EDUCATIONAL STRATEGY WITH NURSING PROFESSIONALS ON MALIGNANT HYPERTERMIA IN A CARDIOVASCULAR SURGICAL CENTER

Estratégia educativa com profissionais de enfermagem sobre hipertermia maligna em um centro cirúrgico cardiovascular

Estrategia educativa con profesionales de enfermería en hipertermia maligna en un centro quirúrgico cardiovascular

Elisabete Silvana de Oliveira Sene[1]*, Tatiana Garcia Viana[2], Keren Agra Catunda Bettero Valle[3], Eliana Bittar[4]

ABSTRACT: Objectives: To evaluate the knowledge of the nursing staff of the surgical center (SC) about malignant hyperthermia (MH), before and after lecture, and to implant a kit for the treatment of MH with anesthesiologists. **Method:** Quasi-experimental before and after study. Data collection with 43 professionals (three nurses, seven technicians and 33 assistants) from the SC of a cardiology hospital in São Paulo. Five questions were applied before and after lecture, and McNemar and Fisher's exact tests were used. After analyzing the literature and industry materials and meeting with the medical team, a treatment kit was prepared. **Results:** There was a significant difference ($p < 0.05$) regarding the team's knowledge about MH; After class, progress was seen in the three categories (assistants 89.42%, technicians 90%, and nurses 100%). The questions with percentage above 90% after class were: definition of MH, triggering agents, and treatment. A treatment kit was developed and implemented. **Conclusion:** The knowledge of the nursing staff about MH before and after the lecture was evaluated, and a treatment kit was implemented. The knowledge of the team was satisfactory after the taught class.
Keywords: Nursing, team. Malignant hyperthermia. Operating room nursing. Perioperative nursing.

RESUMO: Objetivos: Avaliar o conhecimento da equipe de enfermagem do centro cirúrgico (CC) sobre hipertermia maligna (HM), antes e depois de aula expositiva, e implantar *kit* para tratamento da HM com os anestesiologistas. **Método:** Estudo quase experimental do tipo antes e depois. Coleta de dados com 43 profissionais (três enfermeiros, sete técnicos e 33 auxiliares) do CC de um hospital de cardiologia de São Paulo. Aplicaram-se cinco questões antes e depois de aula expositiva, e utilizaram-se teste exato de Fisher e teste de McNemar. Após análise da literatura e dos materiais do setor e reunião com equipe médica, elaborou-se um *kit* de tratamento. **Resultados:** Houve diferença significante ($p<0,05$) em relação ao conhecimento da equipe sobre HM; após a aula, viu-se progresso nas três categorias (auxiliares 89,42%, técnicos 90% e enfermeiros 100%). As questões com porcentagem acima de 90%, após a aula, foram: definição de HM, agentes desencadeantes e tratamento. Foi elaborado e implantado um *kit* de tratamento. **Conclusão:** Avaliou-se o conhecimento da equipe de enfermagem sobre HM, antes e depois da aula expositiva, e implantou-se *kit* de tratamento. O conhecimento da equipe foi satisfatório após a aula ministrada.
Palavras-chave: Equipe de enfermagem. Hipertermia maligna. Enfermagem de centro cirúrgico. Enfermagem perioperatória.

RESUMEN: Objetivos: Evaluar el conocimiento del personal de enfermería del quirófano (CQ) sobre la hipertermia maligna (HM), antes y después de la conferencia, e implantar un *kit* para el tratamiento de HM con anestesiólogos. **Método:** Cuasi-experimental antes y después del estudio. Recopilación de datos con 43 profesionales (tres enfermeras, siete técnicos y 33 asistentes) del CQ de un hospital de cardiología en São Paulo. Se aplicaron cinco preguntas

[1]Nurse; specialist in Surgical Center, Anesthetic Recovery and Material and Sterilization Center (Centro Cirúrgico, Recuperação Anestésica e Centro de Materiais e Esterilização – CC/RA/CME) by Faculdade Israelita de Ciências em Saúde Albert Einstein (FICSAE) – São Paulo (SP), Brazil.
[2]Nurse; specialist in Cardiology by Universidade Federal de São Paulo (UNIFESP) – São Paulo (SP), Brazil.
[3]Nurse; specialist in CC/RA/CME by FICSAE – São Paulo (SP), Brazil.
[4]Nurse; PhD in Management Practices in Nursing and Health by Universidade de São Paulo (USP). Technical Director of the Health Service of Instituto Dante Pazzanese de Cardiologia – São Paulo (SP), Brazil.
*Corresponding author: bete_sene@hotmail.com
Received: 04/19/2019 – Approved: 11/24/2019
DOI: 10.5327/Z1414-4425202000010007

antes y después de la conferencia, y se utilizaron la prueba exacta de Fisher y la prueba de McNemar. Después de analizar la literatura y los materiales de la industria y de reunirse con el equipo médico, se preparó un *kit* de tratamiento. **Resultados:** Hubo una diferencia significativa ($p<0.05$) con respecto al conocimiento del equipo sobre MH; Después de la clase, se observó progreso en las tres categorías (auxiliares 89.42%, técnicos 90% y enfermeras 100%). Las preguntas con un porcentaje superior al 90% después de la clase fueron: definición de MH, agentes desencadenantes y tratamiento. Se desarrolló e implementó un *kit* de tratamiento. **Conclusión:** Se evaluó el conocimiento del personal de enfermería sobre MH antes y después de la conferencia, y se implementó un *kit* de tratamiento. El conocimiento del equipo fue satisfactorio después de la clase impartida.

Palabras clave: Grupo de enfermería. Hipertermia maligna. Enfermería de quirófano. Enfermería perioperatoria.

INTRODUCTION

Malignant hyperthermia (MH) is a disease manifested as a hypermetabolic crisis by exposing an individual to inhaled anesthetic agents such as those of the halogenated group or succinylcholine. Reactions occur most often in men, and clinical manifestations vary. The most consistent signs are hypercarbia, sinus tachycardia, generalized or masseter muscle rigidity[1]. In a MH crisis, mutation of the ryanodine receptor gene and exposure to halogenates and depolarizing muscle relaxants lead to excessive calcium release in the muscle fiber cytoplasm, leading to a set of biochemical events resulting in clinical and laboratory signs of MH. Excessive heat production occurs from rigid skeletal muscles, anaerobic glycolysis, increased carbon dioxide and lactic acid, adenosine triphosphate (ATP) hydrolysis, and muscle fiber disruption[2]. MH was described in the 1960s and occurs in 1:10,000 general anesthesia in children and 1:50,000 general anesthesia in adults, thus affecting mainly children[3].

In Brazil, the Hotline service has been in existence since 1991 to monitor by telephone (+55-11-5575-9873) the progression of MH episodes and provide assistance. An investigation of its activity was published in 2009, when 77 annual crises were estimated[4]. In an analysis of the notification forms of patients with personal or family suspicion of MH between 1997 and 2010, susceptibility was confirmed in 79.4% of the 92 relatives investigated with an *in vitro* muscle contracture test[5].

MH is an anesthetic emergency and there are protocols with explicit functions for each team member, which should be standardized and oriented to resolute care. Its treatment consists in recognizing and removing the triggers and administering Dantrolene. The occurrence of this syndrome intraoperatively characterizes emergency situation and requires immediate treatment[6].

In 2004, the World Health Organization (WHO) launched the World Alliance on Patient Safety to reduce harm and to set safety standards[7].

Therefore, the knowledge of the nursing staff about the pathophysiology, complications, and form of care in the MH crisis is fundamental to patient care with competence and quality[8].

Thus, upon questioning about the knowledge of the nursing staff on MH, it was decided to conduct an educational activity in service and explain the theme, highlighting the actions of the team. The lecture was chosen because of its potential to strengthen teaching, based on the understanding that methodological strategies should develop knowledge and skills and stick to the patient in a state of urgency and emergency[9].

Items for the treatment of MH crisis by the Malignant Hyperthermia Association of the United States (MHAUS) were listed[10]. In addition, the American Association of Nurse Anesthetists (AANA) states that the institution should adopt a MH treatment kit inspection process, with due regard to the expiration date of the items[11]. Therefore, it is believed that the design and implementation of a MH kit will optimize treatment. This kit is a crucial tool for the treatment of patients facing a MH crisis, facilitating the immediate treatment of the occurrence by the health professionals involved.

OBJECTIVES

- To evaluate the knowledge of the operating room nursing staff about MH, before and after lecture;
- To implement a standardized kit for treating malignant hyperthermia with anesthesiologists.

METHOD

This is a quasi-experimental before and after study, in which a systematic search was performed on the knowledge of

nurses, technicians and nursing assistants working in the surgical center (SC) of a reference teaching hospital in the city of São Paulo.

The institution has three buildings, with a total of 378 beds, and is considered a large hospital. The research data collection site has nine operating rooms, one of them being hybrid, and four beds for anesthetic recovery (AR). 3,725 surgical procedures were performed in 2016.

The nursing staff consists of five nurses, seven technicians and 34 nursing assistants. Of this amount, two nurses were excluded because they were principal researchers. One helper has been deleted due to work leave. Based on the sample calculation with alpha error of 0.05%, from the 46 professionals, 43 (93% of the active team) were included in the study.

The inclusion criterion included nursing professionals working directly in the care provided in the SC. Professionals who did not wish to participate and those who were on vacation, sick leave, maternity leave or bonus leave during data collection were excluded.

The project received approval from the Research Ethics Committee of the host institution via Plataforma Brasil Ethical Appreciation Presentation Certificate (CAAE) No. 55069316.6.0000.5462, on January 31st, 2016. Participants signed the Informed Consent Form prior to data collection, respecting the ethical precepts of Resolution No. 466/2012 of the National Health Council.

Data collection took place between September and October 2016, using an instrument built by the authors, based on the practices recommended by the Association of periOperative Registered Nurses (AORN)[12]. The instrument was validated by two SC nurses and subjected to reliability analysis using Cronbach's alpha test. It covered the variables of the sociodemographic profile (age, gender, time of professional formation and time working in SC) and contemplated five questions with five objective alternatives each, of which only one was the correct one.

The questions involved knowledge about the etiology of the disease, triggering factors, crisis suggestive signs, medication for treatment and nursing practice. Cronbach's alpha coefficient of the questionnaire was 1, indicating the reliability of the instrument, which was applied by two nurses.

Each correct response was assigned one point, and the total score for the knowledge test was the sum of the correct answers. Scores above 70% were considered knowledge on the subject. The questionnaire was answered individually, during working hours, and immediately returned to the researchers, ensuring anonymity. Then, the participants attended the lecture given by the authors, lasting 30 minutes, using the Microsoft Office PowerPoint 2010® software. The concepts of MH, pathophysiology and epidemiology, the history, Decree No. 46601 of March 12th, 2002[13], Resolution No. 1.802/2006 of the Federal Council of Medicine[14], classifications, clinical manifestations, treatment and preventive measures were addressed. After one week, the employees answered the same questionnaire again to measure their learning.

After collection, data were tabulated in a spreadsheet of Microsoft Office Excel 2010®. The analysis was systematized and took into account the scores of three professional categories (nurses, technicians, and nursing assistants), not the isolated scores of each subject. For sample calculation of variables related to sociodemographic characteristics, the test answers were summarized, presented descriptively and tabulated by frequency, and absolute and mean values. For statistical analysis, Fisher's exact test, which compared the means before and after each category, and McNemar's test were used to evaluate the means of each question. The significance level adopted was 95% ($p<0.05$).

A treatment kit for MH was prepared according to Decree No. 46.601 of March 12th, 2002[13]. The process of building the kit took place in phases:

- Searching for evidence in the literature;
- Communication between nurses and doctors;
- Requesting to assemble the kit to the pharmacy;
- Completion of the kit.

As criteria for the composition of the MH treatment kit, the materials in the surgical and anesthesia kit were evaluated. It was found that the amount of compresses of the surgical kit met the demand for the patient in an episode of MH; therefore, no compresses were included in the MH kit. Cooled saline was excluded because of the impossibility to cool it — the pharmacy industry provides 50 units of 500 mL of cooled saline. As for the anesthesia equipment circuit, according to MHAUS[15], there are four management possibilities, including the replacement of the circuit ahead of the crisis. Due to the volume, this material was excluded, and there was a reserve in the guard room for inhaled material.

The formulation of the kit was validated by the professionals: chief physician of the anesthesiology section, chief physician of the surgery section, pharmacist, chief nurse of the sector, and authors of the research. There was a formal record of this meeting, which lasted 60 minutes, aiming to standardize information and update the MH care protocol.

RESULTS

Forty-three employees (93% of the active team) participated in the research, being three nurses, seven technicians and 33 nursing assistants. Mean age was 45±10.3 years, and females prevailed in the three categories. As for the time of training, the mean was 18±8.6 years, and the experience in the area of practice in SC had a mean of 13±8.5 years. Sociodemographic characteristics are presented in Table 1.

Table 2 shows the level of knowledge of professionals before and after the lecture.

Table 2 shows the statistical difference of knowledge after lecture on MH in the three categories. In the nursing assistants category, the average of pre-test hits was 14 (44.1%), to 30.4 (89.4%) in the post-test, reaching a score higher than 70% of correct answers only in the post-test. In the nursing technicians category, the mean pre-test hits was 1.2 (20%), to 5.4 (90%) in the post-test, reaching a score above 70% of correct answers in the post-test only. In the nurses category, the average of pre-test hits was 2.8 (93%) to 3 (100%) in the post-test, reaching a score above 70% in both the pre- and post-tests.

Regarding the statistical values ($p<0.05$), there was significance in the general knowledge of professionals in the pre- (value of 0.2) and post-tests (value of 0.8) phases.

Table 3 shows the general comparison of correct answers before and after the lecture.

Table 3 shows a percentage difference above 90% in three of the five knowledge items after the lecture: crisis triggering agents (95.3% — 41 correct answers), MH treatment (93% — 40 correct answers) and definition of MH (90.7% — 39 correct answers).

As scientifically recommended, Dantrolene medication, indicated to treat MH, was made available in the amount established for immediate care. Among the kit's organizing committee, a 100% agreement was reached regarding its composition. The inputs were listed and deposited in a box (Chart 1) and the kit available at the pharmacy.

Table 1. Sociodemographic characteristics of the study participants (n = 43).

Variables	N	%
Age range (years)		
21–30	1	2.3
31–40	14	32.6
41–50	13	30.2
51–60	10	23.3
61–70	5	11.6
Gender		
Female	32	74.4
Male	11	25.6
Training time (years)		
<5	1	2.3
6 to 10	5	11.6
11 to 20	21	48.8
>20	16	37.2
Time in the operating room (years)		
1 to 4	8	18.6
5 to 10	13	30.2
11 to 15	7	16.3
> 15	15	34.9
Total	43	100.0

Table 2. Level of knowledge of employees pre- and post-test, according to professional category.

Variables	Nursing assistants				Nursing Technicians				Nurses				p*	
	Pre		Post		Pre		Post		Pre		Post		Pre	Post
	N	%	N	%	N	%	N	%	N	%	N	%		
Malignant hyperthermia definition	15	44.1	30	88.2	2	33.3	6	100	3	100	3	100	0.1	1
Triggering agents of the crisis	18	52.9	32	94.1	1	16.7	6	100	3	100	3	100	0.4	1
Initial clinical manifestations	15	44.1	31	91.2	2	33.3	4	66.7	3	100	3	100	0.1	0.1
Malignant hyperthermia treatment	13	38.2	31	91.2	0	0	6	100	3	100	3	100	0.0	1
Nursing team performance	9	26.5	28	82.4	1	16.7	5	83.3	2	66.7	3	100	0.3	1
Mean	14	44.1	30.4	89.4	1.2	20.0	5.4	90	2.8	93.3	3	100	0.2	0.8

*Fisher's exact test.

Table 3. Comparison of means of knowledge correct answers according to pre- and post-test evaluation items of the educational activity. São Paulo, SP, 2019.

Variables	Knowledge				
	Pre-test		Post-test		p*
	N	%	N	%	N
Malignant hyperthermia definition	20	46.5	39	90.7	0
Triggering agents of the crisis	22	51.2	41	95.3	0
Initial clinical manifestations	20	46.5	38	88.4	0.6
Malignant hyperthermia treatment	16	37.2	40	93	0
Nursing team performance	12	27.9	36	83.7	0.1
Mean	18	39.8	38.8	90.2	0.1

*McNemar test.

Chart 1. Kit for Malignant Hyperthermia (MH) treatment

Quantity	Medications and supplies
36	Dantrolene
01	500 ml bottle of distilled water
01	250 ml bottle of 8.4% sodium bicarbonate
05	20 ml 50% glucose ampoules
03	10 ml 10% calcium chloride ampoules
01	Mannitol flask 20%
10	Furosemide ampoules 20 mg
01	0.9% saline bottle – 100 ml
01	Regular insulin bottle (in the pharmacy fridge)
01	Urethral bladder catheters No. 6, 8, 10, 12, 16
01	Nasogastric probes No. 6, 8, 10, 12, 16, 18
01	Blood transfusion device
02	Infusion pump equipment
02	Intravenous catheters No. 14, 16, 18, 20, 22, 24
01	Invasive pressure monitoring kit
05	Blood gas syringes
01	Adult and pediatric central venous catheter

DISCUSSION

The qualification of the nursing professional enables better chances of success in the care and recovery of the patient under a MH crisis. The combination of multiple knowledge and practice is fundamental for the reframing of knowledge, in view of the constant change in the teaching-learning process, seeking for professionals who are more critical, creative, competent, and prepared for life and work[16].

The continuous education of the team through lecture helped to increase the level of knowledge of the SC nursing professionals, as education is a broad process that sees the professional from all angles in a humanized, permanent and consistent way, which is attentive to the real needs of employees and the work environment[12].

The literature reports growing interest in improving the quality and safety of hospitalized patients. To this end, there is a need for progress in the review of security mechanisms in order to identify prevention opportunities and life-threatening events in order to optimize crisis response[17].

The results in the pre-test of the research showed insufficient knowledge of the technicians and nursing assistants about MH, which obtained a score below 70%. For nurses, the correct score was 90%, demonstrating greater knowledge of care about MH.

A study conducted in the United States pointed to the lack of nursing knowledge about the management of MH crisis. It also emphasized that quality nursing care adds essential components for quality improvement and error reduction, with preparation of the nursing team, efficient communication, and participation of family members[18].

In the present research, after the lecture class, there was a considerable average percentage of correct answers in the knowledge test, evidencing the effectiveness of the presented content. In the nurses category, a pre-test statistical mean was obtained from 2.8 (93.3%) to 3 (100%) in the post-test. There was not, therefore, a low score, which suggests greater knowledge on the subject due to higher education. The nursing technicians category obtained a pre-test mean from 1.2 (20%) to 5.4 (90%) in

the post-test, and the nursing assistants category mean in the pre-test from 14 (44.1%) to 30.4 (89.4%) in the post-test. Considering the questionnaire designed for a technical professional audience, pre-test knowledge of MH below 70% was seen as unsatisfactory, demonstrating lack of information of these professionals on the subject. However, these results were positively modified after the educational class: 89.4% correct answers for assistants and 90% correct answers for technicians, which corresponded to the goal set by the researchers.

In the analysis of the items that make up the questionnaire, there was a significant difference in three of the five elements after the educational activity: definition of MH, with a pre-test mean of 20 (46.5%) to 39 (90.7%) in the post-test; crisis-triggering agents, with a pre-test mean of 22 (51.2%) to 41 (95.3%) in the post-test; and MH treatment, with a pre-test mean of 16 (37.2%) to 40 (93%) in the post-test.

The literature points out that the educational process is an individual commitment that occurs through changes in attitude as a result of the experiences lived in social and professional interpersonal relationships and that aims to transform the qualification of professionals, so that they act more safely and quickly in patient care. Personal development that should be enhanced characterizes continuing education, involving specific technical training and the acquisition of new knowledge, concepts, and attitudes. Thus, continuing education is essential in hospital practice and indispensable to the training of workers in order to offer quality, considering the lives of patients[19].

It is pertinent to emphasize that MH is classified as an immediate compulsory notification disease, regulated by the Resolution of the State Secretariat of Health SS-20 and instituted by the state of São Paulo on February 22nd, 2006. According to this document, the healthcare professional has a duty to complete the Compulsory Adverse Event Notification Form and refer it to their state's pharmacovigilance[20].

In the search for national literature on nursing knowledge focused on this theme, there was a shortage of specific material that could be compared with the findings, denoting the lack of national studies. Given this, the need for training and expansion of knowledge of health professionals for recognition and management of patients in crisis of MH in the perioperative period is a fact.

Given the complexity of the MH treatment, the literature suggests the development of training days, associated with the simulation of MH crisis incidents at least once a year, with the nursing staff[21]. However, AORN recommends that training encompasses all operating room staff, focusing on the skills applicable to the roles required to manage a HM crisis[22]. These exercises not only keep the team up to date and alert, but increase collaboration among its members. The AANA directs all certified anesthesiologist nurses to maintain their competence through continuing education regarding the management of MH. MHAUS stresses the availability of Dantrolene medication in all healthcare facilities performing anesthetic-surgical procedures[11].

The elaboration and availability of the kit in the SC pharmacy with all the necessary items to assist the patient in a MH crisis made it possible to standardize the essential materials in the kit, as well as to update and make the care protocol available to the surgical ward entire team. Standardization is an important management tool and gives uniformity to actions, reducing dispersion and making it possible to perform services in a targeted and safe manner[23]. The nurse, in his competence, faces many challenges in order to ensure patient safety. Thus, the four pillars of nurses' performance (research, teaching, care and management) are essential in the commitment and training of professionals[24].

The availability of Dantrolene for MH treatment in healthcare facilities where anesthetic-surgical procedures are performed is insufficient to initiate immediate treatment, and in some places it is nonexistent. Such conduct goes against constitutional principles, and the institution may be penalized for the irregularity of exposing the patient to imminent risk. The existence of the MH kit and specific care protocol supports accurate and immediate patient care, and all operating room professionals are protagonists of their actions[25].

A study conducted in a private institution in São Paulo[26], which aimed to evaluate the knowledge and the correctness rate of the nursing staff working in the SC and in anesthetic recovery, identified weaknesses in the nursing team's knowledge about the diagnosis and treatment of MH and pointed out that such weaknesses may hinder the correct action in reversing the crisis, facilitating errors that may bring harm to patients.

Given the above, it is vital to have training and teamwork in order to ensure the quality of care provided to patients in MH crisis, with constant assessment of this quality, ensuring the patient's rights, safety and well-being.

As a limitation of the research, the results of a local population, which cannot be generalized are mentioned. The scarcity of research prevents a comparison of the results of this study with a similar population. Thus, it is encouraged to conduct scientific research on MH that examine the performance of the nursing staff, in order to expand the theme, alert and train professionals to serve these patients with excellence.

CONCLUSION

The MH crisis is a serious event that requires a team prepared and able to act and requires diagnosis, treatment and immediate assistance to reverse the picture and the risk of death. As it is an extremely relevant disease, there was concern regarding the knowledge of the nursing staff about the disease and the availability of a kit in the institution for treatment, as recommended by the Ministry of Health.

The lecture showed effectiveness and added knowledge to nurses, technicians and assistants of the operating room staff, which was measured by the results, directing professionals to act safely. The existence of a MH crisis kit is essential to ensure patient care. The team's knowledge about the availability of the kit and the acknowledgment of its members' actions in the face of the crisis favored the standardization of the acts assigned to each professional. It should be emphasized that a team training with realistic simulation will add expertise in dealing in the care of patients in a mh crisis.

It is essential for nurses, as leaders, to update themselves scientifically for a practice with excellence and to expand the knowledge of their staff, with the aim of increasing the competence of employees. The performance of the nursing team, whether in care or management, in line with other members of the surgical and anesthetic team, is an indispensable factor when assisting in the recognition and clinical manifestations of a MH crisis and initiating the necessary actions to safe and effective care.

REFERENCES

1. Litman RS. Malignant hyperthermia: diagnosis and management of acute crisis [Internet]. Oxford: UpToDate Database; 2019 [acessado em 26 jul. 2019]. Disponível em: https://www.uptodate.com/contents/malignant-hyperthermia-clinical-diagnosis-and-management-of-acute-crisis?search=Malignant%20hyperthermia:%20clinical%20diagnosis%20and%20management%20of%20acute%20crisis%20&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1

2. Silva HCA. Fisiopatologia e genética. Rev Neurociênc [Internet]. 2014 [acessado em 26 jul. 2019];22(4):475-97. Disponível em: http://www.revistaneurociencias.com.br/edicoes/2014/2204/VI_curso_HIPERTERMIA%20VOL%2022%2004%202014.pdf

3. Haluka J. Malignant hyperthermia. [Internet]. ACLS Training Center; 2018 [acessado em 3 jan. 2019]. Disponível em: https://www.acls.net/malignant-hyperthermia.htm

4. Silva HCA, Almeida CS, Brandão JCM, Silva CAN, Lorenzo MEP, Ferreira CBND, et al. Malignant hyperthermia in Brazil: analysis of hotline activity in 2009. Rev Bras Anestesiol [Internet]. 2013 [acessado em 21 jul. 2016];63(1):13-26. Disponível em: http://doi.org/10.1590/S0034-70942013000100002

5. Silva HCA, Ferreira G, Rodrigues G, dos Santos JM, Andrade PV, Hortense A, et al. Profile of malignant hyperthermia susceptibility reports confirmed with muscular contracture test in Brazil. Braz J Anesthesiol [Internet]. 2019 [acessado em 25 jul. 2019];69(2):152-9. Disponível em: http://doi.org/10.1016/j.bjan.2018.09.007

6. Sousa CS, Bispo DM, Cunha ALM, Siqueira ILCP. Educational intervention on malignant hyperthermia with nursing professionals of the operating room. Rev Esc Enferm USP. 2015;49(2):290-5. http://doi.org/10.1590/S0080-623420150000200015

7. Pancieri PA, Carvalho R, Braga ME. Applying the safe surgery checklist: experience report. Rev SOBECC. 2014;19(1):26-33. http://doi.org/10.4322/sobecc.2014.006

8. Denholm BG. Using a vulnerability theoretical model to assess the malignant hyperthermia susceptible population: implications for advanced practice emergency nurses. Adv Emerg Nurs J [Internet]. 2015 [accessado em 21 mar. 2019];37(3):209-22. http://doi.org/10.1097/TME.0000000000000073

9. Morais Filho LA, Gue Martini J, Lazzari DD, Vargas MA, Backes VMS, Farias GM. Strategies used for teaching urgency/emergency in a nursing undergraduate course. Texto & Contexto Enferm. 2018;27(4):e3210016. http://doi.org/10.1590/0104-07072018003210016

10. Malignant Hyperthermia Association of the United States. What should be on an MH cart? [Internet]. 1981 [acessado em 26 jul. 2019]. Disponível em: https://www.mhaus.org/healthcare-professionals/be-prepared/what-should-be-on-an-mh-cart/

11. American Association of Nurse Anesthetists. Malignant hyperthermia crisis preparedness and treatment. [Internet]. American Association of Nurse Anesthetists [acessado em 26 jul. 2019]. Disponível em: https://www.aana.com/docs/default-source/practice-aana-com-web-documents-(all)/malignant-hyperthermia-crisis-preparedness-and-treatment.pdf?sfvrsn=630049b1_8

12. Cain CL, Riess ML, Gettrust L, Novalija J. Malignant hyperthermia crisis: optimizing patient outcomes through simulation and interdisciplinary collaboration. AORN J. 2014;99(2):301-11. http://doi.org/10.1016/j.aorn.2013.06.012

13. São Paulo (Estado). Secretaria de Saúde do Estado de São Paulo. Resolução SS nº 23, de 27 de fevereiro de 2004. Aprova a norma técnica relativa às diretrizes para o diagnóstico, tratamento, prevenção, notificação e investigação epidemiológica dos casos de hipertermia maligna. [Internet]. São Paulo; 2004 [acessado em 28 maio 2017]. Disponível em: http://tc-legis2.bvs.br/leisref/public/showAct.php?id=69&word=

14. Conselho Federal de Medicina. Resolução CFM nº 1.802/2006. Dispõe sobre a prática do ato anestésico [Internet]. Brasília: Conselho Federal de Medicina; 2006 [acessado em 31 jul. 2019]. Disponível em: http://www.portalmedico.org.br/resolucoes/cfm/2006/1802_2006.htm

15. Malignant Hyperthermia Association of the United States. Table of contents. [Internet]. Malignant Hyperthermia Association of the United States; 2012 [acessado em 29 jul. 2019]. Disponível em: https://www.mhaus.org/mhau001/assets/File/Recommendations%20with%20Table%20of%20Contents(1).pdf

16. Gottems LBD, Alvarez AM, Almeida LMWS. Nursing education: quality, innovation and accountability. Rev Bras Enferm. 2014;67(4):501-2. http://dx.doi.org/10.1590/0034-7167.2014670401

17. Taguti PS, Dotti AZ, Araujo KP, Pariz PS, Dias GF, Kauss IA, et al. The performance of a rapid response team in the management of code yellow events at a university hospital. Rev Bras Ter Intensiva [Internet]. 2013 [acessado em 5 set. 2017];25(2):99-105. Disponível em: https://doi.org/10.5935/0103-507X.20130020

18. Denholm GB. Using informatics to improve the care of patients susceptible to malignant hyperthermia. AORN J. 2016;103(4):364-74. http://doi.org/10.1016/j.aorn.2016.02.001

19. Pinto JR, Ferreira GSM, Gomes AMA, Ferreira FIS, Aragão AEA, Gomes FMA. Permanent education: reflection in practice nursing hospital. Tempus (Brasilia) [Internet]. 2015 [acessado em 29 set. 2017];9(1):155-65. Disponível em: http://www.tempusactas.unb.br/index.php/tempus/article/download/1699/1409

20. São Paulo (Estado). Secretaria de Saúde do Estado de São Paulo. Resolução SS nº 20, de 22 de fevereiro de 2006: atualiza a lista de doenças de notificação compulsória no estado de São Paulo. [Internet]. São Paulo; 2006 [acessado em 10 out. 2019]. Disponível em: fehosp.com.br/app/webroot/files/circulares/2b257b09784b0963399612d26cc914fc.doc

21. Theofanis F. Malignant hyperthermia: nursing implications for care. Br J Anaesth Recovery Nurs [Internet]. 2015 [acessado em 12 out. 2017];15(4):15-7. Disponível em: http://eprints.brighton.ac.uk/14549/1/Malignant.pdf

22. Seifert PC, Wahr JA, Pace M, Cochrane AB, Bagnola AJ. Crisis management of malignant hyperthermia in the OR. AORN J. 2014;100(2):189-202. http://doi.org/10.1016/j.aorn.2014.06.014

23. Sene ESO, Jardim DP. Nursing practice in minimally invasive vídeo-assisted cardiac surgery. Rev SOBECC. 2016;21(3):170-7. http://doi.org/10.5327/Z1414-4425201600030008

24. Lima GF, Rinaldi PA, Catunda KA, Bittar E, Bianchi ERF. The role of nurses in the structuring and implementation of a hybrid surgical room. Rev SOBECC. 2014;19(2):110-8. http://doi.org/10.4322/sobecc.2014.017

25. Sousa CS, Diniz TRZ, Cunha ALSM. Malignant hyperthermia: proposing a care protocol for surgical centers. J Nurs UFPE On line [Internet]. 2013 [acessado em 29 out. 2017];7(esp.):6714-8. Disponível em: http://doi.org/10.5205/reuol.5058-41233-3-SM.0711esp201320

26. Titato MMS, Carvalho R. Malignant hyperthermia in the operating room: can the nursing team recognize it and intervene? Rev SOBECC. 2017;22(2):82-9. http://doi.org/10.5327/Z1414-4425201700020005