การประเมินการคัดกรองภาวะเพ้อหลังผ่าตัดด้วยเครื่องมือ 4 'A' Test ฉบับภาษาไทยในผู้ป่วยสูงอายุที่เปลี่ยนข้อสะโพกหรือข้อเข่า

Assessment of Postoperative Delirium Screening with the Thai-Version 4 'A's Test in Elderly Patients Undergoing Hip/Knee Replacement

นที วีรวรรณ*, ธนาวดี ประชาสันติ์*

Natee Viravan*, Thanavadee Prachason*

* ภาควิชาจิตเวชศาสตร์ คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล

* Department of Psychiatry, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand.

บทคัดย่อ

วัตถุประสงค์ เพื่อประเมินผลการคัดกรองภาวะเพ้อหลังการผ่าตัดด้วยเครื่องมือ 4 'A' Test (4AT) ฉบับภาษาไทยและสำรวจความคิดเห็นของผู้ใช้เครื่องมือ

วัสดุและวิธีการ ผู้ป่วยสูงอายุที่เข้ารับการผ่าตัดเปลี่ยนข้อเข่าหรือข้อสะโพกจำนวน 69 คนได้รับการคัดกรองภาวะเพ้อหลังการผ่าตัดด้วยเครื่องมือ 4AT ฉบับภาษาไทย ผู้ป่วยที่ผลการคัดกรองเป็นบวกได้รับการประเมินซ้ำโดยจิตแพทย์เพื่อยืนยันการวินิจฉัยโรคตามเกณฑ์ DSM-5 ผู้นิพนธ์เก็บข้อมูลร้อยละของผู้ป่วยที่มีภาวะเพ้อ ระยะเวลาในการนอนโรงพยาบาล และอัตราการตาย โดยเปรียบเทียบกับข้อมูลกลุ่มควบคุมในอดีตซึ่งได้จากการทบทวนเวชระเบียนของผู้ป่วยสูงอายุจำนวน 154 คนที่เข้ารับการผ่าตัดชนิดเดียวกันในช่วงก่อนนำระบบคัดกรองมาใช้ ภายหลังกระบวนการคัดกรองเสร็จสิ้น พยาบาลผู้คัดกรองภาวะเพ้อจำนวน 30 คน จะได้รับการสำรวจความคิดเห็นโดยใช้แบบสอบถามเกี่ยวกับการคัดกรองภาวะเพ้อในผู้สูงอายุ

ผลการศึกษา ในกลุ่มผู้ป่วยที่ได้รับการคัดกรองพบผู้ป่วยที่มีภาวะเพ้อหลังการผ่าตัดร้อยละ 1.3 ซึ่งใกล้เคียงกับกลุ่มควบคุม (ร้อยละ 1.4) (P = 1.00) ผู้ป่วยทั้งสองกลุ่มไม่มีผู้เสียชีวิต ระยะเวลาในการนอนโรงพยาบาลในกลุ่มควบคุมมีค่ามัธยฐาน 67 ชั่วโมง (พิสัยควอไทล์ = 23) ซึ่งมากกว่ากลุ่มคัดกรอง (มัธยฐาน = 52, พิสัยควอไทล์ = 25) (P =.023) พยาบาลผู้คัดกรองร้อยละ 80 เห็นด้วยว่าการคัดกรองภาวะเพ้อโดยใช้เครื่องมือ 4AT ฉบับภาษาไทยทำได้ง่าย ไม่ซับซ้อนและพึงพอใจกับการใช้เครื่องมือนี้ อย่างไรก็ดี พยาบาลร้อยละ 33.3 เห็นว่าการคัดกรองเป็นการเพิ่มภาระงานมากเกินไป และร้อยละ 26.7 เห็นว่าการคัดกรองใช้เวลานาน

สรุป ผลการคัดกรองภาวะเพ้อหลังผ่าตัดด้วยเครื่องมือ 4AT ฉบับภาษาไทยพบว่าในการศึกษานี้มีความชุกของภาวะเพ้อต่ำ อย่างไรก็ดี ผู้ใช้เครื่องมือส่วนใหญ่พึงพอใจกับการใช้เครื่องมือนี้แม้ว่าผู้ใช้เครื่องมือบางส่วนมีความกังวลถึงผลกระทบต่อภาระงานที่เพิ่มขึ้น

คำสำคัญ การผ่าตัดเปลี่ยนข้อ ภาวะเพ้อ ผู้สูงอายุ การประเมินผล ภาวะแทรกซ้อนหลังการผ่าตัด

Corresponding author: ธนาวดี ประชาสันติ์

วารสารสมาคมจิตแพทย์แห่งประเทศไทย 2561; 63(1): 77-88

ABSTRACT

Objective : To assess effects of postoperative delirium screening using the Thai-Version 4 'A's Test (4AT-T) and survey users' opinions on using this instrument.

Methods : Sixty-nine elderly inpatients receiving hip/knee arthroplasty were enrolled to undergo postoperative delirium screening with the 4AT-T. Patients screened positive were re-evaluated by a psychiatrist to confirm diagnosis based on DSM-5. The percentage of confirmed delirium cases, length of hospital stay (LOS) and mortality rate were collected and compared with historical control data of elderly inpatients (n = 154) receiving the same operations during the pre-implementation period, which were reviewed from medical records. After all the screening process, 30 experienced nurses were surveyed for their opinion of the 4AT-T by questionnaire.

Results : The percentage of patients with delirium in the screening group was 1.3%, comparable to 1.4% in the control group (*P* = 1.00). Mortality rates in both groups were zero. The LOS (in hours) of the control group (Median = 67; Interquartile range, IQR = 23) was greater than that of the screening group (Median = 52; IQR = 25) (*P* = .023). Eighty percent of the nurses agreed that the screening is easy and simple. They were satisfied to use this instrument. However, 33.3% and 26.7% considered it to increase excessive workloads and time-consuming, respectively.

Conclusion : The postoperative delirium screening by the 4AT-T revealed low prevalence of delirium in this study. However, most users were satisfied to use this instrument despite some concerns about impacts on their workload.

Keywords : arthroplasty, elderly, postoperative delirium

Corresponding author: Thanavadee Prachason

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Introduction

Delirium is a neurocognitive disorder characterized by an acute disturbance in attention, awareness and cognition with a typical fluctuation in severity during the course of a day[1]. It is one of the most common complications among older patients undergoing surgery and also a red flag for underlying physical conditions that are potentially life-threatening. Its prevalence could be as high as 60% among older patients undergoing major surgery[2], but one to two-thirds of delirium cases are under-detected[3]. Delayed diagnosis is associated with increased morbidity and mortality, prolonged hospital stay, higher health care costs, and higher rate of postoperative complications[4]. Thus, routine screening in high-risk population could be a key strategy leading to early management of this serious condition.

Even though a number of strategies to prevent postoperative delirium have been proposed, some major risk factors of delirium, such as advanced age and cognitive impairment, are unfortunately unmodifiable. This fact is particularly true for some operations that mostly involve older people, which include hip/knee arthroplasty. Indeed, the rate of postoperative delirium after elective hip/knee replacement was reported to vary from 5 to 10%, but the prevalence could rise to 16.5% if emergency cases were also included[5].

To improve delirium detection, a number of delirium assessment scales have been developed. However, some drawbacks still limit their use in routine practice. For example, Confusion Assessment Method (CAM), one of the most popular delirium screening instruments, was shown to have excellent sensitivity (100%) in detecting postoperative delirium, but its performance significantly dropped to 13% if training experience of the person administrating is inadequate[6]. In a more recent study, the performance of another two delirium screening tools, Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) and Nursing Delirium Symptom Checklist (NuDESC), was tested against a clinical diagnosis of delirium based on DSM-IV criteria[7]. It was revealed that inadequate sensitivity (28-32%) to detect postoperative delirium still remains a significant problem despite satisfactory specificity (>90%) of both instruments[7].

To overcome such limitations, the 4 'A's Test was recently developed as a brief instrument for delirium detection without prior special training required[8]. The tool exhibited a good performance for delirium screening in various settings and has been translated into various non-English languages[9-12], including French, Italian, German and Thai. A validation study of the Thai version of the 4 'A's Test (4AT-T) in general medical inpatients also confirmed its acceptable sensitivity (83.3%) and reasonable specificity (86.3%) for delirium screening similar to the original version[13]. In addition, all three nurses who participated in the screening in the previous study verified that the instrument is brief, easy to use, and compatible with their high-workload setting, like most primary care hospitals in Thailand[13]. However, opinions of users and the effects of its use for delirium screening in real-life practice have never been evaluated.

In this study, we therefore performed a pilot implementation of postoperative delirium screening with the 4AT-T among elderly patients undergoing hip or knee arthroplasty, as a representative of

population at high risk of delirium, and involved a larger number of nurses in the screening. The aim of this study is to answer two research questions: 1) whether postoperative delirium screening with the 4AT-T would increase detection rate of postoperative delirium and improve its associated outcomes when compared to routine care, and 2) what nurses who use the 4AT-T for postoperative delirium screening think about implementation of this new screening strategy.

Methods

-Design-

This study was conducted at Ramathibodi Hospital, Bangkok, Thailand from 1 May 2016 to 31 October 2017. It was designed as a historical-controlled study comparing outcomes after a screening strategy was implemented with those in the pre-implementation period. An observational design was used to explore opinions of 4AT-T users after participating in the screening procedure. Informed consents were obtained from all patients in the screening group as well as the participating nurses. The study was approved by the Ethical Committee of Ramathibodi Hospital, Mahidol University.

-Populations-

Control Group

The control group was comprised of all patients aged 60 or older, who were admitted to an orthopedic ward at Ramathibodi Hospital between 1 July 2015-31 December 2015 and documented to receive one of the followings operations: total hip replacement, total knee replacement, partial hip replacement, revision of hip replacement or revision of knee replacement. At that time, no specific postoperative delirium screening was implemented in patient's care. Patient characteristics and outcome measures were retrospectively reviewed from electronic medical records of Ramathibodi Hospital.

Screening Group

Patients aged 60 or older admitted to an orthopedic ward at Ramathibodi Hospital between 1 November 2016-30 April 2017 and who received either total hip replacement, total knee replacement, partial hip replacement, revision of hip replacement or revision of knee replacement were enrolled to participate in this study regardless of their diagnosis. Those who had severe difficulty in communication or denied to participate in this study were excluded. Outcome measures were prospectively collected.

Participating Nurses

Nurses who routinely work at an orthopedic ward were enrolled to participate in this study. Those who denied to do the screening or to give feedback after finishing the process of patient assessment were excluded.

-Screening Instrument-

The 4AT-T[13] was used as a screening tool for postoperative delirium in this study. It has Cronbach's alpha for the internal consistency of 0.75, intraclass correlation coefficient for the interrater reliability of 0.998, sensitivity of 83.3% and specificity of 86.3%[13]. The instrument consists of four domains of assessment. First, alertness is evaluated by observing wakefulness of patients or their responses after awakening. If the alertness is clearly abnormal, this item will be scored four; otherwise, zero. Second, the 4-item Abbreviated Mental test assesses patients' cognition by asking them about their age, date of birth, the present

place and the current year. If the patient makes no mistake, it will be scored zero; one mistake, one; two mistakes, two. Third, patients' concentration is tested using Month Backwards. If the patient achieves seven months or more correctly, this item will be scored zero; less than seven months or refused to start, one; untestable due to being unwell or drowsy or inattentive, two. Fourth, acute change or fluctuation of consciousness are used to evaluate the onset and the course of altered mental status. If it arises over the last two weeks and is still evident in the last 24 hours, it will be scored four; otherwise, zero. The total score ranges from 0 to 12; a score of four or above indicates a positive screening result suggesting possible delirium.

-Patient Assessment-

After having undergone surgery and been moved back to an orthopedic ward, patients in the screening group were assessed for postoperative delirium by a participating nurse using the 4AT-T. No specific training was provided to the nurse despite a brief introduction about the instrument at the beginning of the project. The evaluation was performed once a day, mostly during 8AM to 5PM, until a screening result became positive or the patient was discharged from the hospital. In case of a positive screening result, the head nurse would notify the author (PT) who is a board-certified psychiatrist to verify whether the patient truly had delirium according to Diagnostic and Statistical Manual of Mental Disorders-5th edition (DSM-5)[1]. The patients would then be taken care of as appropriate according to their clinical conditions.

-Data Collection-

Patient characteristics, including demographic data, medical history and intraoperative factors potentially associated with postoperative delirium, were reviewed from patients' medical records. Here are some detailed descriptions of the collected data. Charlson Comorbidity Index (CCI)[14] was calculated to reflect seriousness of the overall comorbid illness in each participant; the score rangefrom 0 to 33. The number of medications used before operation was defined as the total number of medications that had been given to the patient within 24 hours before surgery. Drugs reported to have delirium, confusion, or hallucination as their adverse events at a rate of at least 1% in Micromedex were regarded as delirium-inducing medications[15]. The most recent serum albumin before surgery were also recorded, and creatinine clearance was calculated from the most recent serum creatinine based on the Cockcroft and Gault formula[16]. Baseline oxygen saturation was measured before the operation started. Intraoperative hypotension was considered present if mean arterial pressure became less than 50 mmHg during the operation. Post-operative hemoglobin were determined within 24 hours after surgery.

-Outcome Measures-

The primary outcome was the percentage of delirium detected in each study period. In the control group, delirium cases were defined as those with a diagnosis of delirium noted in their discharge summary, either as a principal or secondary diagnosis. In the screening group, participants with a positive 4AT-T result and a clinical diagnosis of delirium confirmed by a psychiatrist were considered detected delirium.

Secondary outcomes were length of hospital stay after operation (LOS), mortality rate and

opinions of the nurses participating in delirium screening using the 4AT-T. LOS was defined as the duration in hours from surgical end time to hospital discharge. Mortality rate was the percentage of cases discharged by death. Opinions of the participating nurses were surveyed after all the screening process was completed. A 5-point Likert scale was used to assess their attitude about delirium in older population as well as implementation of a screening strategy, particularly the application of the 4AT-T. Additional comments or suggestions were also allowed in the evaluation form.

-Statistical Analyses-

Sample size calculation was performed using Power and Sample Size Calculation[17]. The prevalence of postoperative delirium among patients undergoing hip/knee arthroplasty was previously reported to vary from 5-17%[5, 18]. According to data from the medical statistic unit of Ramathibodi Hospital, the rate of delirium among elderly patients undergoing hip/knee replacement in the previous year was 1.3%. A study comprising at least 66 patients in the screening group and 145 patients in the control group would be able to detect a prevalence of delirium in the screening group at 12% with type I error of 5% and type II error of 20%.

Data analyses were performed using IBM SPSS Statistics for Windows, version 18 (IBM Corp., Armonk, N.Y., USA). Percentages of detected delirium cases and characteristics of patients in the screening and the control groups were compared. For categorical variables, Chi-square statistic or Fisher's exact test was used to determine statistical significance as appropriate. Independent sample t-test and Mann-Whitney U test were used for normally distributed and non-normally distributed continuous variables, respectively. P-values of less than .05 were considered statistically significant. Nurses' opinions were described using descriptive statistics.

Results

-Patient Characteristics-

A total of 223 patients, 154 in the control group and 69 in the screening group, were included in this study. Characteristics of the patients in each group were summarized in Table 1. Over 80% of the participants in both groups were female. No statistically significant difference between groups was observed regarding median age, body mass index, comorbidity index and the number of medications used before operations. The proportions of patients with a neurocognitive disorder, a history of stroke and those taking delirium-inducing medications in the screening group were all comparable to those in the control group; however, baseline creatinine clearance and serum albumin of the former group were significantly higher than those of the latter ($t(221) = 2.41$, p-value = .017 and $U = 4,253.5$, p-value = .042, respectively). Eighty to ninety percent of the participants had osteoarthritis of the knee and received total knee arthroplasty under regional anesthesia. No significant difference in duration of anesthesia, rate of intraoperative hypotension, lowest oxygen saturation during the operation and postoperative hemoglobin was observed between the two groups, but estimated blood loss in the control group (Mdn = 20, IQR = 90) significantly differed from that in the screening group (Mdn = 20, IQR = 28)($U = 6,527.5$, p-value = .006).

Table 1. Patient characteristics

	Screening group (n=69)	Control group (n=154)	*P*-value †
Female, n (%)	61 (88.4)	127 (82.5)	0.260
Median age, years (IQR)	71 (12)	70 (12)	0.619
Mean BMI, kg/m^2 (SD)	26.8 (4.5)	26.1 (4.4)	0.269
Comorbid major/mild NCD, n (%)	1 (1.4)	3 (1.9)	0.795
History of stroke, n (%)	2 (2.9)	6 (3.9)	0.711
CCI, median (IQR)	0 (1)	0 (1)	0.512
Taking DIM, n (%)	42 (61)	86 (56)	0.380
Number of medications used before operation, median (IQR)	7 (5)	8 (5)	0.090
Mean CrCl, ml/min (SD)	72.4 (25.8)	64.1 (23.6)	0.017*
Median serum albumin, g/L (IQR)	38.2 (4.3)	37 (4.4)	0.042*
Diagnosis, n (%)			0.157
OA knee	61 (88.4)	121 (78.6)	
OA hip	1 (1.4)	11 (7.1)	
Hip fracture	4 (5.8)	18 (11.7)	
Knee complications	3 (4.3)	2 (1.3)	
Hip complications	0 (0)	1 (0.6)	
Others	0 (0)	1 (0.6)	
Operations, n (%)			0.060
Total knee arthroplasty	61 (88.4)	122 (79.2)	
Total hip arthroplasty	1 (1.4)	12 (7.8)	
Partial hip arthroplasty	3 (4.3)	17 (11)	
Revision of knee replacement	1 (1.4)	1 (0.6)	
Revision of hip replacement	3 (4.3)	1 (0.6)	
Others	0 (0)	1 (0.6)	
Anesthesia techniques, n (%)			0.070
GA	3 (4.3)	12 (7.8)	
RA	64 (92.8)	142 (92.2)	
GA + RA	2 (2.9)	0 (0)	
Median DOA , minutes (IQR)	150 (35)	145 (45)	0.175
IOH, n (%)	3 (4.3)	3 (1.9)	0.306
Median EBL, ml (IQR)	20 (28)	20 (90)	0.006*
Intraoperative lowest O_2 sat, median (IQR)	99 (3)	98 (2)	0.356
Mean postoperative Hb, g/dl (SD)	11.3 (1.5)	11.3 (1.6)	0.881
Median LOS, hours (IQR)	52 (25)	67 (23)	0.023*
Detected delirium, cases (%)	1 (1.4)	1 (1.3)	1.00

† *P*-values were derived by Fisher's exact test, Chi-square test, independent sample t-test or Mann-Whitney U test as appropriate.

* P-value < .05

BMI indicates body mass index; NCD, neurocognitive disorder; CCI, Charlson Comorbidity Index; DIM, delirium-inducing medication; CrCl, creatinine clearance; OA, osteoarthritis; GA, general anesthesia; RA, regional anesthesia; DOA, duration of anesthesia; IOH, intra-operative hypotension; EBL, estimated blood loss; O_2 sat, oxygen saturation; Hb, hemoglobin; LOS, length of hospital stay.

-Outcomes of Postoperative Delirium Screening-

In the screening group, two patients had positive 4AT-T results. Confirmed by a psychiatrist, the one with a 4AT-T score of 12 truly had delirium whereas the other with a score of four did not. As shown in Table 1, the rate of delirium detection in the screening group was thus one out of 69 (1.4%) while that of the routine care group was two out of 154 (1.3%). Such difference was not statistically significant (p-value = 1.00, Fisher's exact test). No patients were discharged by death in both groups. The LOS (in hours) of the control group (Mdn = 67, IQR = 23) was significantly longer than that of the screening group (Mdn = 52, IQR = 25) (U = 6,322.5, p-value = .023).

-Feedback from Nurses-

Opinions derived from 30 orthopedic nurses who participated in delirium screening were summarized in Table 2. Over 90% of the nurses agreed or totally agreed that delirium is common in the elderly after surgery and that delirium screening leads to earlier diagnosis of the condition. Around three quarters agreed or totally agreed that implementation of delirium screening with the 4AT-T facilitates delirium detection while the rest were not sure about that. Approximately 40% of the nurses did not think that delirium screening with the 4AT-T is time consuming, but nearly a quarter did. The proportions of those responding with either agreement, disagreement, or uncertainty to the idea that delirium screening with 4AT-T increases excessive workload were all comparable. However, 80% of the nurses were satisfied with delirium screening using the 4AT-T and thought that it is easy and simple. Over half of them agreed that it should be used for postoperative delirium screening in every older patient undergoing surgery. There were also two additional comments. The first one underscored that the 4AT-T should be used for postoperative delirium screening in every older patient whereas the other suggested that the 4AT-T should be used only in a group of patients with higher incidence of delirium.

Table 2 Opinions from nurses participating in postoperative delirium screening using the 4AT-T

	Number of nurses (%)				
	Totally agree	Agree	Not sure	Disagree	Totally disagree
Delirium is common in the elderly after surgery.	9 (30)	19 (63.3)	1 (3.3)	1 (3.3)	0 (0)
Delirium screening leads to earlier diagnosis of delirium.	5 (16.7)	23 (76.7)	2 (6.7)	0 (0)	0 (0)
Implementation of the 4AT-T facilitates detection of delirium.	4 (13.3)	19 (63.3)	7 (23.3)	0 (0)	0 (0)
Delirium screening with the 4AT-T is time-consuming.	2 (6.7)	6 (20)	9 (30)	12 (40)	1 (3.3)
Delirium screening with the 4AT-T is easy and simple.	8 (26.7)	16 (53.3)	4 (13.3)	2 (6.7)	0 (0)
Delirium screening with the 4AT-T increases excessive workloads.	1 (3.3)	9 (30)	11 (36.7)	8 (26.7)	1 (3.3)
Postoperative delirium screening with the 4AT-T should be implemented in all older patients undergoing surgery.	2 (6.7)	15 (50)	10 (33.3)	3 (10)	0 (0)
Personally, you are satisfied with using the 4AT-T for delirium screening.	2 (6.7)	22 (73.3)	5 (16.7)	1 (3.3)	0 (0)

Discussion

This study revealed that postoperative delirium was detected in only about one percent of elderly patients undergoing hip or knee replacement at Ramathibodi Hospital. The rate of detection was similar even after a delirium screening strategy was implemented. Even though some characteristics of the patients in the screening group were different from those of the control group, it is not possible to adjust for those variables due to a very limited number of delirium cases in our study. To check whether such a low rate of delirium in the screening group either reflects the actual prevalence in our studied population or is a result of missed diagnosis, we contacted the psychiatric consultation-liaison team and reviewed patients' history from electronic medical records to identify if there were any cases of delirium detected by their attending or consulting physicians but missed by our study. No additional case was found, suggesting that the former hypothesis is more possible. Moreover, according to the diagnostic properties of the 4AT-T[13], if a true prevalence of delirium was as high as 10%, the tool still exhibits a negative predicted value at nearly 98% implying that a false negative result is less likely.

In contrast to a surprisingly low rate of delirium detected by the 4AT-T in our study, a recent nationwide delirium-screening study using the 4AT among hospitalized older patients in Italy reported that the prevalence of delirium across different settings, including orthopedic wards, ranges from 14-28%[19]. Studies focusing on patients undergoing hip or knee replacement similarly revealed a high prevalence of delirium, ranging from 5-17%[5, 18]. Such discrepancy between our results and others might be partly explained by some distinct nature of our studied samples. First, around 80% of the patients in our study underwent total knee arthroplasty. A recent prospective study in total joint arthroplasty patients showed that operation has three times lower risk of postoperative delirium compared to hip replacement surgery (7% and 23%, respectively)[5]. In elderly patients with hip fracture, the incidence of postoperative delirium was reported to be even higher[20]. Moreover, almost 90% of our participants were diagnosed with osteoarthritis of the hip or knee, implying that the operation they received was elective. In such cases, those who have high risks of postoperative complications, including delirium, might not pass preoperative evaluation and could be switched to conservative treatment rather than undergoing surgery. Indeed, most of our participants had no severe medical comorbidity as reflected by zero CCI score. These aforementioned characters could, at least in part, contribute to a low rate of postoperative delirium in the present study.

After implementation of the screening strategy, reflections from the participating nurses revealed that most of them are aware of a high risk of postoperative delirium among the elderly. The majority also thinks that a screening strategy might facilitate detection of this serious condition, but a significant proportion still concerns about time-consuming and workload-increasing issues related to the screening. Considering that undetected delirium could cause marked disturbance of

patients' behaviors and cooperativeness leading to difficulty in nursing care, different perspectives might be revealed in a clinical setting where delirium is highly prevalent and already regarded as problematic. Actually, 80% of the nurses in our study reported that they were satisfied with the 4AT-T use and considered it easy and simple. Altogether, we propose that some burdens related to delirium screening with the 4AT-T seemed minor and could be outweighed by a potential benefit of early control of such serious and disturbing condition.

This study is the first to apply the 4AT-T for postoperative delirium screening and assess its practical use in real clinical care. Furthermore, we are also concerned about opinions and satisfaction of the practitioners, which would be important predictors for protocol adherence if a strategy were to be implemented in routine practice. However, our study does have some limitations. First, the small sample size could render this study underpowered to detect a prevalence of postoperative delirium that is below 12%. Second, most patient assessment was performed during daytime, which might cause under-diagnosis of delirium due to fluctuating nature of the condition. Third, most patients in this study had no serious comorbid illness and underwent total knee arthroplasty under regional anesthesia. Thus, cost-effectiveness of delirium screening might not be evident in this group of patients, and generalizability of our results to population with greater risks of delirium is limited. Fourth, owing to a historical-controlled study design, data of the control group, including estimation of delirium cases, may be subjected to error and bias. Moreover, differences in treatment protocol and patient care system between the two study periods might be unrecognized and could confound the results. Lastly, due to a low frequency of delirium in our study, adjustment for potentially confounding factors is impossible. Further studies in other settings with higher prevalence of postoperative delirium are required to assess cost-effectiveness of a delirium-screening strategy with the 4AT-T.

Conclusion

This study demonstrated that postoperative delirium screening with the 4AT-T did not increase the detection rate of delirium in this study due to a low frequency of delirium in the studied population. However, the instrument gained a high rate of satisfaction from nurses who used the tool in real-life practice. Most of the nurses are aware of the significance of postoperative delirium among older patients undergoing surgery as well as a potential benefit of routine postoperative delirium screening. Yet some concerns about an increased workload related to the screening still exist. Further studies in clinical settings with higher incidence of postoperative delirium are needed.

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