Implementation of a checklist to prevent infections associated with central venous catheterization

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ABSTRACT

Background: Currently, worldwide policy on patient safety corresponds to a change in paradigm of international health programs. The World Health Organization leadership has provided methods and contents avoiding unnecessary and costly spill of resources when different views and an accelerated increase in knowledge on the topic arise.

Objective: The objective of this study is to propose and implement a checklist of measures that could decrease the frequency of bloodstream infections associated to central venous catheterization (CVC). **Methods:** A prospective study divided into two stages: (a) design of a checklist that included 17 variables for CVC and (b) implementation of the checklist in the adult intensive care unit, from October 2016 to April 2017. **Results:** The global efficiency index was 97.2%. The total efficiency index per stage of the procedure was 98.6% before insertion, 98.3% during insertion, and 88.2% after insertion. **Conclusions:** The identification of risk factors in CVC allows the development of practice protocols which could decrease the frequency of adverse events. (Hosp Med Clin Manag. 2018;11:8-12)

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RESUMEN

Introducción: Actualmente la política mundial sobre seguridad del paciente corresponde a un cambio de paradigma en los programas de salud a nivel internacional. El liderazgo de la Organización Mundial de la Salud (OMS) ha aportado métodos y contenidos que han evitado un desbordamiento de recursos innecesario y costoso, frente a la gran diversidad de enfoques y a la producción acelerada de conocimientos respecto al tema. **Objetivo:** Proponer e implementar una lista de verificación mediante un formato que favorezca la disminución de infecciones del torrente sanguíneo asociadas a la colocación de acceso venoso central. **Material y métodos:** Estudio prospectivo dividido en dos fases: a)

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diseño de un instrumento llamado lista de verificación para la instalación del catéter venoso central (CVC). b) implementación en el período de octubre de 2016 a abril del 2017, aplicando 51 listas de verificación en la Unidad de Cuidados Intensivos de Adultos. **Resultados:** Se obtuvo un índice de eficiencia global de 97.2%, e índice de eficiencia total por etapa de 98.6% antes de la inserción, 98.3% durante la inserción y 88.2% después de la inserción. **Conclusiones:** El conocimiento de los factores de riesgo en la colocación de un acceso venoso central nos permite establecer protocolos de práctica que reducirán la ocurrencia de eventos adversos.

Palabras clave: Auditoría clínica. Evento adverso. Catéter venoso central. Cuidados Intensivos. Infecciones de torrente sanguíneo.

INTRODUCTION

Due to its complexity and expanse, along with patient vulnerability, health care is not risk free. The identification of risks in health organizations allows for the establishment of control programs or strategies to decrease or eliminate such risks; in hospitals, most risks are not timely identified or not known in depth¹. However, these problems may lead to continuous improvement in the organizations.

Currently, worldwide policy about patient safety follows a change in the paradigm in international health programs². The World Health Organization (WHO) leadership has provided methods and contents avoiding unnecessary and costly spill of resources when different views and an accelerated increase in knowledge about the topic appear.³

As it is currently proposed worldwide, and since the implementation of hospital certification in Mexico⁴, the main goal of patient safety programs is to identify potential risks to prevent adverse events (AE), i.e., risk management^{2,5}.

An important factor to improve safety assessment is to obtain information about the occurrence of adverse and sentinel events. Unfortunately, in many countries, these records are only kept in isolated health institutions. Despite the efforts to improve safety assessment in Mexico, there is no federal mandatory surveillance system that could produce a national record.

In 2010, a study was conducted by the Ministries of Health and Social Policy from Spain, Mexico, Peru, Argentina, Costa Rica, and Colombia in collaboration with the World Alliance for Patient Safety of the WHO and Pan American Health Organization¹. The objective of the study was to gain knowledge on the frequency of AE in their hospitals, to advise decision makers on strategic policies to improve patient safety. The study found an incidence of AE of 28.9%, with a higher risk in surgical services and

Intensive Care Units (ICU), with associated variables such as emergency admission, hospital stay, exposure to invasive procedures, or any comorbidity that could increase health-care risk. In agreement with the study of AE detected, all of them were related to care (16.24%), medication usage (9.87%), nosocomial infection (35.99%), any other procedure (26.75%), and an erroneous diagnosis (5.10%). Other frequent AEs were pressure ulcers (8.92%), surgical wound infections (7.96%), nosocomial pneumonia (6.37%), sepsis or bacteremia (6.37%), and phlebitis (5.73%), with a total of 35.4% AE identified. In incidental cases as well as prevalent ones, it is important to proceed on nosocomial infections and care-related AE¹.

Another important source of AE is a summary published by The Joint Commission International, with information from 2014 to 2016 on the main sentinel events in their network, including events associated to nosocomial infections⁶.

Some tools have been designed to improve care and cooperation with organizations looking for safe procedures for their patients. One of these tools is the checklist, used for the first time in 1935 in aviation to standardize procedures. This tool has been successfully employed to decrease AE in surgery (safe surgery) and bloodstream infections (BSIs), among others⁷.

Several organizations, including the WHO, have demonstrated that safety and prevention of the risks affecting the patient's well-being and life could be improved through the use of checklists during surgical procedures. Thus, the existence of a prospective surveillance system is very important to evaluate infections and other AE associated to vascular catheters⁸.

In Mexico, the Epidemiologic Surveillance Hospital Network (Red Hospitalaria de Vigilancia Epidemiológica, RHOVE), in a recent report from 2015, identified BSI associated to vascular line as the first kind of usual infection, related

Table 1. Checklist variables

Step of the procedure	Variable
Before insertion	Identify patient correctly?
	Verify that patient or relative has signed informed consent?
	Evaluate insertion site?
	Patient's correct position for procedure?
	Wash hands with water and soap, alcohol?
	Prepare skin with chlorhexidine?
	Allow antiseptic drying before function?
	Use complete body surgical field for the patient?
	Use facemask, gloves, and head cap?
During insertion	Personal in charge of insertion uses facemask, gloves, head cap, and sterile robe?
	Maintains a sterile field?
	Team participating in insertion uses facemask?
	Stitch is used to fix catheter?
	Use semipermeable sterile bandage?
After insertion	Bandage was placed with sterile technique?
	X-rays are taken and tip of catheter is verified within the first 24 h? (number of hours_____)
	Catheter opening is recorded?

to an increased risk of hospital stay and death. Moreover, an important conclusion to this report was that complications are highly preventable. For these reasons, BSI could be considered a public health problem for our country.

At Hospital Juárez, one of the largest general hospitals in Mexico, BSI associated to vascular line is a priority as an AE associated to health care, and in our records, it is the third type of nosocomial infections according to the site of infection.

For this reason, we designed and implemented a checklist to modify the course of BSI in our hospital. In addition, we implemented the Bacteremia Zero National Strategy in its six components.

METHODS

Study design

The study was divided into two stages. The first stage included the design of a checklist for central venous catheterization (CVC). It was used in the adult ICU (AICU) during 1 week, after which suggestions for improvement were incorporated.

The checklist for CVC included 17 variables (Table 1) comprising a global efficiency index (GEI), a total efficiency index per stage (TEI), and an efficiency index per

activity (EIA). Within the tool, the procedure was divided into three sections: before, during, and after insertion. To decrease the risks during the procedure, the Center for Diseases Control and Prevention (CDC) recommendations as well as national guidelines and strategies were considered in the checklist development.

In the second phase, the tool was compulsorily applied in the AICU. This unit was selected since it is a critical service with well-identified and controlled patients. The checklist was applied during 7 months, from October 2016 to April 2017.

Data collection

AICU nurses collaborated with medical personnel in installing CVC following the checklist, so a teamwork was assured. The studied variables are listed in table 1.

The catheter clinic verified the information and turned it to the Epidemiological Surveillance Unit, where it was recorded. AICU patients were followed up through an active epidemiological surveillance format.

Outcomes

The objective was to reduce BSI associated to vascular line in AICU using the checklist to improve good practices, comparing with a similar period previous to implementation.

Statistical analysis

The checklists for 50 CVC procedures performed between September 2016 and April 2017 were analyzed. Checklist variables were recorded, measuring frequencies and completeness of the checklist correlating with BSI. Univariate analysis was performed with SPSS v.18 for the procedures from January 2015 to June 2017, considering that the measures taken to prevent BSI started in September 2016. The t-test was used for a sample of cases and BSI rates, per 1000 CVC days for the 30 months, observed. Excel v.2017 was used to create graphs of BSI cases and rates per 1000 CVC days.

RESULTS

From October 2016 to April 2017, 51 checklists for CVC were applied in the AICU; 50 of them were completed (98%) and one did not report the name of the physician responsible.

The GEI was 97.2%, and TEI per stage was 98.6% before insertion, 98.3% during insertion, and 88.2% after insertion.

Data according to the stage were analyzed for each variable, with the following EIA.

Before the procedure

A TEI of 98.6% was obtained when preparing to insert the catheter; a failure was recorded in six cases (1.4%).

Three failures (6%) occurred when validating the existence of a signed informed consent form for CVC; all of them occurred during the night duty.

In one case (2%), it was impossible to place the patient in a correct position for insertion, due to the subject's hemodynamic status.

In two of them (4%), a complete body surgical field was not used in the patient.

During insertion

The TEI obtained was 98.3%, with the following failures: in 2 cases (4%), a sterile field was not preserved. In one case (2%), there was a failure using the face mask by the team

participating in insertion, and in two of them (4%), transparent bandage was not placed with a sterile technique.

After insertion

TEI obtained was 88%, showing the lowest accomplishment, with the following results. In six cases (12%), X-ray post-insertion was taken 62 h after catheter placement. A failure was observed also in six cases (12%) when recording catheter opening.

Table 2 shows that the decrease in cases of BSI over the study period is not random, while figure 1 shows a trend to decrease during the same period.

DISCUSSION

In October 2004, the WHO proposed the World Alliance for Patient Safety and the "Safe Surgery Saves Lives" campaign started in 2007. In 2008, a safety checklist was created to reinforce the already accepted safety practices and promote the communication and teamwork among different clinical disciplines⁹.

Just like the Safe Surgery Checklist was intended to improve the safety of surgical patients and decrease preventable complications and deaths by professionals involved; a checklist for CVC was designed as a reference to decrease risks during this procedure. Its content was built on recommendations based on evidence. The implementation of the checklist in the present trial allows to focus on specific areas to improve the catheterization procedure since the results obtained point to mistakes in its execution.

CDC guidelines include the following recommendations: hand hygiene for insertion, maintain and replace any catheter (AI category), skin antisepsis should always be done before catheter insertion using preferably a 70% alcohol solution combined with 2% chlorhexidine gluconate solution (AI category), maintain an aseptic technique for intravascular insertion and catheter care (BI), use barrier methods to guarantee a maximum sterile medium (robe, face mask, head cap, and sterile clothes covering the field as much as possible) for CVC (AI category), and use bandages with sterile dressing or sterile semipermeable transparent bandage to cover catheter insertion place (AI category)¹⁰. All of these items were included in the checklist designed in this study.

Table 2. Statistical analysis

Variable	T	gl	Sig. (bilateral)	Mean differences	95% confidence interval for mean differences	
					Lower	Upper
Cases	4	29	0.000	0.533	0.261	0.806
Days CVC	17.58	29	0.000	182.267	161.069	203.464
BSI rate ×1,000 days CVC	1.98	29	0.056	6.056	-0.170	12.284

A $p < 0.05$ in these cases demonstrates such decrease was not by chance.

Figure 1. Bloodstream infection trend from January 2015 to June 2017.

The percentage of accomplishment showed that checklists are a useful reference to the procedure, allowing for each feature to be analyzed separately and give the proper recommendations to implement corrective measures. However, results of the present trial should be confirmed in a future study with a larger sample size to validate the checklist and suggest its generalized use.

CONCLUSIONS

Identification of the risk factors involved in CVC enables the design of practice protocols to reduce the occurrence of AE related to the insertion of these devices. Furthermore, health-care teamwork should share responsibilities to apply and fulfill actions to guarantee positive results. Finally, the checklist for CVC is a safe, efficient, and useful control system since it identifies situations of risk, which could lead to complications and/or AE. Its implementation could reduce hospital stay and morbimortality, improving the quality of health care. Likewise, it is important to mention an educational process in all areas involved to achieve a culture of patient safety, using specific evidence-based practice approaches like the one presented here.

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