A Cohort Study on Nurse-Led Checklist Intervention to Reduce Catheter-Related Bloodstream Infection in an intensive Care Unit

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Abstract

Background: Several collaborative studies have shown that infectious complications arising from the use of central venous catheters (CVC) in intensive care units (ICU) are preventable and that the implementation of a safety program can reduce the incidence of infection.

Objective: To structure, based on the best available scientific evidence, and evaluate the results of implementation by the nursing staff of a checklist to prevent these complications.

Methods: The sample analysed comprised 164 patients and was selected based on criteria of inclusion/exclusion. The accepted procedures and concepts were standardized, and both the questionnaire and the factsheets for the collection of clinical and laboratory data had been structured previously. The variables analysed in the study were: gender, age, duration of CVC maintenance, length of stay, mortality, type of condition on admission, type of dressing, chlorhexidine use, association with other concomitant venous access, anatomical region of CVC insertion, presence of consumptive disease, use of chemotherapy and awareness of the importance of professional intervention in implementing the checklist. The primary outcome measure was the presence or absence of bloodstream infection.

Results: Statistical analysis showed that the test and control groups were homogeneous. The study findings revealed significant differences ($p<0.05$) for the presence of bloodstream infection, length of hospital stay and the duration of catheter maintenance, in both the univariate analysis and the linear regression.

Conclusion: The application of the checklist used here prevents infection of the bloodstream by CVC and reduces the length of hospital stay as well as the duration of catheter maintenance, thus influencing the incidence of bloodstream complications.

Keywords: Checklist; Critical care; Catheter-related infection.

Introduction

This research, which focuses on the management in the care of health professionals in public hospitals is based on the structuring, implementation and analysis of the results of applying an auxiliary instrument in the prevention of bloodstream infection (ICS) associated with the use of central venous catheter (CVC), in patients in intensive care unit (ICU), the Municipal Hospital Cubatao-Pro-Health. The research protocol was reviewed by the ethics committees of the institutions involved in research and were included only adult patients study demonstrated, in its own way or through responsible favourably to the inclusion in the investigation.

In order to reduce the number of bloodstream infections of patients in adult ICU was implemented application by the nursing department of a checklist with daily procedures, with specific time to run in all patients with CVC. Thus our aim was to evaluate the results of the application by the nursing a checklist to prevent infection of the bloodstream through a central venous catheter, formulating the hypothesis that this conduct reduces its incidence in adult ICU.

Literature Revision

The incidence of complications related to the use of catheters varies considerably, depending on their type, frequency manipulation, the length of stay and patient-related factors. The choice of location, antisepsis, the manipulation of the CVCs, the bandage at the insertion site, catheter exchange, the care with the liquid and infusion systems (equipment, burette, extender and gathering cultures are steps important to consider in sepsis prevention programs related to the use of CVC [1,2].

A collaborative study of historical cohort, showed that the incidence of ICS by CVC in ICU was reduced significantly so, when measured by the number of events per 1000 catheter-days after the adoption of intervention based on the best evidence científica [3].

It is known that about 250,000 infections occur annually in patients undergoing intervention with CVC and 25% of these develop sepsis in intensive care units (ICU), totalling 31,000 deaths per year, only in the USA. In a recent review it was shown that the cost of these events to the health system of the USA could be estimated at about $ 9 billion [4-6].

Noteworthy in this respect a study of clinical trial type controlled multicentre, steps to reduce infections of the bloodstream by CVC in 45 ICUs in 35 hospitals belonging to two care systems to health in the USA. It was demonstrated in this study a causal relationship between the intervention and the reduction of ICS by CVC and sustained reduction after implementation of intervenção [7].

When we analysed the impact of an educational program on the prevention of infections associated with central venous catheters in paediatric intensive care units of university hospitals in our country it was concluded that a strategy focuses on the insertion and maintenance of venous access may decrease the infection rates associated with this acesso [8].

In a prospective, multicentre study in intensive care units also in our midst, it was concluded that when used for more than 13 days one CVC, especially those made up of multiple lumens, the likelihood of sepsis related to catheter can be up to three times maior [9].

In a recent report of the International Nosocomial Infection Control Consortium prospective data from 43 countries in Latin America, Asia, Africa and Europe on bloodstream infection associated with central venous catheters in intensive care units, it was observed in a total of 605,310 patients, incidence of 4.9 per 1000 cvc.dia, index considered five times greater than that calculated in the USA1 hospital environment.

Based on the guideline of the Center for Disease Control and Prevention, was structured in our midst, a protocol for the prevention of CCV infection in the ICU setting, emphasizing the importance of indicating the passage of the catheter, the separation of materials for nursing and the various steps catheter [10] the passing procedure.

When it investigated the bloodstream infection in paediatric units in Brazil revealed a significant microbiological, epidemiological and clinical, it was concluded that the most frequent (66.4%) was the central venous catheter, with high mortality, a large proportion of gram-negative bacilli with high levels of resistência [11].

The analysis of the impact of the recommended by INICC strategy to prevent infection of the bloodstream through a central venous catheter in intensive care units in developing countries showed that staff education involved in service, the periodic analysis of the results and the application protocols of shares reduced, significantly so, both the incidence and associated mortality in the first two years [2].

Methods

Type of study and sample

The model of research is prospective and controlled nature, setting up a study of the historical cohort. We considered patients in the control group those hospitalized, consecutively, the first 6 months of research and not subject to the checklist and how to test those hospitalized, also consecutively, in the second six months of the investigation and submitted the checklist performed by professional of ICU nursing. Regular meetings of all professionals involved in this security program, exposing them to the research development approaches, based on the best available scientific evidence on the subject of research were conducted. Primary endpoint and study variables.

The primary endpoint of this study is the incidence of bloodstream infection characterized by positive blood culture serially, the positive CVC material culture and identification of micro-organism. ICS carriers CVC patients were considered those that develop in the first two weeks after insertion of CVC. The following independent variables were analysed: gender, age, mortality, type of condition in hospital, anatomical region for insertion of the CVC, display or not the professional checklist of the applicator to the theoretical program of problem awareness, duration of CVC maintenance, occlusive dressing transparent film, local application of chlorhexidine, consumptive presence of terminal illness and use of other concomitant venous access.

Calculating the sample size

The calculation of sample size to estimate the number of patients to be inserted in each arm of the study was done assuming error of the type $\alpha=0.05$, β=Error type 0:20, the value ICS incidence difference by CVC 30% to 40% and by using dichotomous variables of the continuous type.

Statistical analysis

We used the Mann Whitney U test for comparisons between test and control groups. To see which variables were associated with bloodstream infection a rate was conducted a statistical linear logistic regression. Was adopted for these analyses the significance level of $p<0.05$.

Results

Table 1: Distribution of numbers, percentages and values of the medians of patients in test and control groups and their p values.

Variables	Test	Control	p
Male	57/82 (70%)	47/82 (57%)	0.093
Female	25/82 (30%)	35/82 (43%)	0.093
Age (years)	58.0±20.5	57.0±18.7	0.951
Infection Present	2/82 (2.50%)	31/82 (37.80%)	0
Maintenance (days)	10.0±1.14	10.0±18.2	0.235
Hospitalization time (days)	10.0±1.14	10.0±18.2	0.235
Mortality	32/82 (38.30%)	39/82 (47.60%)	0.232

(Table 1) shows the general data and the degree of homogeneity among patients from the test and control groups, according to the research protocol.

It is observed in the results of the univariate analysis that test and control groups showed no significant differences as compared to the variables considered except for the presence of bloodstream infection (p<0.000).

With regard to the other variables considered in this research as the type of condition in hospital, the type of applied dressing, use or not of chlorhexidine in place of the CVC insertion, the presence of other associated venous access, the anatomical region access central venous, the presence of consumptive disease, administration of chemotherapeutic agents and the professional intervention of awareness that applied the checklist, the overall analysis of the data showed homogeneity between the test and control groups.

Table 2: Regression analysis results logistics relating to the test and control groups.

Variables	With Infection	No Infection	p	Beta
Test	2.50%	97.50%	0	-0.44
Control	37.80%	62.20%	0	-0.44
Duration of CVC maintenance	22.0±22.3	9.0±9.6	0	0.39
Hospitalization time (days)	22.0±22.3	9.0±9.6	0	0.39

(Table 2) shows the results of logistic regression analysis, considering the maintenance time variables for catheter use and length of stay in the presence of bloodstream infection or without bloodstream infection.

It is observed in Table 2 presence of statistical significance on the analysis of the variables analysed for the presence or absence of bloodstream infection.

As for the culture of microorganisms found in the catheter tip and the serial blood cultures, the following types have been identified: Staphylococcus aureus, Acinetobacter baumannii, Pseudomonas aeruginosa, Mautophilia stenotrofomonas, Klebsiella pneumoniae and Enterococcus faecalis carbapenemase.

As regards the other variable accesses associated with CCV was found that in 16/82 (19.5%) patients of the test group it was present, while it was not observed in any of the patients from the control group. Regarding the anatomical structure vascular selected for insertion of the CVC, if the jugular or subclavian vein, it was observed that in the test group and control group the figures were equivalent 47 accesses have been made in the subclavian vein and 35 into the jugular vein for each group analysis.

Discussion

The intervention tool: checklist

The checklist term designates a working tool structured on a control sheet, which contains various behaviours or traits and aims to conduct a systematic observation. It can be translated as a checklist, or a control instrument consists of a set of behaviours, names, items or tasks that should be considered and/or followed. A checklist can be applied in various activities such as aviation, for example, where el consists of a core list that must be met before take-off and landing [2].

The research method and the possible causes of bias

The research design adopted for this research was the cohort in the historic mode, i.e., the control group was formed by the collection of previous data and the test group prospectively. It is important to emphasize that some authors report that the methodological limitations of the relevant studies are determined, in most cases, the ICU staff resistance to randomly allocate patients, preferring to apply the imediato [3] prevention tool.

Another aspect emphasized in the literature is possible underestimated account of the incidence of bloodstream infections in ICU related to the CVC and the lack of previous reference data as a basis for analysing the results of the implementation of the checklist, which can lead to a bias important mensuração [3]. It should be mentioned that the literature is often the absence of data identifying the causative microorganisms of ICS [12].

The results obtained in this investigation

We think that this research was highly feasible and with great potential to promote real impact on the health care of patients. Our findings and conclusions are similar to many others cited in the literature consulted [10,12].

These results were probably due to the increased adhesiveness and awareness of staff involved. It stands out in this latter regard the role of the nursing sector which represented a leading component in the various stages of the application procedure of the analysed intervention.

From both a clinical point of view of the results of statistical analysis employed we can infer that the intervention carried out, the hospital stay and the CVC dwell time can be regarded as determining factors in the results of the primary endpoint of our study. From a pathophysiological point of view, it is reasonable to assume that both the hospital stay as the CVC dwell time, the longer exposure of patients to the risks of infection are relevant to this event. This causal connection between the primary outcomes, however, and the study variables cannot be clearly demonstrated due to the methodological design of the study [12,13].

Implications for clinical practice and for research

The results of this investigation in terms of routine clinical practice, implies the need to adopt use of a checklist for the purpose of prevention of bloodstream infection related to the central venous catheter; the adoption of preventive measures of this same effect related to length of stay and duration of

CVC maintenance is also recommended. The organization of the working group consisting of several professionals, led by the nursing sector, regular consensus meetings and especially awareness of the issue raised, allowed to achieve the results pursued this research. The ideal way to avoid possible bias would be to conduct a prospective, randomized controlled. We not found in the literature, such studies addressing this research question.

Conclusion

We can conclude that application of the checklist prevents infection of the bloodstream through a central venous catheter and decreases the length of stay of patients and the duration of catheter maintenance, thus influencing the incidence of this complication in adult intensive care units.

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