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Research Article

The Design and Verification of Chinese Standard Scale for Discharging from the Postanesthesia Care Unit

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Abstract

Objective: To design a Chinese scale for discharging from the Postanesthesia Care Unit (PACU), and to validate its stability and reliability. *Methods:* According to the evaluation methods of post-anesthesia recovery and the currently commonly used international anesthesia recovery scale, combined with the clinical situation of post-anesthesia care unit in our country, a multi-dimensional post-anesthesia recovery scale was formulated. The revised version of the scale was formed after the relevant experts discussed. One hundred and three patients undergoing general anesthesia were selected and evaluated by the revised scale. Item analysis, exploratory factor analysis, and reliability test were conducted to verify the reliability and stability of the scale. *Results:* The item analysis results of the revised scale showed that each item of the scale had high homogeneity with the total score of the scale. The results of critical ratio method and correlation coefficient method showed that the difference between the high score group and the low score group was statistically significant (P<0.05). The correlation coefficient between each item score and the total score of the scale was statistically significant (P<0.05), and each item of the revised scale had good discrimination. The Cronbach's α coefficient of the revised scale was 0.647, indicating that the detection effect of each item was reliable. After excluding any item, Cronbach's α was above 0.5, indicating good internal consistency, high stability and satisfactory reliability of the scale. *Conclusion:* The standard scale for discharging from the Postanesthesia Care Unit developed in this study can evaluate the recovery quality of post-anesthesia patients from multiple dimensions with high discrimination, reliability and stability.

Keywords

Scale, PACU, Recovery Period

1. Introduction

Post-anesthesia monitoring and treatment are crucial for post-operative anesthesia management. Patients who have undergone general anesthesia remain susceptible to circulatory and respiratory complications due to incomplete dissipation of anesthetic effects and the delayed recovery of protective reflexes, which may adversely impact post-operative recovery. Implementing effective post-anesthesia monitoring measures and adopting more comprehensive, scientifically

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grounded methods for assessing recovery quality are vital strategies for reducing the risk of post-anesthesia complications, carrying significant clinical implications for ensuring perioperative patient safety.

Currently, scales like the Aldrete score, Steward score, and Observer's Assessment of Alertness/Sedation (OAA/S) score are commonly used clinical scales for evaluating post-anesthesia recovery quality [1]. However, they have limitations such as quantification difficulties, simplistic criteria, and restricted applicability. A standardized, multidimensional tool for evaluating post-anesthesia recovery quality is lacking.

To enable more accurate and comprehensive evaluation of recovery quality in anesthetized patients, there is an urgent need for a practical, functionally robust post-anesthesia recovery quality scale that can be widely applied in both clinical anesthesia practice and research. Such a tool would serve as a valuable reference for clinical adoption.

2. Method

2.1. Development of the Chinese Version of the Post-Anesthesia Recovery Scale

With reference to the evaluation methods for post-anesthesia recovery quality outlined in the "Expert Consensus on Post-Anesthesia Monitoring and Treatment (2021 Edition)" [2] and the "Expert Consensus on Quality Control in Anesthesiology (2020 Edition)" [3], as well as internationally commonly used anesthesia recovery scales, a multidimensional post-anesthesia recovery quality initial scale tailored to Chinese national conditions was developed based on the clinical realities of domestic PACUs. After the initial scale was formulated, it underwent revisions by a panel of experts who assessed the content validity of the scale, including the importance, relevance, stability, functionality, and practicality of each item, resulting in the revised version of the scale. The patients who regained consciousness in the PACU after undergoing general anesthesia and applying this revised scale to evaluate its practicality, functionality, reliability, and validity, providing a reference for discharging assessment in domestic PACUs (Table A1).

2.2. Validation of the Chinese Revised Version of Anesthesia Recovery Scale

The patients during awakening period of general anesthesia in the PACU were selected in the Department of Anesthesia, Fourth Hospital of Hebei Medical University from October 2022 to February 2023, for the evaluating the revised scale, and the practicability, functionality, validity and reliability of the scale were evaluated according to the evaluation criteria.

Inclusion criteria:

1) Patients under general anesthesia who do not require transfer to the intensive care unit postoperatively but are unsuitable or unable to have their tracheal tubes removed immediately in the operating room.
2) Patients with unstable vital signs after surgery who require brief observation.
3) Patients who do not need transfer to the intensive care unit but have major organ system dysfunctions, postoperative hypothermia, and require further management and brief observation.
4) Patients with unstable neurological or mental status after surgery.
5) Pediatric patients unable to cooperate shortly after surgery.

Exclusion criteria:

1) Patients with critical conditions and unstable circulation system who still require vasoactive drugs for maintenance.
2) Patients with respiratory failure, multiple organ dysfunction, and incompletely corrected shock.
3) Patients with complex oral or pharyngeal surgeries who still require respiratory support or intensive monitoring and treatment.
4) Patients with preoperative conditions such as coma or vomiting with aspiration.
5) Patients with extensively exposed infected wounds.
6) Patients with communication barriers who cannot cooperate to complete scale assessments.

2.3. Statistical Methods

SPSS 22.0 statistical software was used to perform item analysis, exploratory factor analysis, reliability testing on the scale, and to calculate sensitivity, specificity, Youden's index, and cutoff values. AP-value <0.05 was considered statistically significant.

Since individual items in the scale cannot be used independently to diagnose patient conditions, diagnostic evaluation could not be conducted.

3. Results

3.1. General Information

A total of 103 patients undergoing general anesthesia and recovery management in the PACU were included in this study. Among them, there were 55 cases with total intravenous anesthesia and 48 cases with combined intravenous and inhalation anesthesia.

Endotracheal intubation was in 44 cases, double-lumen bronchial tube was intubated in 29 cases, and laryngeal mask airway in 30 cases.

Thyroidectomy was performed in 27 cases, gynecological laparoscopic surgery in 17 cases, Video-Assisted Thoracic Surgery in 29 cases (left/right=12/17), and

Breast-ConservingTherapy in 30 cases (left/right=16/14).

Male/female=38/65. Age was 48±10.6 years. Recovery time was 21±8.6 min.

3.2. Item Analysis

The revised scale items were analyzed using the critical ratio method and correlation coefficient method, with the following results:

3.2.1. Critical Ratio Method (Extreme Value Method, Decision Value Method)

Independent samples t-tests were conducted to compare the differences between the high-score group and the low-score group for each item. If the difference for an item was not significant (P >0.05), the item was either removed or deemed to have low clinical significance. The results showed that except for the "circulation" item, all other items exhibited significant differences between the two groups (P <0.05). The "circulation" item had a uniform score of 2 points, rendering statistical analysis impossible due to the absence of variation. See Table 1.

Table 1. Critical ratio method and Pearson correlation coefficient between sub-items and total scores.

Item	*t*	*r*
Activity	4.585[a]	0.328[b]
Respiratory Function	9.000[a]	0.162
Consciousness	5.293[a]	0.324[a]
Circulatory Function	Unable to calculate	0.162
SpO_2	1.000[b]	0.129
T ℃	1.500[a]	0.031
Pain	1.965[a]	0.236
PONV	1.000[b]	0.144

Note: [a] P<0.01, [b] P<0.05

3.2.2. Correlation Coefficient Method

The correlation coefficients between each item's score and the total scale score were calculated.

3.2.3. Reliability Test

Table 2. Reliability test results.

	Mean value of the scale after item deletion	Scale variance after deletion of items	Corrected item-total correlation	Cronbach's alpha after deletion
Activity	13.10	1.579	.326	.626
Respiratory Function	12.85	2.131	.000	.661
Consciousness	13.20	1.754	.112	.707
Circulatory Function	12.95	1.690	.442	.592
SpO_2	13.00	1.692	.328	.620
T ℃	12.98	1.615	.475	.580
Pain	12.95	1.587	.590	.555
PONV	12.93	1.661	.581	.567

The reliability coefficient of 0.647 indicates that the detection effects of each item are reliable. Cronbach's-α values are all above 0.5, demonstrating high consistency between the measurement results and the item content, confirming satisfactory scale reliability. See Table 2.

4. Discussion

Due to the combined effects of surgical trauma, anesthesia and disease, patients exhibit unique pathophysiological changes and potential life-threatening risks during the anesthesia recovery period. Postanesthesia care unit (PACU) and professionally trained medical personnel are required to manage these patients, ensuring stable vital signs and enabling timely identification and management of anesthesia- and surgery-related complications in the modern anesthesiology, thereby reducing the risk of adverse events during recovery [4, 5]. Therefore, employing an appropriate postanesthesia recovery scale for accurate and safe assessment of

recovery quality in PACU patients is very significant importance in clinical anesthesia management.

To ensure the scientific rigor, clarity, and logical structure of the scale, our research team reviewed relevant literatures and commonly used anesthesia recovery scales in clinical practice [6, 7]. Based on the most widely used clinical anesthesia scale and tailored to the actual conditions of PACUs in China, the initial scale was further optimized through evaluations of its validity and item content by multiple six Chinese anesthesiology experts, ultimately resulting in an 8-item Chinese revised version Scale discharging from PACU. See Table A1.

Item analysis is a critical step in the scale revision process, used to evaluate the quality of each item. The results of this study's item analysis showed high homogeneity between individual items and the total scale score. The critical ratio method revealed significant differences between high- and low-scoring groups, indicating good discriminative power of the scale items, with effectively reflecting the quality of vital sign recovery in each item before discharging from PACU. Correlation coefficient analysis demonstrated significant differences between the scores of the "activity" and "consciousness" items and the total scale score, while no such differences were observed for the remaining six items. This discrepancy may be attributed to the scale's limited scoring range (only 1 or 2 points per item, with no zero scores possible) and the requirement that each patient's total discharge score must not fall below 14 points, leading to minimal variation in item scores and concentrated data distribution.

Scale reliability is a key indicator for assessing precision, stability, and consistency, commonly measured by Cronbach's α coefficient [8]. The internal consistency of this scale, as reflected by a Cronbach's α coefficient of 0.647, confirms the reliability of item measurements. Removal of any single item, Cronbach's α still maintained above 0.5, indicating satisfactory internal consistency, high stability, and overall scale reliability.

Compared to anesthesia recovery scoring systems such as the Aldrete Score, Steward Score, and Observer's Assessment of Alertness/Sedation (OAA/S) Score abroad, this scale incorporates a multidimensional evaluation of recovery quality, including limb movement, respiration, circulation, consciousness, oxygen saturation, and temperature. Each assessment criterion is graded on a 0–2 point scale based on its clinical impact, facilitating detailed calculation and ease of use in clinical anesthesia management. Furthermore, the refined scoring indicators enhance precision and digitization in PACU-related anesthesia research, enabling more scientifically objective evaluations.

During the anesthesia recovery period, ensuring a smoother and safer recovery for patients is the core element of anesthesia management. The transition from general anesthesia to wakefulness involves critical indicators such as circulatory function and breath function. In the era of perioperative ERAS (Enhanced Recovery After Surgery, ERAS) management, optimizing the control of these indicators-including better recovery of consciousness, reduced pain stress, earlier restoration of mobility, and fewer instances of PONV (Postoperative Nausea and Vomiting, PONV) can significantly facilitate patients' quicker return to the ward and enhance postoperative recovery.

Compared to the most commonly used assessment tools both domestically and internationally, such as the Steward Score [9], Aldrete Score [10], and Modified Postanesthetic Recovery Score (MPARS) [11] etc, these methods have gradually expanded their observation metrics, for instance, from the initial three items to five. However, factors like hemorrhage, ambulation status, urine volume, and other complications are not central to ERAS, and some items hold limited clinical significance for PACU management.

SpO2 appears to overlap with the work of breathing indicators, but a 2024 study titled "Meta-analysis of risk factors associated with postoperative hypoxemia in the postanesthesia care unit" suggests that SpO2 remains an independent, valid, and sensitive marker for assessing hypoxemic status during transport and in the PACU [12]. This scale lists SpO2 separately, allowing it to better reflect a patient's oxygenation level beyond the work of breathing metrics. However, it should be noted that variations exist in SpO2 readings across different fingers. A study from India found that the highest readings were obtained from the middle finger, while the lowest came from the little finger [13]. This research highlights the need to consider the choice of monitoring site for SpO2 during PACU. So we selected the middle finger to obtain SpO2.

Body temperature, as a crucial core indicator in perioperative management, has received significant attention within ERAS. Active protection of body temperature can markedly impact patients' PND (Perioperative Neurocognitive Disorders, PND) and postoperative functional recovery [14, 15]. Regarding body temperature as an independent risk factor and incorporating it into the observation items of the scale is highly essential.

This scale draws upon previous Homo sapiens research and adheres to the ERAS management model, selecting eight core indicators most closely related to patients' vital signs after general anesthesia and most readily obtainable in clinical practice. By better evaluating the quality of PACU recovery, the 0–2 three-tier scoring system can more effectively quantify patients' awakening quality, providing a more detailed, feasible, and objective assessment tool for scientific observation. The total score of the Chinese standard scale for discharging from the Postanesthesia Care Unit is 16 points, and the patient could leave the PACU after reaching 14 points upon awakening.

In conclusion, adhering to scale development principles and conducting validation analyses, this scale comprises eight essential anesthesia monitoring items, suitable for PACU discharging assessments.

Abbreviations

PACU	Postanesthesia Care Unit
OAA/S	Observer's Assessment of Alertness/Sedation
ERAS	Enhanced Recovery After Surgery
MPARS	Modified Postanesthetic Recovery Score
PONV	Postoperative Nausea and Vomiting
PND	Perioperative Neurocognitive Disorders

Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

Table A1. *Chinese standard scale for discharging from the Postanesthesia Care Unit.*

Activity	Able to move limbs and lift head independently or upon command	2 score
	Able to move two limbs and perform limited head lifting independently or upon command	1 score
	Unable to move limbs independently or upon command	0 score
Respiratory Function	Can breathe deeply and cough freely	2 score
	Respiratory distress or restricted breathing, requiring an oropharyngeal airway	1 score
	No breathing, requiring respiratory support	0 score
Consciousness	Fully awake	2 score
	Drowsy but can be awakened	1 score
	Unresponsive to stimuli	0 score
Circulatory Function	Blood pressure fluctuation within 20% of pre-anesthesia level	2 score
	Blood pressure fluctuation between 20% to 49% of pre-anesthesia level	1 score
	Blood pressure fluctuation exceeding 50% of pre-anesthesia level	0 score
SpO2	Breathing room air SpO2>92%	2 score
	Requires oxygen supplementation to maintain SpO2>92%	1 score
	SpO2<92% despite oxygen therapy	0 score
T ℃	Axillary temperature >36 ℃	2 score
	Axillary temperature 35.5 ℃ to 36 ℃	1 score
	Axillary temperature <35.5 ℃	0 score
Pain	VAS＜4	2 score
	VAS4～7 Can be relieved through oral medication	1 score
	VAS≥7 Requires medication injection for relief	0 score
PONV	No or mild nausea without vomiting	2score
	Moderate nausea and/or vomiting	1score
	Severe nausea and/or repeated vomiting	0score

Aggregate score=16, ≥14 could leave PACU

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