Frontiers of Nursing • 9(1) • 2022
DOI: 10.2478/fon-2022-0003

sciendo

Frontiers of **Nursing**

Inter-Professional-Compassionate pain management during endotracheal suctioning: a valuable lesson from a Chinese surgical intensive care unit

Original article

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Received: 13 February 2021; Accepted: 21 April 2021; Published: 20 March 2022

Abstract: **Objective:** To compare the effects of a pain management program and routine suctioning methods on the level of pain presence and agitation in Chinese adults admitted to the intensive care unit. To disseminate the results from the implementation of the evidence-informed pain management interventions for reducing pain presence and agitation during endotracheal tube suctioning (ETS) and translate the key finding to clinical nursing practice.

Methods: A quasi-experimental study of a two-group post-test design was conducted in adults admitted after surgery to a surgical intensive care unit (SICU) of the Second Affiliated Hospital of Kunming Medical University, Yunnan, China in 2018. Fifty-two adults who met the study eligibility were included after consent, 26 in each group. Patients in the control group received usual care while patients in the intervention group received interventions to reduce agitation and pain-related ETS. The impacts of the intervention on the level of pain presence and agitation were measured at 5 measuring time points using the Chinese versions of Critical-Care Pain Observation Tool (CPOT) and Richmond Agitation Sedation Scale (RASS).

Results: The level of pain presence in the intervention group statistically significantly decreased during, immediately after, and 5 min after suctioning. The level of agitation in the intervention group significantly decreased during and immediately after suctioning.

Conclusions: The findings provide support for the positive pain-relieving effects of the evidence-informed pain-related ETS management interventions when compared with the usual ETS practice. The study interventions were sufficiently effective and safe to maintain patent airway clean and patent as standardized suctioning and helps pain relief. So, evidence-based pain-related ETS management intervention is worthy of recommending to utilize in SICU patients as well as other patients who required suctioning. It is worth noting that integrating pre-emptive analgesia prescription and administration with non-pharmacological intervention plays a critical role in achieving pain relief.

Keywords: *agitation • China • endotracheal tube suctioning • intensive care unit • pain management • pain presence*

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1. Introduction

Endotracheal tube suctioning (ETS) is one of the most painful procedures experienced by adult patients admitted to intensive care unit.[1–5] A number of existing ETS guidelines for adult patients have been launched with much less concern for managing pain than maintaining patent airway.[1] Optimal management of suctioning-related pain, according to Barr et al.[8] and Czarnecki et al.[10], needs to be initiated before, during, and after completion of the procedure.

To avoid developing adverse physical and psychological outcomes from unrelieved pain-related ETS in patients, adequate pain management is required.[5–7]

How to cite this article: Ruan QW, Khomapak M, Sangchan H. Inter-Professional-Compassionate pain management during endotracheal suctioning: A valuable lesson from a Chinese surgical intensive care unit. *Front Nurs*. 2022; 1:19–28.

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Previous studies have focused on examining the efficacy of a single suctioning technique and revealed positive effects on pain relief.[1,7–11] To our knowledge, there is no existing published research adequately covering a holistic procedural pain management approach for pain-related ETS.

Given the lack of critical attention paid to enhancing the efficacy of pain-relief–related ETS, the development and implementation of evidence-based practice (EBP) in a hospital was the basis for our study. Hence, the steps in developing and implementing EBP, integrated with the relevant, current, best available evidence, were employed to develop recommendations for holistic pain-related ETS management. The recommendations were also modified to fit into the individual Chinese intensive care unit context, as well as the preferences of individual patients. To integrate painless suctioning into nursing curriculum and in-service training for nurses should be employed espoused as a policy making across the nation.

The study aimed to compare the effects of a pain management program and routine suctioning methods on the level of pain presence and agitation in Chinese adults admitted to the intensive care unit. Another aim was to disseminate the results from the implementation of the evidence-informed pain management interventions for reducing pain presence and agitation during ETS and translate the key finding into clinical nursing practice.

2. Methods

2.1. Research design

A quasi-experimental study using two-group post-test design was carried out to determine the differences between the two groups after the intervention. The present study was conducted to compare the effects of a pain management program with the routine suctioning praxis on the level of pain presence and agitation of intubated adult patients who were hospitalized in a surgical intensive care unit (SICU). The hypotheses tested in the study were: (1) SICU Chinese adults who participate in the ETS pain management program will have a lower level of pain presence and (2) they will have a lower level of agitation.

2.2. Sample setting and recruitment

The research was conducted at the Second Affiliated Hospital of Kunming Medical University, Yunnan, China, between December 2017 and January 2018. Age and gender matching were employed prior to consecutively assigning the patients into the respective groups to avoid generating confounding factors.

The sample size was estimated based on a power analysis using the effect size of two similar previous studies were weighted 0.70 with power was set at 0.80 and the alpha value at 0.05. The sample consisted of 52 adults, admitted after surgery to a SICU, who met the study inclusion criteria, agreed to the circumstances involved in the study, and were willing to voluntarily give consent to participate in this study. The first 26 eligible patients were allocated as the control group; the subsequent 26 patients were assigned into the intervention group.

The study inclusion criteria were in orientation with time, place, and person: (1) adults >18 years of age; (2) requiring ETS; (3) consciousness level with Glasgow Coma Scores (GCSs) of ≥7; (4) no deep sedation with high-dose sedatives or tranquilizers during the previous 6 h; (5) no severe facial trauma; (6) no neurological damage affecting breathing (such as quadriplegia); (7) no record of mental illness or neuromuscular diseases; (8) communicable, and no history of and current hearing deficit and cognitive impairments; and (9) written informed consent could be obtained from the family member of the patient. Exclusion criteria included: (1) requiring suctioning at an interval <20 min; (2) development of dysrhythmia, and reduced oxygen saturation (SpO_2) level by >10% during suctioning; and (3) unplanned extubation and reintubation.

2.3. Instruments

The data were collected using the demographic and clinical characteristics questionnaire, a documentation form for ETS pain management outcomes using Chinese versions of “Critical-Care Pain Observation Tool” and “Richmond Agitation–Sedation Scale”. The percentage of inter-rater reliability of the Chinese versions of Critical-Care Pain Observation Tool (CPOT) and Richmond Agitation Sedation Scale (RASS) was 100%. The internal consistency of the documentation form for ETS pain management outcomes assessed by Cronbach’s alpha were CPOT (0.57–0.86) and RASS (0.53–0.84). The instruments scale content validity index (S-CVI) of the overall content using the universal agreement approach was 1.00.

2.3.1. Demographic and Clinical Characteristics Questionnaire

The questionnaire was developed by the researchers based on the relevant literature. The questionnaire collected the demographic characteristics of the patients,

and information regarding pain, ETS, mechanical ventilation, health, and analgesics' prescription.

2.3.2. Documentation Form for ETS Pain Management Outcomes

Pain management outcomes were level of pain presence and agitation at the selected 5 measuring time points. Pre-procedural pain presence and level of agitation were first assessed to determine the baseline pain and agitation of the patient. Assessed levels of pain presence and agitation during, immediately after, 5 min after, and 15 min after the procedure aimed at measuring procedure-related changes in levels of pain presence and agitation.

2.3.3. Chinese versions of CPOT

The primary outcome in participants was level of pain presence measured with the Chinese version of CPOT. Measurements of the level of pain presence were carried out based on 4 behavioral domains: facial expression, body movements, compliance with the ventilator, and muscle tension. The score of each aspect ranged from 0 (not at all) to 2 (very much). The total scores ranged from 0 to 8 and higher scores represent the higher level of pain presence.[12]

2.3.4. Chinese versions of RASS

Level of participants' agitation was measured as the secondary outcome using the Chinese version of RASS. RASS is a 10-point scale to categorize behaviors: combative, very agitated, restless, alert and calm, drowsy, light sedation, moderate sedation, deep sedation, and unarousable. RASS scores incorporate a range, consisted of a 4-level hierarchy of agitation ranging from +4 to −5. Higher positive RASS scores indicate higher level of agitation.[13]

2.4. Procedure

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Nursing, Prince of Songkla University (PSU), and the Medical Research and Ethics Committee (MREC), Ministry of Health, China. A total of 52 eligible patients admitted to the SICU participated in the study. Informed consent was fully obtained from all participants and relatives. The data collection for both groups followed the same procedure and employed the same research instruments. The first 26 patients were consecutively assigned into groups to receive the usual suctioning from the staff nurses. There was no intervention to the patients in the control group aimed at decreasing pain. The subsequent 26 patients were treated as the intervention group to receive the evidence-based interventions to manage pain-related ETS before, during, and after completion of the procedure administered by the researchers. Levels of pain presence and agitation of both groups were evaluated as outcome measurements at 5 measuring time points. Pre-procedural assessment was aimed at measuring the patient's baseline of pain and agitation. Assessments during, immediately after, 5 min after, and 15 min after the completion of suctioning were aimed at measuring changes resulting from the procedure and the efficacy of the intervention.[2,10,14]

2.5. Intervention

Implication of an evidence-based intervention was initiated before suctioning and it was ongoing during and after the suctioning procedure. In this study, the timeline of pain-related ETS was divided into 3 phases (before, during, and after the procedure) according to a position statement in procedural pain management.

2.5.1. Before the ETS procedure

The ETS procedure is likely to produce pain and/or anxiety, and for this reason a program for managing patient comfort must be created. Pain management before ETS aims at preparing the patient to receive the ETS procedure as well as decreasing pain during the ETS procedure. Pain management before ETS encompasses the following constituents: (1) ETS should be considered a bio-psychosocial experience for the patient; (2) assess and identify the patient's need for suctioning; (3) perform ETS when clinically indicated by the relevant signs; and (4) assessment of the *baseline* pain presence (CPOT scores) and agitation (RASS scores) was made to *detect and obtain assurance about* the effects of the interventions. In addition, before the procedure, an individualized ETS pain management plan should be established, which includes the mutual goal setting decided (e.g., CPOT < 3, RASS = 0). The requirement for patient compliance and family member participation were clearly explained until understanding could be ensured. Important information pertaining to the study was concisely explained to patients before initiation of ETS. Ready-to-use pre-emptive analgesia intervention was planned with patients and relatives. Afterward, a prescribed rapid onset analgesic, 3 μg intravenous dose of Sufentanil, was administered to the patient. Music therapy and/or cold application was provided according to patient preference. Endotracheal tube securement was checked and confirmed to prevent tube movement and subsequent pain.

2.5.2. During the ETS procedure

The ETS was performed as needed based on recognition of the patient's indication for suction criteria according to the recommended criteria and the baseline of each patient's compliance with the unit schedules. Intratracheal suctioning pain management interventions included: use of a qualified suction catheter; application of optimal vacuum pressure between −80 mmHg and −150 mmHg or −200 mmHg for thick and sticky sputum; controlled 10–15 s suction duration; asking a staff nurse or relative to securely hold the endotracheal tube during suctioning; and employing the shallow technique for the depth of catheter insertion. Levels of pain presence and agitation and tolerance of patients were assessed. Psychological support such as touching or holding the patient's hand, gently talking to the patient, and asking for permission and readiness regardless of consciousness were continually provided during suctioning and throughout the procedure.

2.5.3. After the ETS procedure

Upon completion of suctioning, the level of pain presence and agitation were assessed and documented immediately after, 5 min after, and 15 min after the procedure. Patients needing additional support for pain management and comfort were assessed. Additional prescribed pain medication was administered when patient's CPOT score was ≥ 3. The efficacy of the interventions and suggestions for the coming pain management improvement were evaluated with patients as possible and with a family member.

2.6. Data analysis

The IBM Statistical Package for Social Sciences (SPSS 22.0) was used for data analysis. Descriptive data were displayed as frequency, percentage, mean, and standard deviation. Between-group differences were assessed by the Pearson chi-square test, likelihood test, and independent *t* test. Data were evaluated with 95% confidence intervals and a *P* value <0.05 was accepted as significant. The Mann–Whitney *U* test was used to test the study hypothesis to compare between-group differences in the level of pain presence (CPOT scores) and agitation (RASS scores).

3. Results

3.1. Demographic information

The baseline of demographic characteristics between the two groups were compared. The mean age of participants in the intervention group was 61.35 (SD 11.42) years and in the control group 61.38 years (SD 11.37). Both *groups* had *the same percentage of women* (61.5%) and *men* (38.5%) as participants, with the same range of an average body mass index (BMI) (18.5–24.9 kg/m^2). More than half of the participants in both groups received an endotracheal tube size of 7.0 with an intubation length of 8–12 hours (intervention 53.9%, control 65.4%). Every participant received a suction catheter of French sizing (Fr) 14, with opened suction system. There were no significant differences between the groups in terms of clinical characteristics ($P > 0.05$).

3.2. Level of pain presence and agitation

Between-group comparison of level of pain presence and level of agitation before, during, immediately after, 5 min after, and 15 min after the completion of suctioning are illustrated in Tables 1 and 2. There were no differences in levels of pre-procedural pain presence and agitation between the usual care group and the intervention group ($z = 0.00$, $P = 1.00$).

3.2.1. Levels of pain presence in the intervention and usual care groups

The levels of pain presence (CPOT scores) were similar before suctioning in both groups. During suctioning, the median of the CPOT scores increased to 4 (interquartile range [IQR] = 1) and 2 (IQR = 1) in the control and intervention groups, respectively ($z = -5.97$, $P < 0.05$). Immediately after suctioning, the median of CPOT scores decreased to 1 (IQR = 1) and 0 (IQR = 0) in the control and intervention groups, respectively ($z = -5.94$, $P < 0.05$). The CPOT scores in both groups decreased to 0 (IQR = 0) at 5 min and 15 min after suctioning ($z = -2.06$, $P < 0.05$). There was a significant between-group difference for the level of pain presence during ($z = -5.97$), immediately after ($z = -5.94$), and 5 min after tracheal suctioning ($z = -2.06$, $P < 0.05$). There were no statistically significant differences in the CPOT scores before suctioning and 15 min after the ETS procedure ($z = 0.00$, $P = 1.00$) (Table 1).

3.2.2. Levels of agitation in the intervention and usual care groups

There was a between-group difference in the level of agitation (RASS scores) during ($z = -3.05$) and immediately after ($z = -3.91$) the completion of the ETS procedure ($P < 0.05$). There was no between-group significant difference for the RASS scores at before, 5 min after, and 15 min after completion ($z = 0.00$) of the ETS procedure ($P = 1.00$) (Table 2).

CPOT scores	*n*	Median (0–8)	IQR	Mean Rank	Min–Max	Mann–Whitney *U* Test	
						z	*P*
Before ETS						0.00	1.000
Intervention group	26	0	–	26.50	0		
Usual care group	26	0	–	26.50	0		
During ETS						−5.97	0.000
Intervention group	26	2	1	14.31	1–3		
Usual care group	26	4	1	38.69	3–6		
Immediately after ETS						−5.94	0.000
Intervention group	26	0	0	14.98	0–1		
Usual care group	26	1	1	38.02	0–3		
5 min after ETS						−2.06	0.039
Intervention group	26	0	–	24.50	0		
Usual care group	26	0	0	28.50	0–2		
15 min after ETS						0.00	1.000
Intervention group	26	0	–	26.50	0		
Usual care group	26	0	0	26.50	0		

Note: CPOT, Critical-Care Pain Observation Tools; ETS, Endotracheal tube suctioning; IQR, interquartile range.

Table 1. Level of Pain Presence (CPOT Scores) of the Study Participants in the Control and Intervention Groups ($N = 52$).

RASS scores	*n*	Median (0+4)	IQR	Mean Rank	Min–Max	Mann–Whitney *U* Test	
						z	*P*
Before ETS						0.00	1.000
Intervention group	26	0	–	26.50	0		
Usual care group	26	0	–	26.50	0		
During ETS						–3.05	0.002
Intervention group	26	1	1	22.50	0–1		
Usual care group	26	1	–	30.50	1		
Immediately after ETS						–3.91	0.000
Intervention group	26	0	–	20.50	0		
Usual care group	26	0	1	32.50	0–1		
5 min after ETS						0.00	1.000
Intervention group	26	0	–	26.50	0		
Usual care group	26	0	–	26.50	0		
15 min after ETS						0.00	1.000
Intervention group	26	0	–	26.50	0		
Usual care group	26	0	–	26.50	0		

Note: ETS, Endotracheal tube suctioning; IQR, interquartile range; RASS, Richmond Agitation Sedation Scale.

Table 2. Level of Agitation (RASS Scores) of the Study Participants in the Control and Intervention Groups ($N = 52$).

4. Discussion

The study findings are discussed according to the hypotheses that state that SICU Chinese adults who receive the intervention or the ETS pain management program will have a lower level of pain presence and agitation than those who do not receive the intervention or the ETS pain management program. Chinese adults who received the ETS pain management program had significantly lower levels of pain presence and agitation during suctioning and 5 min after completion of the ETS procedure ($P < 0.05$). The positive pain

management outcomes derived from implementation of the program could be acknowledged to benefit EBP utilization for integration with cutting-edge evidence.[15] Evidence-based nursing practice is in accordance with research evidence about clinical expertise and stimulates the individualization of care including patient preferences.[16] According to the evidence derived from previous studies, all potential ETS-related pain factors were integrated into the program, including optimal level of negative pressure, depth of suction catheter insertion, and the number of times and duration of suctioning on each attempt.[1,7,9,11] Expert opinions regarding the control of less pain from the beginning and throughout execution of the tracheal suctioning procedure were included. These opinions provided psychological support and facilitated immobilization of the endotracheal tube. Notably, the principle of procedural pain management involving pre-emptive analgesia underpinning this program and application of non-pharmacological interventions play a vital role in the effectiveness of the intervention. Pre-emptive analgesia was administered before beginning the suctioning to reduce the sensitization of the peripheral and central pain pathways during the ETS procedure.[3,8] This was supported by a great number of authors in the literature.[3,10,17–21] It was reported in the literature that non-pharmacological interventions could decrease the pain related to tracheal suctioning by the synergistic analgesic effect.[5,22–26] These include giving patient education, and the use of music therapy or cold application or both.[5,8,24]

The intervention was developed to fit the context of the SICU of one hospital in China in patients who had a short duration of endotracheal intubation. The lack of random assignment into the intervention group might lead to non-equivalent test groups, which might limit the generalizability of the results to a larger population. The purposive sampling of the study participants could miss some potential responses by such patients, who were not selected. The intervention was only employed by the researchers during the day shift, while the staff nurses followed the usual ETS practices thereafter. Therefore, other confounding factors such as discontinuation might have been present.

In this study, 3-phase endotracheal suctioning-related pain management interventions were implemented to SICU patients to reduce pain presence and agitation. The study findings revealed that the evidence-based interventions significantly lowered the levels of pain presence and agitation during suctioning ($P < 0.05$). These results extend the efficacy of previous studies utilizing music therapy and a catheter size of 12 in reducing pain intensity and agitation.[2,5,11,25,27,28] This study also supports the efficacy of the application of 3-phase procedural pain management in relieving the painful procedures employed in previous studies.[3,8,10,17–19,29]

These results illustrate the benefit of using a systematic EBP process and translating the current best available evidence into nursing practice to provide high-quality care and positive outcomes for patients.[3,7,8,10,18,19,29]

5. Conclusions

The efficacy of the structured evidence-based suction-related pain management interventions indicates the best and feasible practice guidance for nurses. Integrating the interventions with traditional tracheal suction practice enhances the ability of nurses to achieve both maintaining a patent airway and relieving the pain associated with suctioning. The most remarkable result that emerged from the present study regarding the interventions are the cost effectiveness and the acknowledged significant role of nurses in pain management, with the achievement of comfort and safety for ICU patients.

A Valuable Lesson from a Chinese Surgical Intensive Care Unit: Recommendations for successful utilization:

5.1. Compassionate evidence-based pain management

Researchers declare a research complete when disseminated its findings to the target population to achieve foreseeable practice change(s). The significant proven efficacy of the interventions might be meaningless without empowering nurses' awareness, ensuring a climate of understanding and motivation for sustaining the use of the interventions in designated patients, and integrating the interventions with daily practice to achieve positive desired outcomes. The study results showed that tracheal suctioning precipitated the level of pain presence and agitation in SICU patients regardless of the short duration of intubation and less frequent suctioning attempt.

Considerable insight has been gained beyond providing evidence to guide nursing practice. Sustainable utilization of EBP to address tracheal suction-related pain requires the establishment of high value and awareness among nurses. Indeed, unseen suction-related pain is possible to overcome by nurses' compassion and empathy to see a person in pain or feel the patient's pain. Developing nurses' ability to empathize with the patient's pain during tracheal suctioning should be the beginning of the suction-related pain management practice.

Self-report may be difficult or impossible during suctioning in SICU patients and ventilated patients. Empathy helps nurses to hear pain in the absence of

a patient's voice and provides an understanding of the painful sensations experienced by patients. Assumed pain present (APP) also helps nurses to be concerned about the painful therapeutic procedure given to patients as a consequence of tissue trauma and serves to remind them to initiate pain management.

Expert opinions might not always be less important than evidence. Additional caring techniques learnt from experiences can provide spiritual-based practice to relieve suction-related pain. These included touching and holding a patient's hand, gently talking to the patient using empathetic statements, asking for readiness and permission including a plan for appropriate non-verbal communication during suctioning, and securely holding the endotracheal tube during suction.

Best practice for tracheal suction-related pain also requires nurses to be competent in using their critical thinking, clinical reasoning, and clinical decision-making to harmoniously integrate *relevant* clinical *evidence. Apparently, t*he less duration of endotracheal tube placement, the far less patients experienced suction-related pain. Integrated relevant evidence-based clinical guidelines included but were not limited to pulmonary rehabilitation weaning and discontinuing from mechanical ventilator enhanced recovery after surgery (ERAS). Simple preoperative teaching of breathing, coughing, and early mobilization is highly necessary to empower surgical nurses to be aware of and value its significance. Taken together, to increase quality pain management and patient contentment, patients should be informed before surgery about the intubation and management of pain associated with tracheal suctioning that they will experience postoperatively.

5.2. Inter-professional collaboration under Chinese social hierarchy

Administration of pre-emptive analgesia is proved in this study as one of the key components contributing to adequate suction-related pain management. According to the p*rofessional nursing* and midwifery *legislation in China,* nurses have no prescriptive authority. Nurses' collaboration with physicians regarding adequate and appropriate pre-emptive analgesia prescription becomes another key to achieve optimal suction-related pain management. Inter-professional communication and nurses' autonomy in making clinical decisions under Chinese **social hierarchy** might be challenging.[30] Physicians' awareness of nurses' knowledge and skills enhances their collaborations.[31] On the other hand, the lack of recognition by physicians of a professional nursing role was reported as the most important barrier for good relations between these professions.[32] Inter-professional education (IPE) is also acknowledged as a key mechanism for enhancing communication, resulting in optimizing shared clinical decision making and improving care delivery among nurses and physicians.[30] Under the circumstances, establishing IPE and developing nurses' competencies for using evidence should benefit nurses by enabling them to effectively collaborate with physicians regarding pre-emptive analgesic prescription plans for patients.

5.3. Ethical and moral obligation pain management

Distribution of EBP intervention requires nurses to be sufficiently competent in knowledge and skills or tasks required for each intervention, for instance, non-pharmacological interventions, CPOT or RASS tools, or the depth of catheter insertion. Looking forward, developing strategies and actions to empower nurses' awareness regarding ethical and professional responsibility and commitment to establish competency in professional practice is another way to achieve best practice for suction-related pain.[33]

6. Implications for nursing policy

The need for strategic plans to establish inter-professional-compassionate suctioning as well as for creating and sustaining awareness of pain-related suctioning in staff nurses are a valuable nursing lesson gained from the present study. Hence, painless suctioning needs to be integrated into nursing curriculum and in-service training for nurses should be espoused as part of policy making across the nation.

Acknowledgments

The authors gratefully acknowledge Thailand's Educations Hub for the Southern Region of ASEAN Countries (TEH-AC) Scholarship through Prince of Songkla University, Thailand, for a scholarship award to support this study. The authors are sincerely grateful to the Second Affiliated Hospital of Kunming Medical University ICU Kunming, Yunnan, China, and all health care providers of the SICU for granting us permission and support throughout our data collection period. The authors are thankful to all participants who agreed to be respondents and provided their unbiased responses for this study.

Ethical approval

Permission to conduct the research study was approved by the Research Ethics Committee of the Faculty of Nursing, Prince of Songkla University, Thailand, and

from the Medical Research and Ethics Committee (MREC), Ministry of Health, China in November 2017 and December 2017 (No. 2017 NSt-Qn 045). Three ethical issues, including informed consent, protecting confidentiality or anonymity, and avoiding risk to participants, were considered when conducting this study. All participants and primary relatives were well informed about the study, and an information sheet was used to educate participants who voluntarily decided to participate in the study and gave written informed consent. Maintaining the confidentiality and anonymity of the participants' information and identity was ensured using a coding system.

Conflict of interest

None of the authors disclose any potential conflict of interest.

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