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Original article

Applying healthcare failure mode and effect analysis to patient pain management in the anesthesia recovery period

Zhao-Ping Xue^a, Hong-Yan Li^b, Rui-Tong Guan^a, Si Chen^{c,*}^a PACU, The First Hospital of Jilin University, Changchun, 130021, China^b Nursing Department, The First Hospital of Jilin University, Changchun, 130021, China^c Department of Anorectal Surgery, The First Hospital of Jilin University, Changchun, Jilin, 130021, China

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ABSTRACT

Objective: To standardize pain management in the anesthesia recovery period and improve the effects of analgesia on acute postoperative pain.**Methods:** Using healthcare failure mode and effect analysis (HFMEA), we analyzed the primary cause of patients' pain and subsequently determined the process and risk priority number (RPN).**Results:** Actions were taken to improve patients' pain. After using HFMEA, the experimental group's visual analog scale (VAS) scores were lower than those of the control group at 1 h and at discharge from the post-anesthetic intensive care unit (PAICU). The differences were statistically significant ($P < 0.05$).**Conclusions:** The application of failure mode and effect analysis can relieve pain and improve the quality of nursing.© 2016 Shanxi Medical Periodical Press. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Pain can be the worst feeling experienced by patients, and it is also among the most common and most serious forms expressing uncomfortable feelings. In nursing practice, pain is seen as the fifth key vital sign in addition to body temperature, pulse, respiration and blood pressure and is increasingly valued.¹ Statistically, obvious postoperative pain occurs in 75% of surgical patients. Poor management of postoperative pain can cause complications of the respiratory and cardiovascular systems and adversely influence postoperative rehabilitation. To reduce (alleviate) patients' postoperative pain, we applied HFMEA for patient pain management during the anesthesia recovery period. HFMEA is a team-based, systemic and prospective crisis analysis approach. As a quality improvement process, HFMEA represents a new management concept that can be described as "getting all things done at once"² to prevent failures before malfunctions occurs and eliminate or reduce the occurrence of potential failure modes to make designs and programs more secure. Identifying and analyzing the potential

causes of the problems and then solving those problems enables the goal of quality improvement to be achieved. The American Pain Society (APS) proposed that through quality improvement, pain management can be improved.³

2. Materials and methods

2.1. General data

One hundred twenty patients who underwent elective abdominal operations under general anesthesia and tracheal intubation from February to June of 2013 were included. The inclusion criteria were as follows: patients who are 18–65 years old, ASA I–II, literate, and able to use a visual analog scale. The patients were randomly divided into an experimental group ($n = 60$) and a control group ($n = 60$). There were no significant differences in the age, sex, degree of education, the operation time or anesthesia time between the two groups ($P > 0.05$).

2.2. Methods

The HFMEA management group was set up in February of 2013 and consisted of a head nurse, a pain specialist nurse, an anesthesiologist and three other nurses. The head nurse was responsible

* Corresponding author.

E-mail addresses: 1643961393@qq.com (Z.-P. Xue), 875182831@qq.com (S. Chen).

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for training regarding HFMEA-related knowledge, guiding the team members to conduct step analysis by applying their knowledge of HFMEA, and identifying the causes of and assessing the risk factors for postoperative pain during the anesthesia recovery period. Subsequently, all team members followed the head nurse in this process.

Preventive actions were discussed, and improved solutions were developed. The pain specialist nurse organized and implemented the pain control courses for the team and supervised, audited and provided feedback about pain management.

2.2.1. The creation of a flow chart to identify the failure mode of the operation (Fig. 1)

The causes of post-anesthesia pain were categorized into 3 processes according to the flowchart. Before the patient was transferred to the recovery room for the postoperative recovery period and back to the ward, every process and 8 other sub-processes were analyzed using brainstorm methods. The purpose of this analysis was to investigate the causes of the pain and the causes and effects of failures and to identify the potential modes in every process or sub-processes.

2.2.2. The calculation of the RPN value

RPN includes the following 3 dimensions: the frequency of occurrence (frequency of occasion, O), and the difficulty (D) and severity (S) of the failed inspection. Each dimension was scored on a scale from 1 to 10; for example, a frequency of occurrence of 1 indicates “very unlikely”, whereas 10 indicates “very likely”. The $RPN = O * D * S$. The minimum score is 1 point, and the highest possible score is 1000 points. Higher values indicate greater potential influences of failures. The assignments were discussed by the group members as indicated in Table 1.

2.3. Develop improvement solutions

According to the failure mode risk rankings, we listed the top 6 risk factors for the failure mode and then implemented the following improvement measures:

- (1) According to the degrees of pain knowledge and attitudes of the nurses, we developed training plans. These plans included theoretical training, operation training, and training to strengthen the nurses' pain-related knowledge training. It is vitally important to master the correct pain assessment skills and analgesic treatment skills. Before that, we sought to improve the proficiency in the use of pain assessment tools

and the accuracy of the assessments of pain level. It is also essential to provide corresponding treatment according to the different conditions of the patients in the meantime.

- (2) The nurses spent 30 min with the patient, and then offered the patient knowledge about the surgery that he/she was going to undergo and the pain she/he was going to suffer from. Furthermore, chatting with the patient about post-operative analgesia and the possible risks can reduce her/his anxiety and fear about the operation. The nurses can also encourage the patients to express their true feelings about postoperative pain and inform them about pain assessment methods. Establishing a solid relationship of mutual trust can actually ease patients' feelings.
- (3) After surgery, the patients may feel pain when they cough, change posture, or engage in behaviors that cause chest movement primarily because the wound is pulled. Nurses should instruct patients to take some preventive measures and inform them about techniques for reducing pain, such as listening to soft music to distract their attention, playing with the rhythm of light music, slow-paced breathing, Qigong and yoga, which can reduce muscle tension and relieve pain.
- (4) Various drainage tubes can cause pain and discomfort, including abdominal cavity drainage tubes, catheters, and nasogastric tube pipelines. To prevent the tubes from being pulled or twisted, they must be checked, and the tubes' conditions must be fixed properly at all times. Only in this manner can wound stimulation that elicits pain be avoided.
- (5) Conventionally, patients are placed in a recumbent posture without a pillow after general anesthesia. This type of decubitus position results in muscle pain and discomfort. Local massage of compressed skin areas can ease the pain by promoting blood circulation and relaxing the muscle.
- (6) Nurses should maintain soft lights indoors and a suitable temperature and humidity to create a comfortable environment. Simultaneously, the patients should avoid direct sunlight. To avoid noise and other environmental factors that could induce or aggravate pain, the medical care providers should use low and soft voices and gentle movements, try to avoid the effects of medical instruments, and keep the environmental noise in the recovery room below 35 dB.

2.4. The project completion report

The knowledge of HFMEA was applied during the anesthesia recovery period to identify the causes of and risk factors for

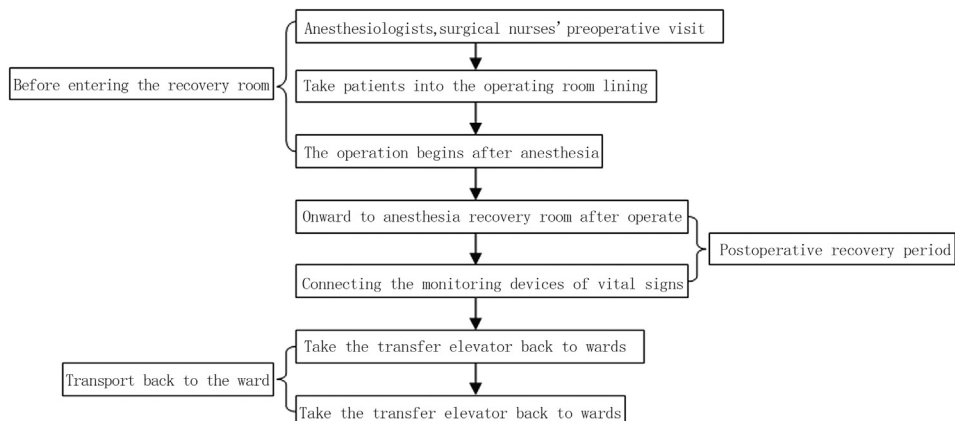


Fig. 1. Flow chart.

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