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การศึกษาอุบัติการณ์และปัจจัยที่เกี่ยวข้องกับการคาท่อช่วยหายใจในผู้ป่วยหลังผ่าตัดศัลยกรรมประสาท

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A Study of Retained Endotracheal Tube After Neurosurgical Anesthesia : Incidence and Associated Factors

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หลักการและวัตถุประสงค์: การวางยาระงับความรู้สึกสำหรับการผ่าตัดสมองมักต้องการให้ผู้ป่วยฟื้นตัวจากการสลบโดยเร็ว แต่อย่างไรก็ตามผู้ป่วยบางส่วนจำเป็นต้องคาท่อช่วยหายใจภายหลังการผ่าตัด ดังนั้นจึงต้องการศึกษาอุบัติการณ์และปัจจัยที่เกี่ยวข้องกับการคาท่อช่วยหายใจในผู้ป่วยที่ได้รับผ่าตัดศัลยกรรมประสาท

วิธีการศึกษา: ทำการศึกษาข้อมูลของผู้ป่วย 325 ราย ที่มารับการวางยาระงับความรู้สึกเพื่อผ่าตัดทางระบบประสาทที่โรงพยาบาลศรีนครินทร์ มหาวิทยาลัยขอนแก่นในช่วงเดือนเมษายนถึงธันวาคม ปี พ.ศ. 2548 ศึกษาแบบ retrospective descriptive ข้อมูลจากใบบันทึกการวางยาระงับความรู้สึก ใบระเบียนประวัติผู้ป่วยในและนอก และผลตรวจทางห้องปฏิบัติการเพื่อศึกษาอุบัติการณ์การคาท่อช่วยหายใจในผู้ป่วยหลังจากผ่าตัดศัลยกรรมประสาท และปัจจัยที่เกี่ยวข้อง

ผลการศึกษา: อุบัติการณ์การคาท่อช่วยหายใจในผู้ป่วยหลังจากผ่าตัดศัลยกรรมประสาทคิดเป็นร้อยละ 57.8 (95% CI 52.3, 63.3) โดยพบปัจจัยที่ทำให้การคาท่อช่วยหายใจ คือ ASA status มากกว่า 2 เป็นการผ่าตัดแบบฉุกเฉิน ระยะเวลาผ่าตัดนานกว่า 2 ชั่วโมง การผ่าตัดเนื้องอกสมอง การผ่าตัด aneurysm การให้เลือดระหว่างการผ่าตัด อุณหภูมิกายน้อยกว่าหรือเท่ากับ 35 องศาเซลเซียส

สรุป: อุบัติการณ์การคาท่อช่วยหายใจหลังการผ่าตัดศัลยกรรมประสาทสูง มีสาเหตุจากหลายปัจจัยซึ่งบางปัจจัยสามารถป้องกันได้ ดังนั้นการปรับปรุงแผนการวางยาระงับความรู้สึกและการดูแลผู้ป่วยหลังผ่าตัดอาจนำไปสู่การลดอุบัติการณ์และการพัฒนาคุณภาพของการวางยาระงับความรู้สึก

Background and objectives: Anesthesia technique for neurosurgery always requires rapid recovery post operative. However, some patients have a delay recovery from anesthesia after the operation which require retained endotracheal tube. Aim of this study is the retained endotracheal tube incidence after neurosurgical anesthesia and the associated factors.

Methods: The authors studied the records (anesthetic records, in-patient records, investigation data) of patients who received anesthesia for neurosurgery at Srinagarind Hospital, Khon Kaen, Thailand during April to December 2004. The authors looked out for the incidence of retained endotracheal tube after neurosurgical anesthesia (we could not remove endotracheal tube in operation room or post anesthetic care unit) and looked for the associated factors (i.e. surgical associated factors, anesthetic associated factors, and patient associated factors).

Results: The authors gathered the information of 325 patients who received anesthesia for neurosurgery. The incidence of the retained endotracheal tube after neurosurgery was 57.8% (95% CI 52.3, 63.3). The incidence was more common in patients who obtained ASA physical status > 2, who had an emergency surgery, the operation time >2 hrs, tumor removal operations, undergone aneurysm surgery, multiple blood transfusion, and their body temperature $\leq 35^{o}C$.

Conclusion: This study found the high incidence of the retained endotracheal tube after neurosurgical anesthesia (57.8%). Some conditions could be prevented

to reduce the incidence. We could improve postoperative care by controlling preventable causes and appropriate post operation care management for unpreventable cause.
Key words: anesthesia, extubation, neurosurgical anesthesia, postoperative period, retained endotracheal tube

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Introduction

Anesthesia technique for neurosurgery always requires rapid recovery post operative with aims to detect the abnormal neurological signs and symptoms during postoperative period.[1, 2] Many anesthesiologists use minimal residual drug effect technique (e.g. short acting anesthetic agent) to decrease recovery time. However, some patients have a delayed recovery from anesthesia after the operation which require retained endotracheal tube.[1, 2] Inappropriate retained endotracheal tube increases length of intensive care and hospital stay, and hence increases the resource utilization and total cost. There are many causes of retained endotracheal tube in neurosurgery. So, the authors decided to study the retained endotracheal tube incidence after neurosurgical anesthesia and to identify the associated factors that might influence the incidence. Appropriate management to be gain from this study is invaluable to decrease the retained endotracheal tube incidence. It could also improve quality of postoperation care after neurosurgical anesthesia.

Methods

After receiving approval from our institution's Research Ethics Board, the authors included patients who received neurosurgery at Srinagarind Hospital, Khon Kaen University, Thailand. This study used patient records of all ages who had received the operations for neurosurgery (operated by neurosurgeon on the brain, spinal cord, and vertebrae) from April to December 2004. The study was designed as a retrospective descriptive study. Data sources assessed were: 1) anesthetic record (pre, peri, and post anesthesia); 2) in and out patient records; 3) surgical record. The patients who had insufficient data were excluded from the study. Definition of recorded the retained endotracheal tube incidence was the patients whom we could not remove endotracheal tube after the end of operation in operating room or in post anesthesia care unit. The authors collected the data that may be related as associated factors. The associated factors were defined in three categories as follows: 1) surgical factors *i.e.* procedure, disease, lesion location, operation time; 2) anesthetic factors *i.e.* anesthetic technique, anesthetic agents (sedative drug, analgesia drug, induction drug, inhalation anesthetics, muscle relaxant), supplement drugs, blood transfusion, vital sign, body temperature; and 3) patient factors (*i.e.* sex, age, ASA classification, underlying disease, Glasgow coma scale score, emergency condition, preanesthetic problem).

Data analysis was performed using STATA for Windows version 8.0 (Stata Corporation, TX, USA). Descriptive statistics was considered to be appropriate. The retained endotracheal tube incidence was reported as percentage and 95% CI. All associated factors had been considered as binary variables. Univariable analysis was used to assess the association between two categorical variables (chi-square test or Fisher exact test). Multivariate analysis via logistic regression with backward likelihood ratio procedure was used to assess the specific effect of each associated factor. Results were reported as odds ratio (95% CI). The sample size required was based on: 1) postoperative retained endotracheal tube incidence of 0.41[3]; 2) a Type I error of 0.05; 3) an absolute precision of 0.005; and, 4) an 80% power.

Results

Three hundred and fifty four patients were included in the study. This study excluded 29 patients due to insufficient information. One hundred and sixty-six patients were female (51.1 %). Most patients were in the age group of 15-60 years old (64%). Most of them had the anesthesia duration of 2-4

Table 1 Demographic data.

	Study population n (%)	Retained entdotracheal tube incidence n (%)
Age group (yrs)		
< 1	16 (4.9)	7 (43.8)
1-15	51 (15.7)	25 (49.0)
> 15-60	208 (64.0)	122 (58.7)
> 60	50 (15.4)	34 (68.0)
Sex		
Male	159 (48.9)	96 (60.4)
Female	166 (51.1)	92 (54.4)
Anesthesia duration (hr)		
< 2	135 (41.5)	63 (46.7)
2-4	162 (49.8)	100 (61.7)
> 4	28 (8.6)	25 (85.3)
ASA physical status		
I	63 (19.4)	20 (31.7)
II	148 (45.5)	66 (44.6)
III	75 (23.1)	63 (84.0)
IV	32 (9.8)	32 (100)
V	7 (2.2)	7 (100)
Glasgow Coma Scale Score		
≤ 8	73 (22.5)	66 (90.4)
> 8	252 (77.5)	122 (46.4)
Condition		
elective	209 (64.3)	94 (45.0)
Emergency	116 (35.7)	94 (81.0)

hours (46%). The most patients had ASA physical statuses II and III (68.6%). Elective condition was 64.3 %. Glasgow coma scale score less than 8 was 22.5% (95% CI 18.0, 27.4) (Table 1).

The retained endotracheal tube incidence after neurosurgical anesthesia was 57.8% (95% CI 52.3, 63.3). The associated factors were analyzed by univariable analysis and multivariable analysis that had statistically significance shown in table 2 and table 3, respectively.

Discussion

Early recovery and extubation in the operating room are the preferred conditions for neurosurgical anesthesia in the relatively normal conscious patient before operation and not on critical brain areas. The reason is to get the early diagnosis of postoperative neurological complications.[1, 4, 5] However, in some patients, who are not physically ready for extubation, the recommendation is retained endotracheal tube in the postoperative period after the patients achieve the cardiovascular and thermal stability.[4, 6] Inappropriate by retained endotracheal tube increases resource utilization and total hospital cost.

Retained endotracheal tube after neurosurgical anesthesia was quite high in our study (57.8%). This incidence was higher than previous study that studied in intracranial aneurysm surgery (40.7% of retained endotracheal tube incidence).[3] Such high incidence, preparation for postoperative care requires a lot of intensive care beds and ventilators. The strategy to reduce the incidence may be necessary for postoperation care improvement.

In the previous study[3], retained endotracheal tube was found to be more common in patients with pre-existing cardiovascular disease, alteration of consciousness, unidentified aneurysm, internal coratid artery aneurysm, preoperative intubation, and fresh frozen plasma administration, mannitol, diuretic administration. This data, after multivariate analysis, the associated factors were high ASA physical status, emergency condition, long operation time (more than 2 hours), and past experiences of tumor removal, aneurysmectomy, blood transfusion, and hypothermia

The emergency cases are always acute and more severe than elective cases. And, most of emergency cases were traumatic patients, that may have associated injuries such as hypotension, multiple organ trauma.[7, 8] Unavailable intensive care unit after procedure especially in non-working hours also increases the incidence. Indeed, most surgical ward could not care for the patients who required the intensive care. The retained endotracheal tube in this situation might be an advantage to patients.

Long operation time were related with more difficult surgical technique. It also increased the risk of brain edema and anesthetic drug consumption that might delay the recovery. Tumor removal procedure and aneurysmectomy that took long operation time were statistical significance after multivariable analysis. Postoperation planning for long procedure, the ventilator and intensive care unit may be required to improved the health care standard.

Table 2 Univariable analysis of the associated factors of postoperative retained intubation.

	Control factors	Odds ratio (95% CI)
Patient factors		
ASA physical status III-IV	ASA physical status I-II	11.3 (5.0, 25.5)
Emergency	Elective	5.2 (3.1, 9.0)
GCS $\leq$ 8	GCS > 8	10.0 (4.4, 22.7)
Preoperative intubation	No	49.6 (11.9, 206.7)
Surgical factors		
Operation time 2-4 hr	Operation time 1-2 hr	1.8 (1.2, 2.9)
Operation time > 4 hr	Operation time 1-2 hr	9.5 (2.7, 33.1)
Tumor removal operation	Biopsy	11.8 (1.5, 96.0)
Aneurysmectomy	Biopsy	38.0 (3.9, 371.3)
Aneurysm or AVM	Benign tumor	3.5 (1.3, 9.4)
Operation ending: non working time	Operation ending: working time	5.9 (3.6, 9.7)
Anesthetic factors		
Etomidate induction	Sodium thiopental induction	2.6 (2.0, 3.5)
Fentanyl > 3 mcg/kg	fentanyl < 3 mcg/kg	4.3 (1.5, 12.1)
Propofol maintenance	Isoflurane maintenance	2.6 (1.1, 6.2)
Blood replacement 1-2 unit	No	15.2 (4.6, 50.3)
Blood replacement 3-4 unit	No	22.7 (3.0, 172.0)
Blood replacement > 4 unit	No	2.1 (1.9, 2.4)
Body temperature $\leq$ 35°C	Body temperature >35°C	3.1 (1.4, 7.0)

Table 3 Multivariable analysis of the associated factors of postoperative retained intubation.

	Control factors	Odds ratio (95% CI)
Patient factors		
ASA physical status III-IV	ASA physical status I-II	13.3 (2.9, 61.7)
Emergency	Elective	2.1 (1.2, 3.5)
Surgical factors		
Operation time 2-4 hr	Operation time 1-2 hr	3.8 (1.3, 11.0)
Operation time > 4 hr	Operation time 1-2 hr	14.4 (2.2, 95.3)
Tumor removal operation	Biopsy operation	42.4 (1.5, 1191.7)
Aneurysmectomy	Biopsy operation	104.6 (2.3, 4701.9)
Anesthetic factors		
Blood replacement 1-2 unit	No	9.3 (1.7, 49.9)
Body temperature $\leq$ 35°C	Body temperature > 35°C	8.2 (2.1, 31.6)

Hypothermia was a preventable factor. In fact, the strategy to control patient temperature may be invaluable to reduce the retained endotracheal tube incidence. Surprisingly, anesthetic drug and technique did not show any statistical significance after multivariable analysis. Due to similar pattern of anesthetic technique at the Srinagarind hospital, factor associated with anesthetic may not show the variation. One of the most important reasons for high

retained endotracheal tube incidence was the insufficient number of beds for postoperative intensive care. Intubated patients were easier to care than extubated patients who were not unconscious who had good orientation and be cooperative.

The advantages of this outcomes are that they can be used for anesthetic planning before the neurosurgery operation. Patients who have high risk for retained endotracheal tube require mechanical ventilator and bed for making close observation. Although other scientists can conclude about the associated factors of retained endotracheal tube after neurosurgery from our data, but they must always be aware of multivariation in each case that may affect the result. Further study with a larger number of patients and appropriate extubaiton criteria are required.

Conclusion

There was high retained endotracheal tube incidence after neurosurgical anesthesia at Srinagarind hospital. We found some preventable factors (see tables 2 and 3). The advantages of the study results are appropriate for improving the anesthetic planning for neurosurgical anesthesia including postoperative management. However, some associated factors had inconclusive outcomes. The authors recommended further study with larger number of patients to study the detail of specific associated factors.

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