Secondary Insults Related to Nursing Interventions in Neurointensive Care: A Descriptive Pilot Study

CE 2.0 ANCC Contact Hours

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ABSTRACT

The patients at a neurointensive care unit are frequently cared for in many ways, day and night. The aim of this study was to investigate the amount of secondary insults related to oral care, repositioning, endotracheal suctioning, hygienic measures, and simultaneous interventions at a neurointensive care unit with standardized care and maximum attention on avoiding secondary insults. The definition of a secondary insult was intracranial pressure > 20 mm Hg, cerebral perfusion pressure < 60 mm Hg and systolic blood pressure < 100 mm Hg for 5 minutes or more in a 10-minute period starting from when the nursing intervention began. The insult minutes did not have to be consecutive. The study included 18 patients, seven women and 11 men, aged 36–76 years with different neurosurgical diagnoses. The total number of nursing interventions analyzed was 1,717. The most common kind of secondary insults after a nursing measure was high intracranial pressure (n = 93) followed by low cerebral perfusion pressure (n = 43) and low systolic blood pressure (n = 14). Repositioning (n = 39) and simultaneous interventions (n = 32) were the nursing interventions causing most secondary insults. There were substantial variations between the patients; only one patient had no secondary insult. There were, overall, a limited number of secondary insults related to nursing interventions when a standardized management protocol system was applied to reduce the occurrence of secondary insults. Patients with an increased risk of secondary insults should be recognized, and their care and treatment should be carefully planned and performed to avoid secondary insults.

Keywords: neurointensive care, nursing interventions, secondary insults

The Department of Neurosurgery at Uppsala University Hospital receives patients from a region with a population of 1.9 million. Most patients are secondary admissions from local hospitals in the region. At a neurointensive care (NIC) unit, there are patients with different neurosurgical diagnoses, for example, traumatic brain injury, intracerebral hemorrhage, and subarachnoid hemorrhage. These patients have a primary injury causing cellular damage, and the outcome depends partially on the amount of primary cell death. It is well known that cell death will continue several days after the primary injury and that this is caused by two different reasons: destructive biochemical and inflammatory processes and secondary clinical insults. Secondary insults can be both systemic (e.g., hypoxia, hypercapnia, and hypotension) and intracranial (e.g., intracranial hypertension, seizures, and vasospasm; Maas, Dearden, Servadei, Stocchetti, & Unterberg, 2000). The amount of secondary injury will strongly influence the patients' outcome. There have been several clinical trials with neuroprotective drugs that have failed (Narayan et al., 2002), and prevention of secondary insults is still a cornerstone in the management of NIC patients. Implementation of a secondary insult prevention program leads to substantial improvement in outcome (Elf, Nilsson, & Enblad, 2002).

The patients at an NIC unit are frequently cared for in many ways, day and night. Tume, Baines, and Lisboa (2011) studied what effects nursing interventions had on pediatric patients with traumatic brain injury. They studied nonurgent endotracheal suction, repositioning, eye care, oral care, and washing the children's bodies and how the intracranial pressure (ICP) was affected.

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There were significant changes from baseline to maximal ICP when nonurgent endotracheal suction and repositioning were performed, but only 4 of 24 children had ICP > 20 mm Hg for more than 5 minutes (median time = 3 minutes) after suction. After repositioning, the median time to recover back to baseline was 5 minutes, and 7 of 21 children had an ICP > 20 mm Hg for more than 5 minutes. Oral care did not affect ICP when ICP was monitored 30 minutes before, during, and 30 minutes after oral care (Prendergast, Hallberg, Jahnke, Kleiman, & Hagell, 2009). When studying planned endotracheal suction in adults with severe head injuries, Gemma et al. conclude that it can be done without risk for secondary insults if the patients have a level of sedation that precludes moving or coughing (Gemma et al., 2002).

All nursing interventions are made with the aim to benefit the patient; oral care, for example, is made to prevent ventilator-associated pneumonia. When caring for patients at an NIC unit, nursing interventions can result in a secondary insult, and it is the nurses' responsibility to monitor and observe if a secondary insult occurs and interrupt it adequately (Walleck, 1992). It is the nurses' obligation to achieve a balance between prevention of secondary insults and nursing interventions. This balance gives the patient the best possibility to recover (Chamberlain, 1998).

The aim of this study is to investigate the amount of secondary insults related to oral care, repositioning, endotracheal suctioning, hygienic measures, and simultaneous interventions in an NIC unit with standardized care and maximum attention on avoiding secondary insults. The ultimate goal is to develop routines to minimalize the occurrence of secondary insults related to nursing interventions.

Methods and Materials

Study Design

A quantitative prospective observation study was used to investigate the amount of secondary insults related to nursing interventions.

Patient Sample

All consecutive neurosurgery patients older than 18 years who had been monitored with ICP registration and intubated more than 24 hours from May 7 to June 28, 2011 at the NIC unit, Uppsala University Hospital, Sweden, were identified and included in this study. Eighteen patients were included during this period. The patients remained in the study while they were intubated and had ICP monitoring, but for a maximum of 7 days. When a patient had ICP monitoring from both a parenchymal probe and a ventricular drainage, the ICP value was taken from the ventricular drainage.

These authors investigate the degree to which routine nursing care and interventions potentially increase the occurrence of secondary neurologic insults in patients in intensive care settings.

Standardized Management Protocol System and Treatment Goals

Routines and treatment goals at the NIC unit in Uppsala are described in a standardized management protocol system, which is based on good laboratory practice principles (EPA US, 2007). This system is developed and maintained by doctors and nursing staff together. The treatment and care of these patients are focused on avoiding secondary insults. There are, for example, treatment goals of ICP < 20 mm Hg, cerebral perfusion pressure (CPP) > 60 mm Hg, and systolic blood pressure (SBP) > 100 mm Hg written in the standardized management protocol system. How to perform several nursing interventions is also described in the standardized management protocol system, for example, endotracheal suctioning, oral care, and hygiene routines.

Nursing Interventions

At the NIC unit, a licensed intensive care nurse with 4 years of university education is responsible for all nursing interventions. At their disposal are licensed practical nurses. One intensive care nurse and one licensed practical nurse take care of two patients. There are standardized management protocols at the NIC unit describing the importance of giving extra sedation and pain relief to the patients before and during a nursing intervention. As a standard, the patients receive continuous infusion of propofol (maximum of 4 mg/kg/h) for sedation and morphine chloride for pain relief. When a nursing intervention is performed on a patient with an opened ventricular drainage, the drainage should be closed during the intervention according to the routine at the NIC unit. When the intervention is finished and the patient is calm and not coughing, the ventricular drainage is opened again.

This study analyzed four nursing interventions: oral care, repositioning, endotracheal suction, and hygienic measures.

Oral care is performed three times a day with a toothbrush and toothpaste, and after that, foam swabs are used to cleanse the mouth. Chlorhexidine is used four times a day, separately, and it is applied with a foam swab, but this routine is not included in this

study. The patients are repositioned by two persons approximately every 2 hours as a routine. They are positioned in right and left lateral positions, in supine position, and very rarely, in prone position, but always with the neck stretched to avoid venous stasis. Their heads are elevated 30° except for patients experiencing a subarachnoid hemorrhage with clinical signs of vasospasm, who are positioned flat. Endotracheal suction is only performed if necessary, on occasions with decreasing saturation, increasing peak pressure in the ventilator, coughing, or sounds from the endotracheal tube. Strict hygiene, a negative pressure of 20 cm H_2O and as short a procedure (10–15 seconds) as possible are prescribed in the standardized management protocol system (Gemma et al., 2002). The patients' bodies are washed in bed by one or two persons with washcloths every morning and evening and when necessary.

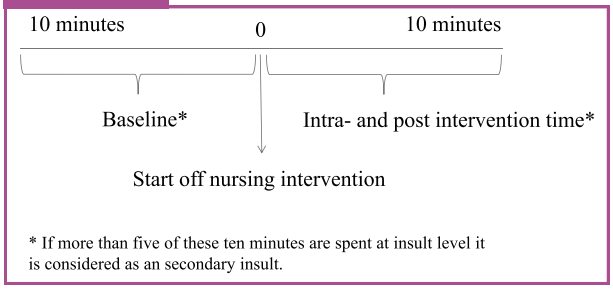
Secondary Insult Definition and Quantification

Secondary insults are described in different ways in many studies. One way to define a secondary insult is that it has occurred if the treatment goals have not been achieved for 5 minutes or more (Jones et al., 1994). This study observed how often a nursing intervention resulted in a secondary insult with the definition of ICP > 20 mm Hg, CPP < 60 mm Hg, or SBP < 100 mm Hg for 5 minutes or more in a 10-minute period starting from when the nursing intervention begins. The insult minutes do not have to be consecutive (Figure 1).

Study Design

All patients at the NIC unit in Uppsala are connected to a monitoring system that collects and stores monitoring data every minute, with exact indication of time, and makes it possible to study physiological monitoring parameters in real time or retrospectively. In this study the intensive care nurses and the licensed practical nurses were instructed to write in the bedside computer the exact time when they performed a nursing intervention as well as what kind of intervention. After collecting all time points when nursing interventions had taken place, each occasion was inspected separately to find out if a secondary insult had occurred (Figure 1). If the abnormal values existed for more than 5 minutes in a 10-minute period before the intervention, a secondary insult was considered as already ongoing and not related to the intervention (Figure 1). If a new intervention was started within 5 minutes of when the first intervention was initiated, the intervention was labeled as a simultaneous intervention because it was impossible to know which of the interventions had influenced the patient.

FIGURE 1 Outline of the Study and Definition of a Secondary Insult



Ethics

The study was approved by the local ethics committee.

Results

Patient Characteristics

The study included 18 patients. There were seven women and 11 men aged 36–76 years (mean = 56.6 years, *SD* = 10.8 years). On admission to the NIC unit, the mean Glasgow Coma Scale-motor was 5.28 (*SD* = 0.96), and at discharge, the mean Glasgow Coma Scale-motor was 5.44 (*SD* = 0.98). The diagnoses among these patients were subarachnoid hemorrhage ($n = 8$), traumatic brain injury ($n = 4$), intracerebral hemorrhage ($n = 3$), malignant middle cerebral artery infarction ($n = 2$), and thalamic infarction ($n = 1$; Table 1).

Secondary Insults Related to Nursing Interventions

The total number of nursing interventions analyzed was 1,717: oral care ($n = 171$), repositioning ($n = 571$), endotracheal suction ($n = 393$), hygienic measures ($n = 93$), and simultaneous interventions ($n = 489$; Table 2). The most common kind of secondary insults totally after all nursing measures were high ICP ($n = 93$) followed by low CPP ($n = 43$) and low SBP ($n = 14$; Table 2). Repositioning ($n = 39$) and simultaneous interventions ($n = 32$) were the nursing interventions causing most secondary insults. There were substantial variations between the patients, where only one (patient no. 3) had no secondary insults (Figure 2). Three patients (nos. 2, 12, and 18) had secondary insults initiated by all kinds of nursing interventions (Figure 2). Patient nos. 9 and 16 had secondary insults in more than 30% of the occasions when a hygienic measure was performed, and patient no. 8 had secondary insults in approximately 30% of the occasions when a simultaneous intervention was performed.

Multiple Insults

On some occasions, one nursing intervention related to more than one secondary insult at the same time. This did not happen at all after performing oral care,

TABLE 1. Patient Characteristics

No.	Age	Sex	Diagnosis	GCS-M, Admission	GCS-M, Discharge	Number of Days at NICU	Type of ICP Measurement
1	52	M	ASDH	4	4	17	Parenchymal probe
2	59	M	Thalamus stroke	6	6	15	Ventricular drainage
3	62	F	SAH	6	6	21	Open ventricular drainage
4	45	F	SAH	6	6	8	Open ventricular drainage and parenchymal probe
5	76	M	SAH	5	6	15	Open ventricular drainage
6	55	M	ASDH	3	4	15	Parenchymal probe
7	66	F	SAH	6	6	9	Ventricular drainage and parenchymal probe
8	57	M	SAH	6	4	26	Ventricular drainage
9	45	F	SAH	6	6	9	Ventricular drainage
10	36	M	EDH	5	6	15	Ventricular drainage and parenchymal probe
11	57	M	SAH	6	6	18	Ventricular drainage
12	43	M	ICH	4	6	20	Parenchymal probe
13	65	M	mMCAI	6	6	11	Ventricular drainage
14	66	F	mMCAI	5	6	10	Parenchymal probe
15	64	M	ICH	4	3	23	Open ventricular drainage
16	63	F	EDH	6	6	7	Parenchymal probe
17	66	F	SAH	6	5	13	Ventricular drainage
18	41	M	ICH	5	6	13	Parenchymal probe

Note. ASDH = acute subdural hematoma; SAH = subarachnoid hemorrhage; EDH = epidural hematoma; ICH = intracerebral hemorrhage; mMCAI = malignant middle cerebral artery infarction; GCS-M = Glasgow Coma Scale-motor (Teasdale & Jennett, 1974); NICU = neurointensive care unit.

but it occurred 6 times of 575 (1.0%) after repositioning, once of 393 (0.2%) after suctioning, once of 93 (1.1%) after performing hygienic measures, and 3 times of 489 (0.6%) after simultaneous intervention (Figure 3).

Secondary Insults Discontinued by Nursing Interventions

Occasionally, there was an ongoing secondary insult, which was discontinued after a nursing intervention. For example, this occurred for high ICP 17 times of 393 (4%) suctions and 17 times of 571 (3%) after repositioning (Table 3).

Discussion

This is the first study to investigate the amount of secondary insults related to nursing interventions with a definition for when a secondary insult has occurred and in an NIC unit with standardized care and maximum attention on avoiding secondary insults. The main

TABLE 2. Secondary Insults Caused by Nursing Interventions

	Total	ICP > 20 mm Hg *n* (%)	CPP < 60 mm Hg *n* (%)	SBP < 100 mm Hg *n* (%)
Oral care	171	6 (4)	2 (1)	0 (0)
Reposition	571	39 (7)	19 (3)	5 (1)
Suction	393	10 (3)	5 (1)	3 (1)
Hygienic measures	93	6 (6)	2 (2)	0 (0)
Simultaneous interventions	489	32 (7)	15 (3)	6 (1)
Total	1,717	93 (5)	43 (3)	14 (1)

FIGURE 2 Secondary Insults on an Individual Basis (The *x* Axes Show Patient Numbers 1–18)

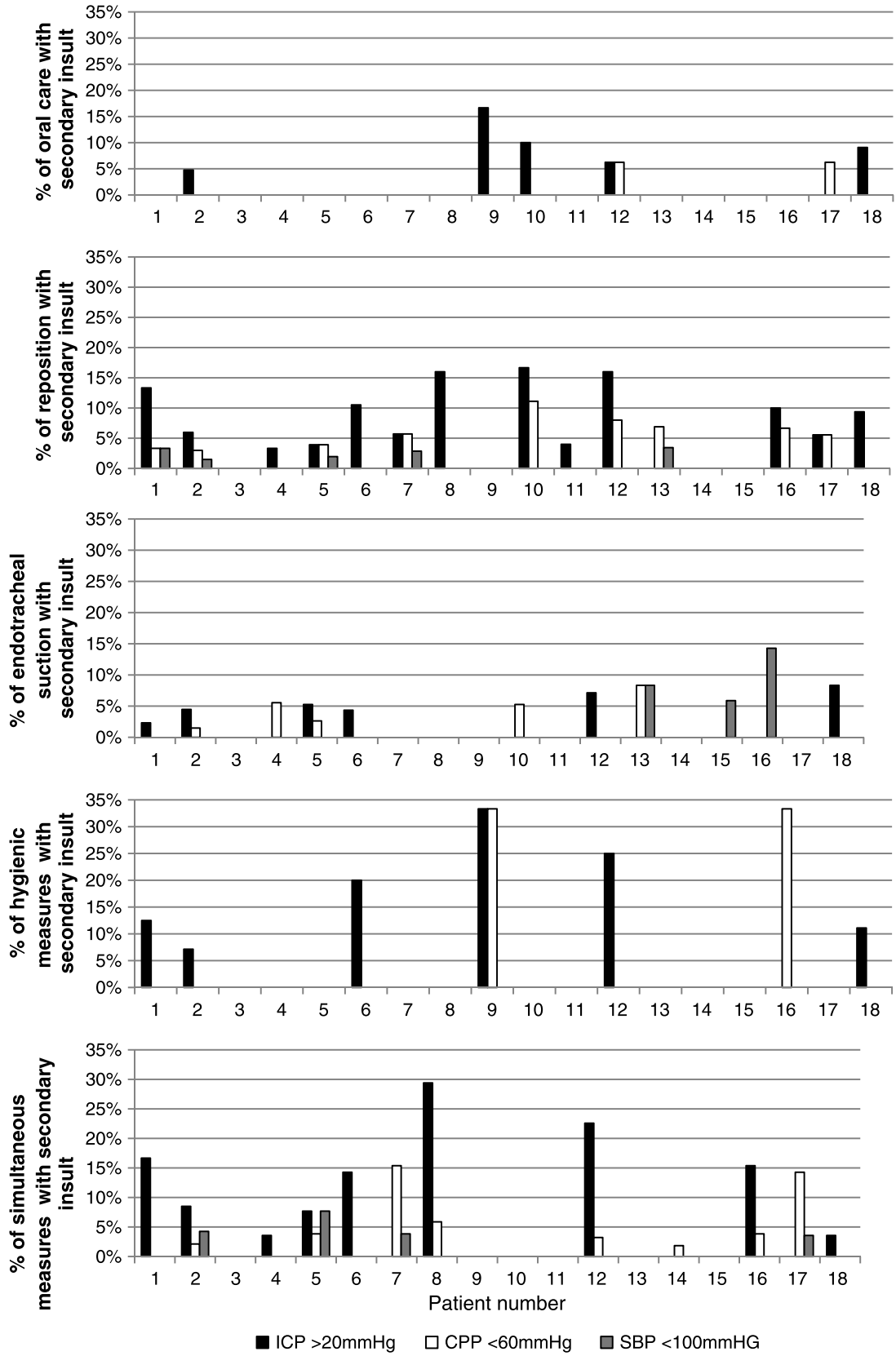
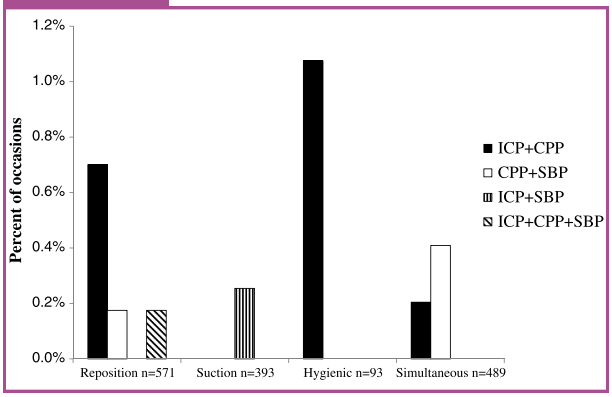


FIGURE 3 Percentage of Occasions When the Nursing Intervention Related to More Than One Secondary Insult



findings in this material were that secondary insults related to nursing intervention were relatively sparse and that there was considerable individual variation.

In this study, repositioning resulted in the highest amount of secondary insults, which was also the result in the study by Tume et al. (2011) in pediatric patients. Oral care did not influence ICP in this study, similar to the study by Prendergast et al. (2009). Some patients in this study had secondary insults in one third of nursing interventions, and other patients had none. This suggests that some patients are more prone to developing secondary insults after nursing interventions. These patients should possibly have restricted nursing interventions. To identify these patients, further studies are needed.

A common way to perform nursing interventions at an NIC unit is to perform additional interventions at the same time to not disturb the patient too often. In this study, simultaneous interventions were analyzed, and for some individuals, it appeared to be better to perform one intervention and let the patient stabilize before performing the next. If nursing interventions are made simultaneously, the procedure will also take a longer time, and the patient may stay at an insult level for a longer time.

The worst kind of secondary insults occurs when more than one treatment goal is not achieved, which, in this article, is called multiple insults and was very rare in this material.

Nursing interventions and preventing secondary insults are a complex field. Sometimes, a nursing intervention may discontinue an ongoing secondary insult, for example, when a patient is coughing and the nurse performs an endotracheal suction that makes it possible for the patient to rest again or when repositioning a patient to a better position in the bed. This is difficult to analyze because it could depend on other reasons as well, for example, increased sedation level because of the patient receiving extra sedation and pain relief before the intervention was initiated. Among patients at an NIC unit, it is important to consider that a nursing intervention can result in unwanted side effects, for example, high ICP. Therefore, a holistic approach is necessary.

This study contains a few patients with different diagnoses and different methods to measure ICP, and the result cannot be applied generally but can give an idea of how nursing interventions and secondary insults relate. For example, patients with an open ventricular drainage often have short ICP insults that disappear once the drainage opens again after the intervention. When studying processes in an NIC unit, it is difficult to avoid confounders, for example, sedation level, hemodynamic status, and differences in the staff performing the nursing intervention.

However, in this pilot study, secondary insults related to nursing interventions rarely occurred. Considering the risk for secondary insults related to nursing interventions, we think this is a topic that should be further explored in larger studies.

Summary

There were, overall, a limited number of secondary insults related to nursing interventions when a standardized

TABLE 3. Secondary Insults Stopped After Nursing Interventions

		ICP > 20 mm Hg	CPP < 60 mm Hg	SBP < 100 mm Hg
	Total	*n* (%)	*n* (%)	*n* (%)
Oral care	171	5 (3)	1 (1)	0 (0)
Reposition	571	17 (3)	12 (2)	4 (1)
Suction	393	17 (4)	11 (3)	1 (0)
Hygienic measures	93	5 (5)	2 (2)	0 (0)
Simultaneous interventions	489	9 (2)	8 (2)	1 (0)
Total	1,717	53 (3)	34 (2)	6 (0)

management protocol system was applied to reduce the occurrence of secondary insults. Patients with an increased risk of secondary insults should be recognized, and their care and treatment should be carefully planned and performed to avoid secondary insults.

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