualis "A" evaluation, considered the best scientific quality in publishing. As for the level of evidence of the articles, 14 journals were categorized as level 4, four as level 3, and five as level 2.

Table 1 - Identification of publications regarding the year, magazine, Qualis Capes, and level of evidence (N=23). Rio de Janeiro, 2015.

| Study | Magazine | Qualis | Year | Evidence level |
|--|--|--------|------|----------------|
| Study 1 - Craniotomy without trichotomy: analysis of 640 cases | Neuropsychiatric files | A1 | 2004 | 4 |
| Study 2- The importance of protecting surgical instrument tables from intraoperative contamination in clean surgeries | Latin American Journal of Nursing | A2 | 2013 | 2 |
| Study 3 - Dressing protocol in craniotomy: infection rate | São Paulo Acta nursing | A2 | 2004 | 4 |
| Study 4 - Is the trichotomy needed in the usual craniotomy practices? | Chilean Journal of Neurosurgery | B4 | 2007 | 4 |
| Study 5 -Prescription of prophylactic antibiotics for neurosurgical procedures in teaching hospitals in Iran | Americam Journal of Infection Control | A1 | 2007 | 4 |
| Estudo 6- Risk factors for neurosurgical site infections: an 18-month prospective survey | Journal of Neurosurgery | A2 | 2008 | 4 |
| Study 7- Zero tolerance to shunt infection: can it be achieved? | Journal of neurological and neurosurgical psychiatry | A2 | 2004 | 3 |
| Study 8- Risk factors and outcomes associated with surgical site infections after craniotomy or craniectomy | Journal of Neurosurgery | A2 | 2014 | 4 |
| Study 9- Effect of an intraoperative double-gloving strategy on the incidence of cerebrospinal fluid shunt infection | Journal neurosurgery pediatrics | B2 | 2006 | 3 |
| Study 10- Impact of surgical site infection surveillance in a neurosurgical unit | Journal of Hospital Infection | A1 | 2011 | 4 |
| Study 11- A standardized protocol to reduce pediatric spine surgery infection: a quality improvement initiative | Journal neurosurgery pediatrics | B2 | 2014 | 3 |
| Estudo 12- Surgical site infection surveillance for Neurosurgical procedures: A comparison of passive surveillance by surgeons to active surveillance by infection control professionals | Americam Journal of Infection Control | A1 | 2007 | 4 |
| Study 13- Risk factors for neurosurgical site infections after craniotomy: a critical reappraisal of antibiotic prophylaxis on 4,578 patients | British Journal of Neurosurgery | B2 | 2005 | 4 |
| Study 14- Shampoo after craniotomy: a pilot study | Canadian of neuroscience nursing | B4 | 2007 | 4 |
| Study 15- Sterile surgical technique for shunt placement reduces the shunt infection rate in children: preliminary analysis of a prospective protocol in 115 consecutive procedures | Child's Nervous System | B2 | 2007 | 2 |
| Study 16- Reduction in surgical site infections in neurosurgical patients associated with a bedside hand hygiene program in Vietnam. | Infection control and hospital epidemiology | A1 | 2007 | 3 |
| Study 17- Bandages, dressings, and cranial neurosurgery | Journal of Neurosurgery | A2 | 2007 | 4 |

| | | | | |
|---|---------------------------------------|----|------|---|
| Study 18- Risk factors for adult nosocomial meningitis after craniotomy: role of antibiotic prophylaxis | Neurosurgery | A2 | 2006 | 2 |
| Study 19- Does shaving the incision site increase the infection rate after spinal surgery? | Spine (Philadelphia PA. 1976) | B1 | 2007 | 2 |
| Study 20- Nonconcordance with surgical site infection prevention guidelines and rates of surgical site infections for general surgical, neurological, and orthopedic procedures | Antimicrobial agents and chemotherapy | A1 | 2011 | 4 |
| Study 21- A simple method to reduce infection of ventriculoperitoneal shunts | Journal neurosurgery pediatrics | B2 | 2010 | 2 |
| Study 22- Surgical safety checklist is associated with improved operating room safety culture, reduced wound complications, and unplanned readmissions in a pilot study in neurosurgery | Scandinavian Journal of Surgery | | 2013 | 3 |
| Study 23- Risk factors for surgical site infection following spine surgery: efficacy of intraoperative saline irrigation | Journal of neurosurgery: spine | B1 | 2007 | 4 |

Source: prepared by the authors

DISCUSSION

The results of this research were organized into four categories: actions in the preoperative period, actions in the intraoperative period, actions in the postoperative period, and surveillance. This last category was added due to its relevance in the context of the theme of this work and the number of publications found. Table 2 shows the articles divided according to the following categories:

Table 2 – Actions grouped into related categories to the Articles of integrative review. Rio de Janeiro, 2015.

| Categories | Actions | Article code | Total articles |
|--------------------------------------|---------------------------|-----------------------------|----------------|
| Actions in the preoperative period | Trichotomy | | |
| | Environmental cleaning | 1,2,4,19 | 4 |
| Actions in the intraoperative period | Paramentation | | |
| | Antibiotic therapy | 5,6,7,8,9,13,15,18,20,21,23 | 11 |
| | Surgical field irrigation | | |

| | Curative protocol | | |
|-------------------------------------|--|---------------|---|
| Actions in the postoperative period | Maintenance of External Ventricular Derivation (EVD) | 3, 14, 16, 17 | 4 |
| | Hair washing | | |
| Surveillance | Hand hygiene | | |
| | Passive surveillance versus active surveillance | 10,11,12,22 | 4 |
| | Verification list | | |
| | Protocol Implementation | | |

Category 1: Actions in the preoperative period

In this category we highlight trichotomy as a prevalent theme emerging in three of the four publications of this group. This is specifically related to the performance or non-performance of shaving the hair during craniotomy and in cervical spine surgery. These studies offer opposite results or outcomes that do not regard the practice of shaving in terms of the impact of SSIs. The findings of these productions corroborate that of other publications found, such as a systematic review which sought evidence concerning

the advantages and disadvantages of this practice. Overall, we studied 21 publications where the authors concluded that there is no evidence to support the routine performance of trichotomy in the preoperative period in neurosurgery for the prevention of SSI⁽¹²⁾.

Category 2: Actions in the intraoperative period

The largest number of articles found in this search referred to some action in the intraoperative period (11 articles). The publications in this category are divided basically into articles that sought evidence of the importance of the correct use of antibiotic prophylaxes, and articles focused on specific actions during the surgical procedure.

The correct surgical antibiotic prophylaxis depends on factors such as administration times during surgery, dosage and duration of treatment. Three selected articles aimed to analyze the impact on SSI of the correct use of antibiotics in neurosurgery. One of them (Study 13) found the absence of this practice as an independent factor for SSI and showed that the correct prophylaxis decreased the 9.7% infection rate to 5.8%. Yet another study cited a rate reduction by half in terms of superficial infections in neurosurgery, but without an impact on meningitis (Study 18). Reinforcing these findings, another study reports that prolonged antibiotic therapy for a period longer than the recommended time does not benefit patients, possibly leading to the resistance of microorganisms and increased costs without benefits in terms of reducing SSIs⁽¹³⁾.

The application of strict aseptic technique in the placement of external ventricular drainage (EVD) was applied in two studies (Studies 7 and 15): in England (2004) in adults, and in children in Belgium (2007). Both studies

have shown significant reduction in SSI rates when related to such drainage devices.

Two other productions in this category refer to interventions with the use of gloves: one (Study 9) showed a reduction of 50% of infections with the adoption of dual-use gloves for handling EVDs in the intraoperative period; the other proved the hypothesis that switching gloves when handling this device in the intraoperative period also reduces the incidence of SSI (Study 21).

The actions found in this category reinforce the need for the HICC to trace surveillance strategies in the intraoperative period. It is known that SSIs happen because of failures in processes carried out in the Surgery Center, which makes the nurse surveillance activities of HICC essential in this location⁽⁴⁾.

Category 3: Actions in the postoperative period

Emphasis on discussion regarding the care of wounds can be observed. Two articles discussed postoperative bandaging. The implementation of a curative protocol involving the maintenance of occlusive bandage until the stitches are removed, and head washing after 48 hours of surgery, showed no reduction of SSI in neurosurgery (Study 3). However, the choice of simple occlusion shows benefits compared to using crepe bandages (Study 17). Another analyzed study investigated hair washing in the postoperative period. The authors concluded that there was no benefit in terms of the reduction of SSIs due to the adoption of this practice.

The assistance provided in the postoperative period is almost in its entirety carried out, or prescribed, by nurses. Proper management of the incision can reduce SSI, and the early detection of signs and symptoms

related to SSI can be seen in daily patient care^(4,17). However, some specific knowledge in terms of infections in neurosurgery, such as infections related to EVD and meningitis should be the domain of these nurses⁽¹⁴⁾. The performance of HICC nurses also be supported by educational activities relating to the training of these professionals, with a view to obtaining lower SSI rates.

Category 4: Surveillance

Articles related to surveillance highlight the predominance of interest in comparing active surveillance of infections with passive surveillance in neurosurgery, and its reflection in the reduction of SSI (Studies 10 and 12). Both emphasized the difference in the SSI rates obtained when active and passive surveillance, which uses data reported by the surgeon, was carried out. It is also highlighted the advantage of active surveillance in terms of the educational activities that can be developed from the observed inadequacies of the data provided.

The implementation of standardized protocols has also been described as a factor leading to a decrease in SSI, as in the example of Article 11. Checklists have been successfully implemented to reduce risks to patients⁽⁴⁾. In a systematic review and analysis of 33 studies, the use of these lists was associated with an increased detection of potential security risks, and minor surgical complications, including SSI⁽¹⁶⁾.

CONCLUSION

The contribution of this study implies directing the actions of the HICC nurses with regard to the control of SSI in neurosurgery,

based on the best evidence presented, in order to optimize the time spent on these actions and get better results in the control of these infections.

Article derivative of the dissertation entitled "Instrument for control and prevention of surgical site infection".

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