Continuing education

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Translation of training to practice – ultrasound guided nerve block for analgesia in patients with hip fracture

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Abstract

Aims: Ultrasound guided nerve blocks have been shown to be an effective analgesia option for patients with hip fracture. An education program was developed to train Emergency Department doctors and it received positive feedback from participants who demonstrated competency after the training. We aimed to evaluate the education program at the behavioral level of the Kirkpatrick Model by determining the translation of training to practice of ultrasound guided nerve blocks in patients with a hip fracture at the Emergency Department. **Materials and methods:** A retrospective review of medical records was carried out from 18 August 2018 to 31 December 2020. Data on patient demographics, type of hip fracture, pain score, analgesia provided and complications were collected using a standardized form and analyzed. **Results:** Among 634 patients, their median age was 79 years old (Interquartile range (IQR): 70 to 85) and 416 (65.6%) were female. The median pain score was 6 (IQR: 5 to 8) and analgesia was provided for 561 (88.5%) patients. Analgesia was administered most frequently via the intravenous route (n=407, 72.5%) and tramadol (n=293, 52.2%) was most commonly used. Ultrasound guided nerve block was performed in 26 (4.7%) patients – all were performed successfully without complications. The utilization increased from 1.0% before to 4.7% after the conduct of the training workshops (p=0.16). **Conclusion:** A significant gap still exists in the translation of training to practice. Barriers must be identified and overcome so that ultimately, the education program can bring about an organizational impact to benefit patients and improve their outcomes.

Keywords: analgesia; education; hip fracture; nerve block

Introduction

Hip fracture is a debilitating condition which affects about 18% of women and 6% of men globally [1]. Among the elderly population, it is associated with significantly higher morbidity and mortality. Optimal pain control plays an important role in the management of patients with hip fracture. Traditionally, opioids are commonly administered for pain relief but can cause side effects such as vomiting and respiratory depression. In recent years, regional nerve blocks such as fascia iliaca compartment block and femoral nerve block have been shown to be effective analgesia for hip fracture, without the unwanted side effects of opioids [2-6]. The use of ultrasound (US) for nerve blocks further allows for direct visualization of patient anatomy, needle pathway and local anesthetic infiltration, thus improving the efficiency and safety of nerve blocks [7-9].

US guided nerve block is easy to perform with a low incidence of complications for patients with hip fracture. A study based in the United States involving emergency medicine residents showed high competency rates in performing femoral nerve blocks after a one-hour training session [10]. A local study demonstrated that a three-hour workshop was effective in teaching doctors working in the Emergency Department how to perform US guided femoral nerve blocks, with all participants achieving the minimum standards required for competency [11]. Al-

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though both studies demonstrated improved competency after educational sessions, there exists a gap in current literature on whether these simulated trainings translate to real practice such that patients with hip fracture had US guided nerve block performed and improved care.

The Kirkpatrick Model, which consists of four levels of evaluation, is widely used to assess education programs [12]. At the most basic level, the program is evaluated based on the reaction of the participants and their thoughts about their experience. This is followed by an evaluation of the participants' acquisition of knowledge, skills and attitudes from the program. The next level is an evaluation of the participants' behavioral change of applying the acquired knowledge and skills at their workplace. Finally, at the top of the model is an evaluation based on the organizational impact of the program, and in healthcare this would include measures such as healthcare cost and quality of care rendered. Indeed, it is important for medical educators to evaluate the education program beyond the immediate reaction and learning of participants during or shortly after the course. In this study as a follow up to our previous work, we aimed to evaluate our education program at the 'behavioral' level of the Kirkpatrick Model by determining the translation of an US guided nerve block training program to actual practice of US guided nerve blocks in patients with hip fracture at the Emergency Department.

Materials and Methods

Study Setting

This study was conducted in the general Emergency Department of a public healthcare institution in Singapore which is part of a tertiary hospital and has an annual attendance of about 105,000.

In order to bridge the gap in training of US guided nerve blocks for patients with hip fracture, a three-hour education program was developed for the Emergency Department [11]. The education program included an online learning module for pre-reading, as well as in-person team-based learning and deliberate practice using simulation. All participants had to achieve a minimum standard of competency as evaluated by a facilitator. The education program started in February 2019 and was conducted on a 6-monthly interval thereafter so that doctors in the Emergency Department could be gradually trained in performing US guided nerve blocks for patients with hip fracture. At the time of writing, 45 (64.3%) out of 70 doctors had completed the education program while the remaining 25 (35.7%) had undergone the online learning module but not the in-person training due to COVID-19 restrictions.

Study Design

A retrospective study involving review of medical records was carried out from 18 August 2018 to 31 December 2020. All patients aged 16 years and older with their first presentation of non-prosthetic hip fractures to the Emergency Department were included. Patients with peri-prosthetic hip fracture and reattendance to the Emergency Department for the same episode of injury were excluded. Information on patient demographics, type of hip fracture, pain score, analgesia provided and complications due to analgesia were collected using a standardized form and analyzed.

This study was approved by the Institutional Review Board at SingHealth (CIRB reference 2020/2165 and 2020/2853).

Data Analysis

SPSS version 22 (SPSS, Chicago, IL) was used to perform the statistical analysis. Categorical and continuous data were presented using frequencies with percentages and median with interquartile range (IQR) respectively. Chi-square test or Fisher's exact test was used to assess associations between categorical variables and Mann-Whitney U test was used to assess associations between continuous variables. Statistical significance was taken at p less than 0.05.

Results

Patient Demographics

Six hundred and thirty four patients with hip fractures were included in the study. The median age of the patients was 79 years old (IQR: 70 to 85) and 416 (65.6%) patients were female. Three hundred and thirty five (52.8%) were intracapsular hip fractures, 296 (46.7%) were extracapsular hip fractures and three (0.5%) were mixed intra- and extracapsular hip fractures.

Pain Score and Analgesia

The median pain score at presentation to the Emergency Department was 6 (IQR: 5 to 8). Analgesia was provided for 561 (88.5%) patients with hip fracture. Table I shows the systemic analgesia provided for patients with hip fracture in the Emergency Department. The intravenous route (n=407, 72.5%) was most frequently used to administer analgesia, and tramadol (n=293, 52.2%) was the most administered drug. One hundred and forty (25.2%) out of 555 patients who received systemic analgesia developed one or more adverse events within 24 hours of drug administration (Table II).

US guided nerve block was performed in 26 (4.7%) patients with a hip fracture. Among these, fascia iliac compartment block and femoral nerve block were performed in 16 (61.5%) and 10 (38.5%) patients respec-

Table I. Systemic analgesia provided for patients with hip fracture in the emergency department (n=555)

Route of analgesia	Type of analgesia	Number of patients, n (%)
Oral		60 (10.8)
	Paracetamol	47 (8.5)
	Tramadol	3 (0.5)
	Anarex	2 (0.4)
	Oxycodone	1 (0.2)
	Codeine	1 (0.2)
	Multiple drugs	6 (1.1)
Intramuscular		40 (7.2)
	Tramadol	33 (5.9)
	Diclofenac	4 (0.7)
	Pethidine	2 (0.4)
	Ketorolac	1 (0.2)
Intravenous		407 (73.3)
	Tramadol	257 (46.3)
	Paracetamol	68 (12.2)
	Morphine	22 (4.0)
	Fentanyl	3 (0.5)
	Ketorolac	2 (0.4)
	Multiple drugs	55 (9.9)
Multiple routes	Multiple drugs	48 (8.6)

Table II. Occurrence of adverse events within 24 hours after administration of systemic analgesia (n=555)

Adverse event	Number of patients, n (%)
Acute retention of urine	71 (12.8)
Constipation	47 (8.5)
Delirium	39 (7.0)
Nausea and/or vomiting	21 (3.8)
Ileus	3 (0.5)
Hypotension	2 (0.4)
Desaturation	2 (0.4)
Drug fever	2 (0.4)
Acute kidney injury	1 (0.2)
Deranged liver function	1 (0.2)
Asthma exacerbation	1 (0.2)

tively. Twenty patients concurrently received systemic analgesia for pain relief in the Emergency Department. All US guided nerve blocks were performed successfully and there were no complications related to nerve blocks performed. The performance of US guided nerve blocks increased from 1.0% before to 4.7% after the conduct of the training workshops which began in February 2019, but this was not statistically significant (p=0.16).

The median time to analgesia was 63 minutes (IQR: 40 to 91 minutes), significantly shorter for US guided nerve block (50 minutes, IQR: 23.5 and 88.5) compared to systemic analgesia (64 minutes, IQR: 40 to 91) (p=0.04). One hundred and eighty eight (33.5%) patients achieved pain relief and the proportion was significantly higher among those who had US guided nerve block performed (69.2%) than those who did not (31.8%) (Relative Risk: 2.18, 95% confidence interval 1.64 to 2.90) (p<0.01).

Discussions

When evaluated at the first two levels of the Kirkpatrick Model which focus on participants' reaction and learning, the education program for doctors in the Emergency Department to be trained in performing US guided nerve block for patients with hip fracture seemed to have met its educational objectives and various principles of adult learning medical education were used effectively in the delivery of the content [11]. However, as this study examined the next level of evaluation focusing on participants' behavioral change of actually performing US guided nerve block in patients with hip fracture at the Emergency Department, we found that positive feedback and increased competency from the education program did not lead to a statistically significant increase in the utilization of US guided nerve block which was low at about 5%.

Evaluation based on the participants' behavioral change at the workplace can be challenging as it requires collection of data and follow-up of participants after initial education program. Moreover, there may be circumstances beyond the individual participants which can lead to failure for behavioral change. In our study, the utilization of US guided nerve block in the Emergency Department was about 5% and this finding was not too different from Emergency Departments in other countries – 7% in Australia and 10% in United Kingdom. We postulated that the contributory factors to this phenomenon in the Emergency Departments can be divided into four main categories: people, process, equipment and environment [13,14] (fig 1).

The first contributory factor was people. Junior doctors rotated through the department as a part of their training and the duration of their posting could range from one to six months. This posed a challenge in ensuring that all doctors in the department were trained in US guided nerve block for patients in hip fracture and exposed to it during their posting. Senior doctors also had inadequate experience with performing US guided nerve block because it was not a core component of the residency curriculum and was therefore not a core competency required of emergency physicians in Singapore. While the education program was meant to address this learning need, doctors who had undergone the program may have

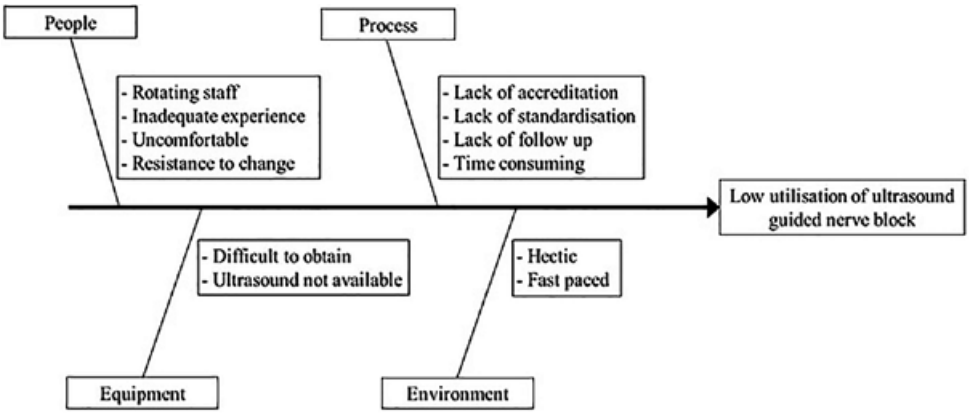

Fig 1. Ishikawa diagram of contributory factors to low utilization of ultrasound guided nerve block in the emergency department

felt uncomfortable with performing US guided nerve block in live patients since they only had performed it on task trainers during the training session. Doctors may also be resistant to change the way analgesia was provided for patients with a hip fracture as they had been using systemic analgesic options for a long time and thus did not have a strong impetus to change their practice despite the existing literature on the advantages of US guided nerve block over systemic analgesia.

The next contributory factor was process. While the education program had evaluated the participants to make sure they achieved the minimum standards for competency, there was a lack of an accreditation process to make sure that trained doctors could perform US guided nerve block competently in actual patients without supervision. There was also no standardization of analgesic option for patients with hip fractures so the attending doctor could order medications based on their preference and this was evidenced by the myriad of systemic analgesia prescribed in this study. There was also a lack of follow up of the outcomes of patients with hip fracture such as patient satisfaction with care in the Emergency Department, or occurrence of adverse events and length of hospitalization. This meant that doctors were not aware of the downstream effect of their analgesic choice for patients with hip fracture. For systemic analgesia, the doctors ordered it on the medical record and the nurses administered the drug, except for controlled drugs such as morphine which required the doctor to administer. But for US guided nerve block, the doctor had to perform the procedure, requiring additional time and effort.

The final two contributory factors were equipment and environment. Performing US guided nerve block requires availability of the US machine which may be in use for other patients in the Emergency Department requiring point-of-care assessment or bedside procedure. Also, supplies such as sterile US gel, dressing set, needles, syringes, and local anesthetics have to be obtained from various locations within the Emergency Department, making it more inconvenient compared to the option of using systemic analgesia. The hectic and fast-paced environment of the Emergency Department with numerous patients having conflicting needs and demanding the attention of doctors and nurses meant that US guided nerve block would be prioritized as a less preferred option.

In response to the contributory factors identified, we suggest the following interventions which may help address and overcome the barriers in translating the training program to clinical practice. Firstly, ongoing training efforts should continue beyond the education program to the workplace so that trained doctors can be supervised when performing US guided nerve block, thus allowing for a proper accreditation framework for independent practice. This will also boost the confidence of doctors, making them more comfortable in performing US guided nerve block for patients with hip fracture. This can be achieved by having a nerve block team which consists of a core group of emergency physicians who are experienced and competent in performing US guided nerve block. The nerve block team can supervise and guide others who may be less experienced, aiding them to translate the knowledge and skill learned at the education program to actual patient care. Next, nerve block bags consisting of the necessary supplies and drugs can be prepacked and set aside for easy access when US guided nerve block is to be performed, thus saving time and making it convenient for the team in the busy Emergency Department. Also, internal audit with regular sharing of success stories, identification of missed cases and troubleshooting of issues identified should be done so that the department is cognizant of the initiative, the ongoing efforts, and the impact on the delivery of emergency care to patients with hip fracture. Last but not least, collaborating with

colleagues from Orthopedics and Anesthesia to formalize US guided nerve block as an analgesic option in the clinical care pathway for patients with hip fracture will help standardize practice and allow continuation of care beyond the Emergency Department.

Our study showed that pain management at the Emergency Department continued to be suboptimal with patient receiving no inadequate or delayed analgesia [15]. Communication issues and cognitive impairment were the major barriers to assessing pain in the elderly population who formed the majority of patients with a hip fracture [16]. The National Institute for Health and Care Excellence guideline suggests that all patients with hip fractures have pain assessed and given analgesia immediately upon presentation to the hospital, followed by the adequacy of analgesia assessed within 30 minutes and hourly until patient is admitted to the inpatient unit [17]. There was a significant gap in the provision of analgesia in our Emergency Department from the recommended guidelines with more than ten percent of patients with hip fractures not receiving analgesia, more than an hour as the median time for administration of analgesia and more than two-thirds of patients having inadequate pain relief. Furthermore, intravenous analgesia particularly opioids, were the most preferred form of pain control with higher rates of adverse events. This was despite the strong recommendations by the National Institute for Health and Care Excellence guidelines, American Academy of Orthopedic Surgeons and Association of Anesthetists for the use of US guided nerve block to improve preoperative pain control for patients with a hip fracture at the Emergency Department [17-19]. An effective education program supported by department workflows and systemic processes would bring about the much needed improvement in practice for the benefit of patients with a hip fracture at the Emergency Department.

Limitations

Firstly, this was a single center study and the results must be interpreted in the context of a general ED within a tertiary hospital located at an urban area. The population of patients with hip fractures in other settings may therefore not be represented. Next, the retrospective nature of this study meant that there would be missing or incomplete information, and lack of standardization in documentation by various medical personnel which could not be verified. For instance, analgesia options were extracted from the medical records and the exact reasons for choosing systemic analgesia over US guided nerve block could not be ascertained. Also, we were unable to evaluate the education program at the highest level of organizational impact according to the Kirkpatrick model as the utilization of US guided nerve block was low, precluding any meaningful analysis of outcome measures such as healthcare cost, or physician and patient satisfaction. Finally, we did not determine the actual root causes for the low utilization of US guided nerve block in the Emergency Department and assess the overall effectiveness of the proposed interventions. The next step would be to embark on a quality improvement initiative to address these issues.

Conclusion

While the education program has introduced US guided nerve block as an option for analgesia in patients with a hip fracture at the Emergency Department, the utilization was low, suggesting that a significant gap still exists in the translation of training to practice. The barriers to practice which are unique to the Emergency Department must be identified and overcome so that ultimately, the education program can bring about an organizational impact to benefit patients and improve their outcomes.

Conflict of interest: none

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