Factors Associated With Postoperative Delirium After Thoracic Surgery

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Background. **Postoperative delirium is an acute confusional state characterized by fluctuating consciousness and is associated with increased morbidity and mortality. We analyzed the incidence and risk factors of delirium following thoracic surgery.**

Methods. **All patients (n = 432) who underwent thoracotomy or sternotomy from 1996 to 2003 were analyzed retrospectively. The diagnosis of postoperative delirium was based on Diagnostic and Statistical Manual of Mental Disorders- IV criteria.**

Results. **Postoperative delirium developed in 23 patients (5.32%) between postoperative days 2 to 12 (mean, 4.4 ± 2.6 days). There were 15 males and 8 females, with a mean age of 59.4 years (24 to 77 years). The delirium group was older (59.4 ± 14.6 vs 51.3 ± 15.5 years, $p < 0.01$) and had a longer operation time than the nondelirious group (5.34 ± 1.58 vs 4.38 ± 1.6 hours, $p = 0.005$). Morbidity and mortality rates were not significantly different between the two groups (56.5% vs 47.1%; 13.0% vs 3.66%, respectively). Univariate analysis showed that the older age, markedly abnormal postoperative levels of sodium, potassium, or glucose, sleep deprivation, operation time, and diabetes mellitus were risk factors ($p < 0.05$). According to multivariate analyses, four factors were selected as predictive risk factors: (1) markedly abnormal postoperative levels of sodium, potassium, or glucose ($p = 0.038$); (2) sleep deprivation ($p = 0.05$); (3) age ($p = 0.033$); and (4) operation time ($p = 0.041$).**

Conclusions. **Postoperative delirium may cause higher morbidity and mortality rates after thoracic surgery. Close postoperative follow-up and early identification of predisposing factors such as older age, sleep deprivation, abnormal postoperative levels of sodium, potassium, or glucose, and longer operation time can prevent occurrence of postoperative delirium.**

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Delirium is defined as a reversible, global impairment of cognitive processes, usually of sudden onset, coupled with disorientation, impaired short-term memory, altered sensory perceptions (hallucinations), abnormal thought process, and inappropriate behavior [1]. Postoperative delirium (POD) is also defined as an acute change in cognitive status characterized by fluctuating consciousness and inattention, occurring after an operation [2]. The overall incidence of POD has been reported as 36.8% within a range of 0% to 73.5% [2]. Postoperative delirium is related to higher mortality rates, difficulties in functional recovery, longer recovery periods, and increased period of hospitalization [3]. Developments in operative and anesthetic techniques have enabled older patients, and those with more serious cases, to undergo surgery. This may be a cause of the increase in the frequency of delirium. It is important to investigate the causes and risk factors of delirium in order to develop effective treatment and prevention techniques. In 1994, Aakerlund and Rosenberg [4] published the initial report on POD in patients undergoing thoracic surgery. Since then, no study has been designed to find out the factors associated with postoperative delirium after thoracic surgery. In this study, we attempt to determine the perioperative risk factors of POD in order to predict and prevent delirium after thoracic surgery.

Patients and Methods

The records of 432 patients older than 18 year of age who were admitted to our hospital between 1996 and 2003 for major elective or urgent thoracic surgery operations, defined as an expected length of stay of 2 or more days, were retrospectively reviewed. Profiles and surgical indications of the enrolled 432 patients are summarized in Table 1.

Thoracic epidural catheters (T6–8) were routine for postoperative pain management, other than contraindications or misplacement. Intravenous patient-controlled analgesia (PCA) was instituted in those situations. Fentanyl and bupivacaine (at concentrations of 0.125%) were infused from the epidural catheter, whereas morphine (1.0 to 1.5 mg, lockout 10 minutes) or meperidine (15 mg, lockout 10 minutes) were used in intravenous PCA. Typical duration for the use of the catheters was 3 to 5 days, after which a nonsteroidal antiinflammatory drug and opioid derivative were started for pain control.

A psychiatric consultation was requested once delir-

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Abbreviations and Acronyms

DFP = delirium free protocol
DM = diabetes mellitus
DSM-IV = Diagnosis and Statistical Manual of Mental Disorders-IV
ICU = intensive care unit
NSAID = non-steroidal anti-inflammatory drug
PCA = patient-controlled analgesia
pO_2 = partial pressure of oxygen
pCO_2 = partial pressure of carbon dioxide
POD = postoperative delirium
SD = standard deviation

ium symptoms were first noted after the operation. A diagnosis was made based on the *Diagnosis and Statistical Manual of Mental Disorders* (DSM-IV) [5]. Antipsychotics, haloperidol, risperidone, and quetapine have been used in treating delusions, paranoia, and perceptual disturbances. Benzodiazepines were used in alcohol and sedative withdrawal syndromes.

The preoperative and postoperative assessments were performed accordingly [3, 6]. The preoperative evaluation included a medical history highlighting the presence of either chronic or acute illnesses like pulmonary, cardiac, renal, and liver disease, presence of diabetes mellitus (DM), alcohol abuse, previous psychological or neurologic diseases, and history of delirium. The definition of alcohol abuse was made based on DSM-IV [5] that describes alcohol abusers as those who drink despite recurrent social, interpersonal, and legal problems as a result of alcohol use. We adopted the approach described by Marcantonio and colleagues [3] for abnormal preoperative chemistry values for postoperative serum electrolyte panels. Abnormal postoperative results were considered present when postoperative serum potassium levels were less than 3.0 meq/L or greater than 6 meq/L, serum sodium was less than 130 meq/L or greater than 150 meq/L, or blood glucose values were less than 60 mg/dL or greater than 300 mg/dL. Respiratory insufficiency was defined as arterial hypoxemia Po_2 less than 55 mm Hg on room air and hypercarbia Pco_2 greater than 45 mm Hg [7]. In order to determine the effects of duration of operation in development of POD, the length of operation time, which was defined as the period from induction of anesthesia to extubation, was measured. Infection was diagnosed when white blood cell count was greater than 12,000/mm^3 and postoperative fever was greater than 37.0°C [6]. The other preoperative and postoperative risk factors that were analyzed are listed in Table 2.

With regard to 10 preoperative factors and 15 postoperative factors based on clinical data, a statistical analysis was performed regarding 23 patients with POD and 409 patients without POD. For univariate analysis, the Student's t test, a χ^2 test, and Fisher's exact test of these factors were performed. Continuous data are presented as mean ± SD unless otherwise noted. To identify factors independently related to the development of delirium, we also performed forward multivariate stepwise (condi-

Table 1. Patient Characteristics and Surgical Indications in all Patients Grouped According to the Development of Postoperative Delirium

	Delirium Patients (n = 23)	Nondelirium Patients (n = 409)	p Value
Age	59.4 (24–77)	51.3 (18–86)	0.04
Male/female	15/8	276/133	n.s.
Length of operation time (hours)	5.34 ± 1.58	4.38 ± 1.6	0.005
Length of ICU stays (days)	2.95 ± 1.8	4.47 ± 12.1	n.s.
Length of stay (days)	11.65 ± 4.5	9.8 ± 9.6	n.s.
Diagnosis			
Malignant	14 (60.9%)	211 (51.5%)	n.s.
Lung cancer	13	155	
Lung metastases	1	24	
Mesothelioma	-	8	
Mediastinal tumors	-	7	
Others	-	17	
Nonmalignant	9 (39.1%)	198 (48.5%)	n.s.
Bronchiectasis	1	24	
Hydatid disease	-	21	
Tuberculosis	2	18	
Empyema	-	14	
Benign tumors	1	14	
Bullous lung disease	-	13	
Myasthenia gravis	1	13	
Interstitial lung disease	-	13	
Others	4	68	

ICU = intensive care unit; n.s. = statistically, no significant difference.