



Prevalence of Aneurysmal Subarachnoid Hemorrhage Safety Indicators and Their Relation with Health Care Outcomes in a Mexican Population

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■ **BACKGROUND:** Aneurysmal subarachnoid hemorrhage (ASAH) is a serious and unstable condition. Patient safety indicators (PSI) are a group of potentially preventable events in patient health care. The aim of this study is to determine the prevalence of 8 relevant PSI in a group of patients with ASAH and their relation with 2 health care outcomes.

■ **METHODS:** We performed a retrospective review of all patients admitted with ASAH. A total of 35 patients were selected with the following variables: age, sex, Hunt and Hess scale at admission, brain aneurysm treatment, length of hospital stay, and Glasgow Outcome Scale (GOS) score with the presence or absence of all 8 PSI: decubitus ulcer, pneumothorax, bacteremia, perioperative hematoma, post-operative respiratory failure, deep vein thrombosis (DVT), pulmonary thromboembolism, and accidental puncture or laceration.

■ **RESULTS:** Average age (\pm standard deviation) was 53 \pm 13.9 years, with a female predominance of 63%. The most common PSI was decubitus ulcer followed by central line-related bacteremia. Prolonged hospital stay was increased for inpatients with DVT. Males had a risk effect (odds ratio, 6.25) in relation to the appearance of pulmonary thromboembolism as well as a poor neurologic condition according to the GOS (GOS score <4) related to the appearance of DVT (odds ratio, 8.0).

■ **CONCLUSIONS:** In our study population, we found 3 PSI related to a poor outcome measured with the GOS or to a longer hospital stay: decubitus ulcer, central line-related

bacteremia, and DVT. PSI have been academically considered as useful tools in clinical, epidemiologic, and research outcome scenarios. An adequate prevention protocol for these indicators could produce better outcomes in medical care for patients with ASAH.

INTRODUCTION

A neurysmal subarachnoid hemorrhage (ASAH) is a serious and unstable condition representing ~6% of patients admitted with diagnosis of stroke.¹ Despite significant advances in the treatment of other vascular problems during the last 10 years, specifically for atherothrombotic cerebral infarction, treatment for patients with ruptured and unruptured aneurysms is still a challenge.² Although medical and surgical treatments have reduced mortality in recent years, the mortality for ASAH decreases 0.5% per year, representing a cumulative reduction of 15% during a 30-year period.³ It is estimated that 12% of patients with ASAH die before receiving medical care and that ~40% of those receiving medical attention die despite medical and surgical efforts.³

The Agency for Healthcare Research and Quality of the U.S. Department of Health and Human Services has defined patient safety indicators (PSI) as a group of preventable and potentially preventable events in patient health care that, when present, have an impact on increasing hospital expenses, longer hospital stays, and increasing mortality.^{4,5} The purpose of these indicators is to serve as a research tool to potentially detect safety problems for patients, offer new insight in the adverse impact of medical errors, and improve measurement references in quality processes.⁶ Adequate prevention of PSI can offer a better outcome.⁷

Key words

- Glasgow Outcome Scale
- Intracranial aneurysm
- Patient safety indicator
- Subarachnoid hemorrhage

Abbreviations and Acronyms

- ASAH:** Aneurysmal subarachnoid hemorrhage
- CLRB:** Central line-related bacteremia
- GOS:** Glasgow Outcome Scale
- OR:** Odds ratio
- PSI:** Patient safety indicators
- PTE:** Pulmonary thromboembolism

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PSI have been validated in multiple clinical scenarios such as pediatrics, pediatric surgery, abdominal surgery, and oncology and in incidental aneurysms.^{5,7-11} In incidental aneurysms, 8 relevant PSI have been identified: decubitus ulcer, pneumothorax, bacteremia, perioperative hematoma, postoperative respiratory failure, deep vein thrombosis (DVT), pulmonary thromboembolism (PTE), and accidental puncture or laceration.¹² However, prevalence of these indicators in ASAH is unknown as is whether the occurrence of these PSI has an influence in treatment outcome.

The aim of this study is to determine the prevalence of 8 relevant PSI in a group of patients with ASAH treated at our center and to determine their relation with 2 health care outcomes: the Glasgow Outcome Scale (GOS) on discharge and length of hospital stay.¹³

METHODS

Patients

We reviewed the clinical history of patients admitted with ASAH in our center between January 2005 and December 2014. Exclusion criteria were terminal conditions associated with ASAH, patients who were not hospitalized for treatment of brain aneurysm, patients who refused treatment, patients who died after receiving treatment, patient aged <18 years or >85 years, and incomplete clinical files. Eighty-four files were eligible and only 35 patients were selected from a simple random sampling. Institutional review board approval was obtained for this study before accessing a patient's clinical chart.

Analyzed Variables

We obtained the following variables from the clinical files: age, sex, Hunt and Hess scale at admission, brain aneurysm treatment, length of hospital stay, and GOS score.^{13,14} We also registered the presence or absence of all 8 PSI: decubitus ulcer, pneumothorax, bacteremia, perioperative hematoma, postoperative respiratory failure, DVT, PTE, and accidental puncture or laceration.¹²

Statistical Analysis

SPSS software version 15.0 (IBM Corp., Armonk, New York, USA) was used for statistical analysis. Categorical variables were described using absolute values and compared between groups using χ^2 or the Fisher exact test. Normally distributed numerical variables ($P > 0.1$ with the Kolmogorov-Smirnov test) were described using mean and standard deviation and compared between groups with the presence or absence of PSI using a t test for independent samples.

To determine variables independently associated with the presence of a PSI, univariate analysis with logistic regression was performed. In each regression model, the dependent variable was a PSI (present or absent) and predictive variables (independent) were age (years), length of hospital stay (weeks), male (yes or no), Hunt and Hess grades III and IV on admission (yes or no), and GOS score <4 (yes or no).

RESULTS

Average age (\pm standard deviation) was 53 ± 13.9 years. Twenty-two patients were female (63%). More than two thirds were admitted with Hunt and Hess grades II and III and most were treated

surgically (69%). Treatment results with GOS were as follows: GOS score 5, 18 (51.4%); GOS score 4, 10 (28.6%); GOS score 3, 4 (11.4%); GOS score 2, 2 (5.7%); GOS score 1, 1 (2.9%), indicating that 80% of patients returned to their activities of daily living.

Table 1 shows the prevalence for each PSI. The most common PSI was decubitus ulcer followed by central line-related bacteremia (CLRB). The least common PSI was accidental puncture or laceration.

Patients with decubitus ulcer had a longer hospital stay than patients without this PSI. In patients with CLRB, more cases had poor or very poor Hunt and Hess grade on admission and a longer hospital stay than those without bacteremia. There were no differences in characteristics for patients with or without pneumothorax and those with a perioperative hematoma (**Table 2**).

Compared with patients who did not present with DVT, patients who did present with this PSI were older. Most had a poor or very poor Hunt and Hess grade on admission. They had a longer hospital stay and there was a larger proportion of patients with GOS score <4. In patients with PTE, a larger proportion of males did not show this. There were no differences in characteristics for patients with or without postoperative respiratory failure or accidental puncture or laceration (**Table 3**).

We found a significant odds ratio (OR) ($P \leq 0.05$) for the following variables: OR 1.57 for hospital stay, average in weeks, in relation to decubitus ulcer; OR 6.61 for Hunt and Hess grades III and IV in relation to CLRB, and 14 related to DVT; and OR 2.37 for weeks of hospital stay in relation with DVT.

Males had a risk effect (OR, 6.25) in relation to the appearance of PTE as well as a poor neurologic condition according to the GOS (GOS score <4) related to the appearance of DVT (OR, 8.0). We did not find a significant statistical relationship in the univariate logistic regression analysis of the following PSI: pneumothorax, perioperative hematoma, postoperative respiratory failure, or accidental puncture or laceration (**Figure 1**).

DVT was the only PSI with more than 2 variables with a significant OR in the univariate logistic regression model. The significant OR was calculated with a multiple logistic regression model that included all variables with $P < 0.05$ in the univariate analysis. None of the variables had a significant OR value after multivariate analysis, suggesting that the association of the other variables with the PSI was not independent.

Table 1. Prevalence of Patient Safety Indicators

	Number	Prevalence (95% Confidence Interval)
Decubitus ulcer	12	34 (9–50)
Pneumothorax	6	17 (5–30)
Central line-related bacteremia	9	26 (11–40)
Perioperative hematoma	6	17 (5–30)
Postoperative respiratory failure	6	17 (5–30)
Deep vein thrombosis	8	23 (9–37)
Pulmonary thromboembolism	7	20 (7–33)
Accidental puncture or laceration	3	9 (0–18)

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