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Effects of multiple protection model in the operating room on physiological stress and risk events in patients undergoing coronary artery stent implantation

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Abstract

Objective: To analyze the impact of multiple protection model in the operating room on patients' physiological stress and risk events after coronary artery stent implantation (CASI).

Methods: During October 2021 to October 2022, 150 patients with coronary heart disease (CHD) were picked as the research subjects, all of whom underwent CASI. The clinical data were retrospectively analyzed, and the patients were divided into two groups according to different nursing methods, with 75 cases in each group. Patients in the intervention group received multiple protection model intervention in the operating room, and the patients in the control group adopted conventional care model. The patient satisfaction with nursing, postoperative recovery, psychological stress scores, physiological stress indicators, and adverse cardiac risk events were recorded.

Results: Patients in the intervention group had much higher percentage of the patient satisfaction with nursing than those in the control group ($P < 0.05$). The time to get out of bed and hospital stay was significantly shorter and the 6-min walking distance was markedly longer in the intervention group than the control ($P < 0.05$). The Hamilton Anxiety (HAMA) scale and Hamilton Depression (HAMD) scale score of patients in two groups were sharply decreased after the intervention ($P < 0.05$), which were strongly lower in the intervention group than the control ($P < 0.001$). After the intervention, the heart rate, cortisol and epinephrine of patients were all sensibly elevated in two groups ($P < 0.05$), which were all memorably lower in the intervention group than the control ($P < 0.001$). The incidence of adverse cardiac risk events in the intervention group was 5.33%, which was dramatically lower than 16.00% in the control group ($P < 0.05$).

Conclusion: The application of multiple protection model in the operating room on patients undergoing coronary stent implantation promoted postoperative recovery, reduced patients' psychological and physiological stress, maintained blood pressure and other vital signs, reduced the incidence of adverse cardiac risk events, and improved the patient satisfaction with nursing.

Keywords: Multiple protection model in the operating room, Coronary stent implantation, Physiological stress, Risk events

Introduction

Coronary atherosclerotic heart disease, also known as coronary heart disease (CHD), refers to heart disease caused by coronary atherosclerosis narrowing or occlusion of the lumen leading to myocardial ischemia, hypoxia or necrosis. It is classified as ischemic heart disease, which is the most common type of atherosclerosis leading to organ lesions. There are many causes of myocardial ischemia, CHD is the main cause of myocardial ischemia, not the only cause, and other diseases can also cause myocardial ischemia [1]. In recent years, the incidence rate of CHD has gradually increased, showing a younger trend, and the number of CHD-related death has also increased year by year. Therefore, improving the early diagnosis rate of patients and providing timely and effective interventions is of great significance in reducing patient mortality [2, 3].

The common surgical methods for CHD mainly include percutaneous coronary balloon angioplasty (PCBA), coronary artery stent implantation (CASI) and so on. These methods help patients unclog narrow or occluded lumens, thereby improving myocardial perfusion and greatly reducing the risk of death [4, 5]. CASI, also known as cardiac stent surgery, is based on the principle of inserting a balloon catheter into a narrowed vessel through vascular puncture, pressurizing and inflating the balloon outside the body, stretching open the narrowed blood vessel wall, and restoring the diseased blood vessel to unobstructed art. CASI has the advantages of simple operation, minimal trauma, and fast postoperative recovery, requiring only local anesthesia [6]. As one of the main sub-fields of nursing, nursing in operating room is an important battlefield for hospitals to rescue critically ill patients, and the quality of nursing is closely related to surgical outcomes and patient prognosis [7]. In CASI, the environment of the operating room and the physiological conditions of the patient are important factors that affect the patient's circulatory function and stress response. The multiple protection mode of operating room refers to a comprehensive intervention model that adopts a variety of measures to protect patients during surgery, which aims to give full play to the advantages of multiple protection in surgical nursing under the guidance of holistic nursing theory and cooperative nursing method. The purpose is to improve the quality of nursing in the operating room, maintain the stability of patients' circulatory function, and reduce surgical stress stimuli [8, 9].

In this study, 150 patients underwent CASI during October 2021 to October 2022 were picked as the research subjects, aiming to analyze the impact of multiple protection model in the operating room on patients' physiological stress and risk events after CASI and providing effective nursing intervention strategies for the rehabilitation of patients.

Results

Comparison of the clinical data between the two groups

There was no significant difference in clinical data (including age, gender, diabetes, hypertension, family history of CHD, urgent PCI, number of stents, and syntax score) between the intervention group and the control group ($P > 0.05$, Table 1).

Table 1 Comparison of the clinical data between the two groups

Clinical data	The intervention group ($n=75$)	The control group ($n=75$)	t/χ^2	P
Male	40 (53.33)	39 (52.00)	0.027	0.870
Age (year)	65.00 ± 16.00	66.00 ± 15.00	0.395	0.694
Diabetes	60 (80.00)	58 (77.33)	0.159	0.690
Hypertension	45 (60.00)	49 (65.33)	0.456	0.500
Family history of CHD	20 (26.67)	25 (33.33)	0.794	0.373
Urgent PCI	62 (82.67)	65 (86.67)	0.462	0.497
Number of stents			1.042	0.307
≥ 3	24 (32.00)	30 (40.00)		
< 3	51 (68.00)	45 (60.00)		
Syntax score	16.25 ± 5.33	17.02 ± 5.29	0.888	0.376

Evaluation of the patient satisfaction with nursing

Patients in the intervention group had much higher percentage of the patient satisfaction with nursing than those in the control group ($P<0.05$, Table 2).

Comparative analysis of postoperative recovery

The time to get out of bed and hospital stay was significantly shorter ($P<0.05$) and the 6-min walking distance was markedly longer in the intervention group than the control ($P<0.05$, Table 3).

Comparative analysis of psychological stress scores

There existed no statistically significant difference in psychological stress scores between two groups before nursing ($P>0.05$). The HAMA and HAMD score of patients in two groups were both sharply decreased after the intervention ($P<0.05$), which were strongly lower in the intervention group than the control ($P<0.001$, Table 4).

Table 2 Evaluation of the patient satisfaction with nursing [*n*/%]

Groups	Cases	Very satisfied	Satisfied	Dissatisfied	Satisfaction
The intervention group	75	44 (58.67)	28 (37.33)	3 (4.00)	72 (96.00)
The control group	75	32 (42.67)	31 (41.33)	12 (16.00)	63 (84.00)
χ^2		–	–	–	6.000
P		–	–	–	0.014

Table 3 Comparative analysis of postoperative recovery ($\overline{x} \pm s$)

Groups	Cases	Time to get out of bed (h)	Hospital stay (d)	6-min walking distance (m)
The intervention group	75	38.40 ± 2.62	12.50 ± 1.50	392.00 ± 25.40
The control group	75	65.00 ± 3.20	18.00 ± 2.50	287.00 ± 18.50
t		55.7000	16.337	28.938
P		< 0.001	< 0.001	< 0.001

Table 4 Comparative analysis of psychological stress scores ($\bar{x} \pm s$)

Groups	HAMA score		HAMD score	
	Before nursing	After nursing	Before nursing	After nursing
The intervention group ($n=75$)	28.77 ± 3.70	12.93 ± 1.50*	27.50 ± 4.10	11.90 ± 1.40*
The control group ($n=75$)	28.90 ± 3.60	19.90 ± 2.10*	27.60 ± 3.99	19.50 ± 1.80*
t	0.218	23.390	0.151	28.863
P	0.827	< 0.001	0.879	< 0.001

*$P < 0.05$ compared with the same group before nursing

Table 5 Comparative analysis of physiological stress indicators ($\bar{x} \pm s$)

Groups	Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)		Heart rate (times/min)	
	Before nursing	After nursing	Before nursing	After nursing	Before nursing	After nursing
The intervention group ($n=75$)	128.12 ± 6.77	115.42 ± 8.52*	86.88 ± 4.52	87.23 ± 5.48	86.35 ± 5.71	90.22 ± 6.13*
The control group ($n=75$)	127.28 ± 7.05	133.25 ± 10.88*	87.06 ± 5.12	88.21 ± 5.74	85.45 ± 5.78	101.26 ± 6.73*
t	0.744	11.174	0.228	1.070	0.959	10.503
P	0.458	< 0.001	0.820	0.287	0.339	< 0.001

Groups	Cortisol (nmol/ml)		Epinephrine (pmol/ml)	
	Before nursing	After nursing	Before nursing	After nursing
The intervention group ($n=75$)	225.43 ± 30.38	239.65 ± 47.88*	33.15 ± 4.58	34.06 ± 4.02*
The control group ($n=75$)	232.59 ± 34.30	301.71 ± 51.52*	32.22 ± 4.87	57.12 ± 4.04*
t	1.353	7.642	1.205	35.040
P	0.178	< 0.001	0.230	< 0.001

*$P < 0.05$ compared with the same group before treatment

Comparative analysis of physiological stress indicators

No significant difference was detected in physiological stress indicators between two groups before nursing ($P > 0.05$). After the intervention, the heart rate, cortisol and epinephrine of patients were all sensibly elevated in two groups ($P < 0.05$), which were all memorably lower in the intervention group than the control ($P < 0.001$, Table 5).

Comparative analysis of cardiac risk events

The incidence of adverse cardiac risk events in the intervention group was 5.33%, which was dramatically lower than 16.00% in the control group ($P < 0.05$, Table 6).

Discussion

Coronary heart disease (CHD) is generally accompanied by obvious clinical symptoms, such as chest pain, chest tightness, shortness of breath, etc. After surgical treatment, clinical symptoms could be improved to a certain extent, and blood vessels could be unblocked to promote blood flow in the body, greatly improving the patient's myocardial function [10]. However, surgical treatment inevitably causes physical or

Table 6 Comparative analysis of cardiac risk events [*n*/%]

Groups	Cases	Coronary artery perforation	Acute coronary occlusion	Cardiogenic shock	Stent thrombosis	Myocardial infarction	Percentage
The intervention group	75	2 (2.67)	1 (1.33)	0 (0.00)	0 (0.00)	1 (1.33)	4 (5.33)
The control group	75	3 (4.00)	3 (4.00)	1 (1.33)	4 (5.33)	1 (1.33)	12 (16.00)
χ^2		–	–	–	–	–	4.478
P		–	–	–	–	–	0.034

psychological trauma to patients, leading to slower recovery. Therefore, timely and effective nursing interventions are necessary. The content of the conventional nursing model is too ambiguous, and the nursing plan lacks a certain degree of comprehensiveness and scientificity, resulting in limited overall nursing effectiveness. Moreover, routine care cannot meet the nursing needs of patients, and more effective nursing intervention models should be sought [11, 12]. In this study, multiple protected mode in operating room was used for patients undergoing PCSI, and good results were achieved.

The multiple protection model in the operating room is one of the new nursing modes, which can further give full play to the advantages of diversified protection on the basis of the holistic nursing mode. The multiple protection model focuses on patients, optimizes surgical procedures, standardizes surgical behavior, and improves emergency response. The formulation of nursing plans has always been based on the patient's own perspective, combined with the patient's needs to improve the nursing plan, and gradually applied to clinical nursing work [13, 14]. At present, multiple protection model has achieved good results in clinical application. Research found that providing multiple protection model for patients undergoing laparoscopic surgery could effectively maintain the stability of their circulatory function and reduce surgical stress stimulation. Previous research proved that implementing multiple nursing interventions during the perioperative period of pediatric surgery was beneficial for improving the negative stress state of children, enhancing their cooperation during anesthesia, and improving the nurse patient relationship and increasing family satisfaction [15]. The results of this study showed that the intervention group had much higher patient satisfaction with nursing, longer 6-min walking distance and sharply shorter time of getting out of bed and hospitalization after nursing than the control group. These above results indicated that multiple protection model could effectively promote postoperative recovery of patients undergoing CASI and improve the patient satisfaction with nursing. The reason might be that in the multiple protected mode, the nurses formulated corresponding nursing plans according to the patient's condition and the possible situation during the operation, and at the same time fully did all basic nursing, including cleaning and disinfection, vital sign monitoring, etc. While providing professional services to patients, nursing staff can actively strengthen communication with patients, thereby helping them alleviate anxiety, improve their understanding of the disease, enhance confidence in overcoming the disease, and promote harmonious doctor–patient relationships.

The postoperative recovery in the observation group was significantly better than that in the control group, which might be due to the fact that the multivariate protection mode intervention focused on the assessment of the overall condition of the patient and formulated a personalized intervention plan according to the specific situation of the patient, so as to improve the safety and effectiveness of the operation. Secondly, through multidisciplinary cooperation, this model gave full play to the advantages of each specialty to provide patients with comprehensive and continuous care, reduced the risk of postoperative complications, and promoted early postoperative recovery. In addition, the multi-protection model also focused on the psychological and social intervention of patients, relieved patients' preoperative tension and postoperative anxiety, reduced stress response, and promoted disease recovery. After years of clinical development [16], the multiple protection model in the operating room has gradually matured. The key step of multiple protection model is that comprehensive nursing intervention mode should be adopted for patients in the perioperative period to reduce surgical trauma and physical stress reaction, promote rapid recovery of patients after surgery, and reduce complications.

Psychological stress refers to the emotional reactions of patients towards the surgery itself and its possible consequences, such as anxiety, fear, etc. [17]. Physiological stress refers to a series of changes in the body caused by trauma or stimulation, mainly manifested as thermoregulation dysfunction, elevated blood pressure, accelerated heart rate, shortness of breath, increased sweating, pale skin, muscle tension, pain, and even nausea and vomiting. Therefore, perioperative nursing intervention is particularly important [18]. Relevant data show that [19], the multiple protected mode of the operating room can effectively reduce the anxiety, depression and other negative emotions of cesarean section women, maintain stable blood pressure and heart rate, and improve maternal satisfaction. The results of this study exhibited that the HAMA score, HAMD score, systolic blood pressure, heart rate, cortisol, epinephrine levels and the incidence of adverse cardiac risk time of patients in the intervention group after nursing were sharply lower than those in the control group. It could be seen that the intervention of multiple protected mode in the operating room could effectively reduce the psychological and physiological stress response of patients due to surgery. The reason might be that in the intervention of multiple protected mode, psychological support through positive suggestion were given to the patients, and scientific, humanized and personalized psychological counseling intervention was provided. Patients' response to surgical treatment was largely reduced, and they could cooperate with doctors with an optimistic attitude to prevent excessive panic and instability of vital signs during surgery. In addition, the adoption of hypothermia protection nursing mode can timely make nursing staff aware of potential risk events that may occur during surgery. In the operating room, the nursing staff can timely keep patients warm and prevent hypothermia by heating the operating bed and irrigating fluid [20]. In addition, the multiple protection model intervenes in transportation protection, paying attention to the patient's physiological comfort during transportation and reducing the occurrence of adverse events during transportation. The multiple protection mode in the operating room emphasizes close intraoperative monitoring, and timely detection and treatment of intraoperative complications, which helps to reduce the incidence of intraoperative complications and improve the safety of

surgery. However, due to the limited sample size included in this study, postoperative complications are likely to be related to the quality of surgical intervention and the quality of drug therapy, so further studies with large sample sizes are needed to verify the results.

In general, the application of multiple protection model in the operating room on patients undergoing coronary stent implantation promoted postoperative recovery, reduced patients' psychological and physiological stress, maintained blood pressure and other vital signs, reduced the incidence of adverse cardiac risk events, and improved the patient satisfaction with nursing. There were still certain limitations in this study. Due to economic and time limitations, it was not possible to conduct follow-up work for each patient after discharge to have a clear understanding of the patient's recovery. In addition, due to limited human and material resources, the subjects in this study were only limited to the patients who had undergone PCSI, and did not involve the patients who had undergone surgery in other departments. Thus, the disease types are still needed to be expanded to further confirm the clinical application value of the multiple protection model in the operating room.

Materials and methods

Clinical materials

A total of 150 patients who underwent CASI during October 2021 to October 2022 were picked as the research subjects. The selection process of these subjects is shown in Fig. 1. The clinical data were retrospectively analyzed. According to the different nursing methods, the patients were divided into the observation group and the control group, 75 cases in each group. Among them, there were 40 males and 35 females in the intervention group, with patients ranging in age from 50 to 80 years old and an average age of (65.00 ± 16.00) years old. There were 39 males and 36 females in the intervention group,

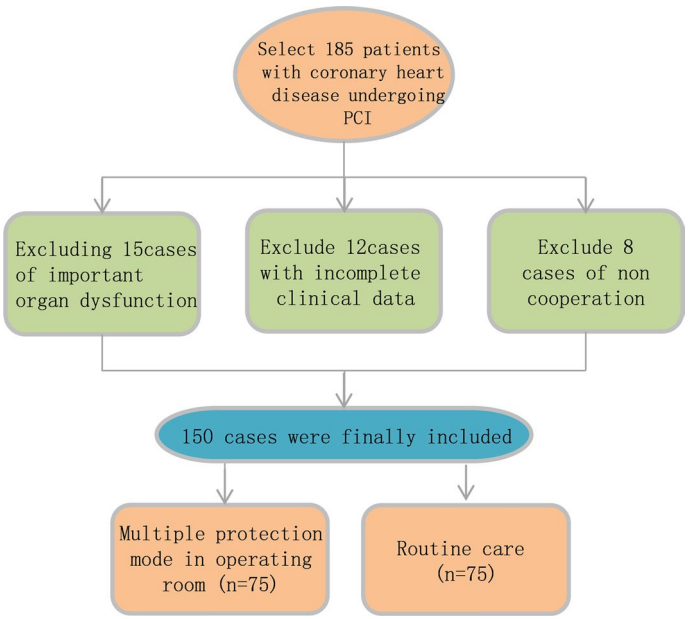

Fig. 1 The selection process of general data

with patients ranging in age from 51 to 81 years old and an average age of (66.00 ± 15.00) years old. There existed no difference in age and gender between two groups ($P > 0.05$).

Inclusion criteria: patients met the diagnostic criteria for CHD in the "*Chinese Expert Consensus on the Diagnosis and Treatment of Coronary Artery Microvascular Diseases*" [21]; the patient underwent imaging examinations (CT, MRI), which all met the surgical treatment indications; all patients had informed consent to this study and signed an informed consent form. Exclusion criteria: patients who did not meet the surgical indications; patients with important organ dysfunction such as heart, liver, and kidney; patients with systemic infectious diseases; patients with coagulation disorders; patients with incomplete clinical data.

Methods

Patients in the control group adopted conventional care model: the patients were guided to cooperate with the surgery and strictly follow the rules and regulations of the operating room. Preoperative visits and preparations were conducted. The patients were instructed to undergo routine blood and urine biochemical tests, as well as preoperative laboratory tests for liver and kidney function. At the same time, imaging examinations were conducted to provide a theoretical basis for subsequent treatment. At the same time, it was necessary to perform electrocardiogram monitoring for patients. Surgical instruments and instruments should be in good condition and in a standby state, and were prepared in advance for possible bleeding and arrhythmia. Intraoperative warmth measures were performed to maintain the patient's body temperature. The noise in the operating room was strictly controlled to reduce the tension of patients. Enhance postoperative pain management and improve patient comfort. Especially, it was necessary to prepare rescue items to prevent accidents from happening.

Patients in the intervention group were given routine nursing combined with multiple protected mode nursing, and the routine nursing was consistent with the control group. Multiple protected mode nursing was as follows: firstly, strengthen preoperative preparation. The operating room tour nursing staff needed to be prepared half an hour before the surgery to ensure that the insulation equipment, surgical instruments, etc., were properly prepared. Secondly, implement a psychological protection intervention model. Nursing staff needed to actively communicate with patients, especially emphasizing preoperative visits and communication. Actively communicate before anesthesia to determine if the patient had psychological problems. If psychological problems occurred, it was necessary to implement psychological counseling for the patient in combination with their own and family finances. It was also possible to evaluate the patient's psychological state and informed them that the development of CASI was relatively mature. In addition, the surgery would be operated by an experienced chief physician, so that patients needed to worry too much and could also enhance the confidence of patients. At the same time, by explaining successful surgical cases to patients, it could increase the confidence of patients and alleviate the psychological stress reactions. In addition, listening to music could help patients relax or vent their unhappiness, thereby improving their treatment cooperation. Thirdly, privacy protection nursing intervention mode. During the surgical procedure, it was important to cover the patient's private area. Nursing staff could enhance the patient's inner sense of security by holding their hands tightly

or touching their forehead. Fourthly, conduct hypothermia protection and nursing interventions. Preheat the disinfectant and shorten the skin disinfection time. Wrap cotton pillows and cotton leg and foot covers on both sides of the patient's abdomen, legs and feet, and apply one-time spontaneous hot patches. Warm up the operating bed 15 min before the surgery and adjust the overall room temperature and humidity in the operating room, usually within a humidity range of 55% and a temperature range of around 25 ℃, depending on the patient's suitability. During the surgery, nursing staff should not only closely cooperate with the doctor in the operation, but also pay attention to the insulation of the surgical instruments to prevent the cold surgical instruments from causing the patient to react aggressively and affecting the surgical effect. In addition, blankets can be used to cover the patient's exposed non-surgical area. The flushing and infusion fluids used during surgery needed to be heated to 37 ℃ using an infusion heater to further ensure that the patient's body temperature remains constant and avoid intraoperative hypothermia. Fifth, transfer protective nursing interventions. Nursing staff were required to clean the blood stains, disinfectant, etc., in the surgical area with physiological saline after the surgery was completed. During the transfer period, it was necessary to guide the patient and their family members to use the analgesic pump correctly and reasonably to prevent the patient from experiencing excessive pain and affecting prognosis and recovery. In addition, it was necessary to connect the patient with electrocardiogram monitoring again to observe the patient's vital signs. If there was an electrocardiogram situation after myocardial reperfusion, corresponding rescue items should be prepared in case of emergency. Sixth, diversified continuing nursing interventions after hospitalization. At discharge, patients could download the client of the mobile medical app. Patients and their families were guided to join the department's extended care service group. WeChat communication was required within 24 h of discharge, and regular discharge health guidance plans were sent to patients to help them further recover their health. At the same time, patients needed to be guided to have a reasonable diet and exercise, focusing on foods with low salt, low fat, high vitamins, beneficial inorganic salts, and high levels of trace elements, and to quit smoking and drinking. In terms of exercise, it was necessary to follow the exercise prescription formulated by the doctor, specifically focusing on aerobic exercise. The intensity of exercise was mainly based on the patient's physical condition, and it was important not to exercise excessively.

Observation indicators

(1) Clinical data: Age, gender, diabetes, hypertension, family history of CHD, urgent PCI, number of stents, and Syntax score were recorded in both groups.
(2) Comparison in the patient satisfaction with nursing: Conduct satisfaction evaluation using a self-made satisfaction survey scale, with a total score of 100 points. A total of 150 questionnaires were distributed and collected, including very satisfied (above 90 points), satisfied (between 80–90 points), and dissatisfied (below 80 points). Total satisfactory cases = case of (very satisfied + satisfied).
(3) Postoperative recovery: The postoperative bed mobility, hospital stay, and 6-min walking distance between patients in two groups were compared. The obtained data were statistically processed

(4) Psychological stress response: The Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD) were used to evaluate the mood at 9 am on the day before surgery and at 9 am on the first day after surgery. Higher HAMA (total 21 points) and HAMD (total 24 points) scores indicated greater the psychological stress response of the patient.
(5) Physiological stress response: The levels of systolic blood pressure, diastolic blood pressure, heart rate, cortisol, and adrenaline of two groups of patients were recorded.
(6) Risk event proportion: Risk events including coronary artery perforation, acute coronary occlusion, cardiogenic shock, stent thrombosis, and myocardial infarction were recorded and statistically analyzed.

Statistical analysis

SPSS23.0 statistical software was adopted for data analysis. The measurement data were represented by 'mean ± standard deviation' and compared by t test. Enumeration data were expressed as percentage and comparison between groups were conducted using χ^2 test. $P < 0.05$ indicated statistical significance.

Author contributions
Jinfu Zhu: data curation, writing—reviewing and editing. Qiaoli Wang: conceptualization, methodology, software and the statistics. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by The Ethics Committee of The First Affiliated Hospital of Nanjing Medical University (2021-SR-146). Informed consent was obtained from participants for the participation in the study and all methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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