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ORIGINSL RESEARCH ANESTHESIOLOGY

Query malignant hyperthermia patients in Saudi Arabia; A questionnaire-based mini-survey

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ABSTRACT

Background & objective: Little is known about Malignant Hyperthermia (MH); as serious hypermetabolic response to anesthetic-related agents regarding its existence inside Saudi Arabia (KSA). Few MH incidents have been reported in periodic medical journals. To our knowledge, this nineteen-questionnaire survey is the first to be performed in KSA regarding MH. The main objective was to report suspected MH patients and the secondary objectives were to assess the availability of dantrolene vials, the management and outcome of the suspected patients.

Methodology: Google Forms were sent to the anesthesiologists working in Ministry of Health hospitals at three geographical districts in KSA (Eastern Province, Riyadh, and Western Province) through anesthesiologists' social platforms. The electronic link was accessible from October 10, 2022, to April 02, 2024.

Results: Most of the 174 anesthesiologists, who replied, were consultants (65.5%), and 70.7% had more than 10 years of experience. 32 (18.4%) anesthesiologists reported having dealt with suspected MH patients during their careers, of which 21 were inside KSA hospitals. Anesthesiologists reporting having six or more vials of dantrolene were 113/174 (64.9%), whereas 23 (13.2%) reported having 3 to 6 vials and 13 (7.5%) 1 to 3 vials. Only 25 (14.4%) reported no vials. Of the anesthesiologists, 66 (37.9%) were aware of the locations of dantrolene in their city. According to 51.7% of respondents, 120 mg of dantrolene may be prepared in 30 min.

Conclusion: Our survey sheds light on susceptible MH cases in Saudi Arabia that remain unpublished or inadequately reported. Establishing a dedicated MH management and database center is a pressing need. The current low number of reported MH cases should not be used as a justification to delay such an initiative, particularly given the absence of accurate statistics. Moreover, the study demonstrates variability in hospital preparedness for MH emergencies, which needs to be addressed urgently. Hospitals with inadequate monitoring systems or insufficient dantrolene supplies need to meet the required standards for optimal patient safety.

Keywords: Anesthesia; Dantrolene; Malignant Hyperthermia; Perioperative Complications

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1. INTRODUCTION

Malignant hyperthermia (MH) is an uncommon hereditary condition that affects the skeletal muscles, causing severe contracture and leading to a hypermetabolic reaction to succinylcholine, a depolarizing muscle relaxant, and several halogenated general anesthetics.[1,2] It could prove fatal if not detected early and treatment started immediately. The Association of Anesthetists' MH crisis management developed guidelines for the display in anesthetic rooms.[3] In the Kingdom of Saudi Arabia (KSA), the incidence of MH is unclear, but in Western countries, it is known to range from 1 in 5000 to 1 in 100,000.[4,5]

No dedicated MH centre exists in any Arabic-speaking Middle Eastern countries. Nonetheless, a few MH incidents have been made public through media or periodic medical journal publications. In 1985, Radwan et al. were one of the first to publish a suspected case of MH from Saudi Arabia to our best knowledge. This MH condition most likely was caused by halothane.[6] Another three clinical case presentations from KSA were retrieved from Pub Med and Google searches.[7-9] Furthermore, three other publications identified ten patients with various syndromes preoperatively as genetically suspected of MH.[10-12]These three publications represent the importance of preoperative evaluation and highlight the presence of MH-suspected patients with other associated syndromes inside the Kingdom.

The main objective of this survey was to report and trace suspected MH cases in KSA, using a questionnaire sent to anesthesiologists working inside the Kingdom. The secondary objective was to assess the availability of dantrolene inside KSA and MH management and outcomes.

2. METHODOLOGY

Formal approval was granted by The King Faisal University Deanship of Research in Hofuf City, Alahsa, KSA, to conduct this survey in 2022 (No. KFU-REC-2022-AUG–ETHICS117). The Saudi Ministry of Health's Alahsa Health Cluster's local research and ethics council authorized the survey questionnaire (IRB No. (H-05-HS-065)). The approval number for the protocol was 18-EP-2024.

Content Validity Index (CVI) was carried out regarding the questionnaire, the initial version of questionnaire included 24 questions (items). Ten experts participated in the CVI analysis. The CVI analysis revealed that total agreement (number of items that have 3 or 4) equal ten. Five items were removed from the originally designed questionnaire because their item CVI (I-CVI) was less than 0.78.(1986).[13] The Five items removed were:

Q4: How often do you measure body temperature in Postoperative Anesthesia Care Unit PACU?

Q10: Does your hospital have a hospital quality approval system, please mention name of the quality provider?

Q11: Does your hospital have a ‘Crisis Card Checklist’ for MH cases?

Q12: Does your city have a support center for MH?

Q15: What was the patient’s gender?

The modified questionnaire was 19 items, with I-CVI ranged from 0.80-1.00 (17 items had I-CVI of 1.00) (All above 0.78), and S-CVI-AV was 0.941 (Excellent content validity according to Lynn (1986).[13]

The specifically designed a nineteen item questionnaire, after validation, is presented in Figure 1. This online survey included open-ended, closed-ended, Likert scale, and yes/no questions.

A Google Forms and an email link were sent to the anesthesiologists working in governmental hospitals at three geographical districts in Saudi Arabia (Eastern Province, Riyadh, and Western Province). The survey questions were sent through the anesthesiologists’ social platforms. This study collected data regarding participants’ perception of MH-related knowledge, availability of domestic dantrolene, and reported MH cases. Anesthesiologists were contacted on October 10, 2022. In January, we sent reminders asking to distribute the questionnaires again among colleagues in their departments. The survey electronic link was accessible from October 10, 2022, to April 2, 2024. Anesthesia consultants were kindly asked to pass the link to other department registrars or colleagues. The anesthesiologists working in the Ministry of Health were the primary target for the survey. According to the Ministry of Health's statistical yearbook, the total number of anesthesiologists (consultants and registrars) working in the three studied regions in Saudi Arabia was

742, of which 266 were consultants (Statistical Yearbook - Statistical Yearbook (moh.gov.sa).[14]

The complete English questionnaire is shown in the following link.https://docs.google.com/forms/d/e/1FAIpQLSfaF48LM3oj1y07s4mN9zpxu4nULrxSLP7pybU2kzcafFGinw/viewform?usp=sf_link

The survey included MH patients' biographical data such as gender, age, triggering agent, how they were managed, and outcome. This study assessed the knowledge and perceptions of the importance of dantrolene availability in hospitals. Participating doctors spent 7 and 10 min to complete the survey. The participants were explained the purpose of the study, the

Box 1: A nineteen questions survey questionnaire for malignant hyperthermia

1- Are you a
a) Resident
b) Specialist
c) Consultant
d) Other

2- Anesthesia Experience?
a) Less than 5 years
b) 5-10 years
c) More than 10 years

3- How often do you measure body temperature during surgery?
a) Always
b) Randomly
c) Sometimes
d) Rarely
e) During emergency cases

4- Is there a free vaporizer anesthetic machine in your hospital operating suite?
d) Yes
e) No

5- How many vials of dantrolene are available in your hospital?
6 vials or more
Between 3 to 6 vials
Between 1 and 3 vials
None
Don't know

6- How many vials of dantrolene are in stock in the operating room?
6 vials or more
Between 3 and 6 vials
Between 1 and 3 vials
None

7- **How is dantrolene obtained in an emergency?**
A predetermined supplier will deliver
No predetermined supplier
Agreement between hospitals to provide dantrolene
Available to prepare 120 mg dantrolene within 30 min
Other

8- Do you know where dantrolene is available in your city?
Yes
No
If yes mention where?

9- How many cases of MH have you personally encountered in your career in and out of Saudi Arabia, kindly mention city and country?

10- Did you personally face any MH cases in Saudi Arabia during your service?
Yes
No

11- What was the age of the patient?
1-17 years
18-50 years
> 50 years

12- What were the signs and symptoms in your patient?
Increased $EtCO_2$
Rise in body temperature
Muscle spasms or muscles rigidity
Hypotension / shock
Tachycardia
Acidosis
Myoglobinurea
Brown or cola-colored urine

13- What was the agent that triggered MH in your reported patient?
Isoflurane
Sevoflurane
Desflurane
Enflurane
Halothane
Not sure

14- What was the muscle relaxant used if any?
Rocuronium
Atracurium
Suxamethonium
Vecuronium
None

15- What was the management for this MH crisis? Multiple choice is allowed
Discontinuation inhaled anesthetics
Give 100% oxygen
Administration of dantrolene
Administration of sodium bicarbonate
Cooling method

16- How much time was required for dantrolene to be ready to administer this case of MH?
Less than 30 min
Between 30 and 60 min
More than 60 min
No answer

17- Did the patient survive this MH crisis?
Yes
No

18- Was this MH case reported or published? Kindly provide citation if any;
Yes
No

19- Do you think we need a MH diagnosis and management center in Saudi Arabia?
Yes
No

Table 1: Review of literature before the Survey

Author	Triggering Agent	Dantrolene Availability	Clinical Presentation	Outcome	MH Test Done or Not
Radwan HE [6]	Halothane.	Yes	Tachycardia, Muscle rigidity, Cyanosis, and Rise in body temperature	Managed Successfully with vigorous cooling, dantrolene sodium, and diuresis.	No
Ahmed AE [7]	Suxamethonium and Halothane	Yes		Managed successfully With dantrolene therapy	No
Majeed A [8]	Sevoflurane	Yes	Two siblings during living donor liver transplantation Temperature increased to 37.3°C, and the end-tidal carbon dioxide level increased to 7.1 kPa	The case is managed successfully in 2 h and 15 min. with a vapour-free anaesthesia machine and intravenous fluids without the need for dantrolene.	Yes, a genetic test later confirmed the MH diagnosis. Samples were sent abroad.
"Malignant hyperthermia." – Private Dallah Hospital (dallah-hospital.com) [9]	Not available information	Not available information	Increase in Temperature, tachycardia and increase in end-tidal carbon dioxisws level	Managed successfully	No

use of data, the benefits of doing such research, the confidentiality of the anesthesiologist participation, the right to participate and complete the survey, and the confidentiality and anonymity of the data, followed by a check box for the agreement to participate. The survey also included questions about the respondents' hospitals and the geographical regions, and the drugs used for anesthesia. No personal data were collected. The results were imported as a data spreadsheet.

Data management and analysis

On completion of the survey, the results were imported as data into an Excel spreadsheet for analysis.

Descriptive analysis was done by prescribing frequency distribution and percentage for study variables, including physician's bio-demographic data, dantrolene availability, and accessibility while working hospital facilities for dantrolene availability and accessibility, frequency of facing MH cases, and number of instances were graphed. Also, bio-clinical data on MH case management and outcomes were tabulated. Cross tabulation to assess factors associated with anesthetic physicians' awareness about the availability of dantrolene was carried out with the Pearson chi-square test for significance and the exact probability test to see if there were small frequency distributions[14].

Table 2: Pre-emptive identification of MH precipitation

Author	Year of Publication	Number of Cases	Syndrome Associated With MH	MH Test Done or Not	Surgical Procedure	Outcome
AlBakri et al. [10].	Dec. 2015	2	Congenital Ptosis and Scoliosis	Genetic	Ptosis surgery	Uneventful
Almomen et al. [11]	Feb. 2024	7	STAC3-related myopathy	Genetic	Cleft Palate	Uneventful
Bahaziq et al. [12].	Apr-Jun 2022	1	Walker-Warburg syndrome is autosomal recessive congenital muscular dystrophy presenting with hydrocephalus, type II lissencephaly, cerebellar malformation, and ocular anomalies.	Genetic	Ventriculo-peritoneal Shunt	Uneventful

3. RESULTS

Tables 1 and 2 represent the few reported or published cases of MH patients within the KSA before the survey started.

3.1. Record flow diagram

Responses were collected from 174 anesthesiologists. However, a response rate cannot be calculated accurately because the precise number of anesthesiologists who received the invitation was unknown. The Anesthesiologists (n=174) responding to the survey were mainly consultants (65.5%), as demonstrated in the following statistics: 114 (65.5%) were consultants, 31 (17.8%) were specialists, and 29 (16.7%) were residents. The majority had an experience of more than 10 years (70.7%; 123), 5 to 10 years (14.9%), and fewer than 5 years (14.4%).

The main responses from the nineteen validated questionnaire survey are presented in Tables 3-7.

Table 3: Work data and the practice among anesthetic physicians of Saudi Arabia (n = 174).

Personal data and practice	N (%)
Seniority	
✓ Resident	29 (16.7)
✓ Specialist	31 (17.8)
✓ Consultant	114 (65.5)
Anaesthesia Experience?	
✓ < 5 years	25 (14.4)
✓ 5-10 years	26 (14.9)
✓ > 10 years	123 (70.7)
How often do you measure body temperature during surgery?	
✓ Rarely	15 (8.6)
✓ Sometimes	55 (31.6)
✓ Randomly	21 (12.1)
✓ In emergency	3 (1.7)
✓ Always	80 (46.0)
Is there a vaporizer free anesthetic machine in your hospital operating suite?	
✓ Yes	107 (61.5)
✓ No	67 (38.5)

PACU, Postoperative Anaesthesia Care Unit

Table 4: Dantrolene availability and access to anesthesia physicians in Saudi Arabia (n = 174)

Availability date	N (%)
How many vials of dantrolene are available in your hospital?	
✓ None	25 (14.4)
✓ Between 1 and 3 vials	13 (7.5)
✓ Between 3 to 6 vials	23 (13.2)
✓ Six vials or more	113 (64.9)
How many vials of dantrolene are in stock in the operating room?	
✓ None	58 (33.3)
✓ Between 1 and 3 vials	24 (13.8)
✓ Between 3 to 6 vials	18 (10.3)
✓ Six vials or more	74 (42.5)
How is dantrolene obtained in an emergency?	
✓ Available to prepare 120 mg dantrolene within 30 min	90 (51.7)
✓ Agreement between hospitals to provide dantrolene	31 (17.8)
✓ A predetermined supplier will deliver	22 (12.6)
✓ No predetermined supplier	18 (10.3)
✓ Other	44 (25.3)
Do you know where in your city dantrolene is available?	
✓ Yes	66 (37.9)
✓ No	108 (62.1)

3.1.1. Percentage and number of suspected MH cases:

Thirty-two anesthesiologists, 32 (18.4%) reported dealing with suspected malignant hyperthermia cases during their careers, of which 21/32 were inside KSA hospitals. 58% of the responding anesthesiologists had never dealt with a MH case inside or outside KSA. 29.3% had dealt with one MH instance, 8% with two, 2.9% with three, and 1.7% with four or five.

3.1.2. MH susceptible patients' demographics:

Twenty-five (78.1%) were males, 19 (59.4%) were aged less than 18 years, 12 (37.5%) were aged 18-50 years, and only 1 case was aged more than 50 years.

3.1.3. MH Clinical Presentation:

Table 5: Demographics of the suspected MH cases faced by anesthetic physicians in KSA (n = 32)

Bio-clinical data	N (%)
Gender of the experienced cases	
✓ Male	25 (78.1)
✓ Female	7 (21.9)
Age of the experienced cases	
✓ 1-17 years	19 (59.4)
✓ 18-50 years	10 (37.5)
✓ > 50 years	1 (3.1)
Signs and symptoms in MH patient	
✓ Risen in body temperature	27 (84.4)
✓ Increased $EtCO_2$	27 (84.4)
✓ Tachycardia	21 (65.6)
✓ Muscle spasms or muscle rigidity	13 (40.6)
✓ Acidosis	8 (25.0)
✓ Hypotension shock	4 (12.5)
What was the agent that triggered MH in your reported patient?	
✓ Sevoflurane	16 (50.0)
✓ Isoflurane	6 (18.8)
✓ Not sure	6 (18.8)
✓ Halothane	3 (9.4)
✓ Desflurane	1 (3.1)

The most reported signs and symptoms were high body temperature (84.4%), elevated end-tidal carbon dioxide (84.4%), tachycardia (65.6%), and muscle spasms or muscle rigidity (40.6%).

3.1.4. Triggering agents:

The most reported triggering agents were Sevoflurane (50%), Isoflurane (18.8%), and Halothane (9.4%), respectively. The most used muscle relaxants were Rocuronium (43.8%), Atracurium (15.6%), and Suxamethonium (15.6%), while 7 (21.9%) did not need muscle relaxants.

3.2. Dantrolene availability

3.2.1. In Hospital dantrolene:

113 (64.9%) reported that six or more vials of dantrolene are available in their hospital, 23 (13.2%) reported 3 to 6 vials available, 13 (7.5%) reported 1 to 3 available vials but 25 (14.4%) told there are no dantrolene vials available in their hospitals.

3.2.2. In Operating rooms dantrolene:

74 (42.5%) reported that six or more dantrolene vials were available in stock in the operating room, 18 (10.3%) reported 3 to 6 vials, 24 (13.8%) reported 1 to 3 vials, but 58 (33.3%) confessed that there were no vials in the stock in their operating room.

3.3. Immediate access to dantrolene

Regarding the method of obtaining dantrolene in an emergency, ready availability to prepare 120 mg of

Table 6: Triggering agent, management, and outcome of the suspected MH patients in this survey (n = 32)

Management and outcome	N (%)
What muscle relaxant was used, if any?	
✓ Rocuronium	14 (43.8)
✓ None	7 (21.9)
✓ Atracurium	5 (15.6)
✓ Suxamethonium	5 (15.6)
✓ Vecuronium	1 (3.1)
What was the management for this MH crisis?	
✓ Discontinuation inhaled anesthetics	31 (96.9)
✓ Cooling method	30 (93.8)
✓ Give 100% oxygen	28 (87.5)
✓ Administration of dantrolene	26 (81.3)
✓ Administration of sodium bicarbonate	19 (59.4)
How much time was required for dantrolene to be ready to administer this case of MH?	
✓ Less than 30 min	21 (65.6)
✓ Between 30 and 60 min	5 (15.6)
✓ No answer	6 (18.8)
Did the patient survive this malignant hyperthermia crisis?	
✓ Yes	28 (87.5)
✓ No	4 (12.5)
Was this MH case reported or published?	
✓ Yes	7 (21.9)
✓ No	25 (78.1)

Table 7: Factors associated with anesthetic physicians' awareness about the availability of dantrolene.

Factors	Knowledge	No Knowledge	P-value
Seniority			
✓ Resident	5 (17.2)	24 (82.8)	*.010**
✓ Specialist	9 (29.0)	22 (71.0)	
✓ Consultant	52 (45.6)	62 (54.4)	
Anesthesia Experience?			
✓ < 5 years	3 (12.0)	22 (88.0)	*.014**
✓ 5-10 years	10 (38.5)	16 (61.5)	
✓ > 10 years	53 (43.1)	70 (56.9)	
How many vials of dantrolene are available in your hospital?			
✓ None	7 (28.0)	18 (72.0)	*.238*
✓ Between 1 and 3 vials	3 (23.1)	10 (76.9)	
✓ Between 3 to 6 vials	7 (30.4)	16 (69.6)	
✓ Six vials or more	49 (43.4)	64 (56.6)	
How many vials of dantrolene are in stock in the operating room?			
✓ None	16 (27.6)	42 (72.4)	*.020**
✓ Between 1 and 3 vials	7 (29.2)	17 (70.8)	
✓ Between 3 to 6 vials	5 (27.8)	13 (72.2)	
✓ Six vials or more	38 (51.4)	36 (48.6)	
Did you personally face any malignant hyperthermia cases in Saudi Arabia during your service?			
✓ Yes	15 (46.9)	17 (53.1)	.249
✓ No	*51 (35.9)*	*91 (64.1)*	

*Pearson X2 test is the test of significance; * P < 0.05 is considered significant*

dantrolene within 30 min was the most reported (51.7%), followed by an agreement between hospitals (17.8%), with a predetermined supplier will deliver (12.6%) dantrolene. In contrast, 10.3% claimed that there was no predetermined supplier. However, 66 (37.9%) of the anesthesiologists knew from where dantrolene could be available in their city in case of need.

4. DISCUSSION

This study provides critical insights into the incidence of suspected malignant hyperthermia (MH), the availability of dantrolene as the primary treatment, and the broader implications of these findings in achieving the study's goals.

The survey reveals a significant dantrolene access gap among anesthetic physicians in Saudi Arabia. Alarmingly, 14.4% of surveyed hospitals reported no dantrolene vials in stock, exposing a significant deficiency in essential medical supplies. This shortage represents a substantial risk to patient safety during surgical procedures that may trigger MH. Similar findings have been reported in other studies, where many hospitals lacked adequate dantrolene stocks.[15,16] The absence of dantrolene in these situations could result in delays in treatment initiation, exacerbating MH crises and leading to increased morbidity and mortality.[17] Additionally, 33.3% of facilities lacked on-site dantrolene in their operating rooms, further complicating timely interventions during MH emergencies. Despite these challenges, it is essential to note that the absence of dantrolene should not delay the immediate management of an MH crisis, as other treatment options must be pursued without hesitation.

Globally, disparities in dantrolene availability have also been noted. For instance, dantrolene is not freely available in India and is stored only in certain hospitals within major cities. Nonetheless, nearly 50% of patients with suspected MH in India have survived the condition despite the unavailability of dantrolene. This emphasizes the critical role of early detection and aggressive management in MH cases.[18]

The study also presents valuable bio-clinical data from MH cases encountered by anesthetic physicians in Saudi Arabia. Among the cases, 78.1% were male, with 59.4% under 18 and 37.5% between 18 and 50 years old. These demographic trends suggest specific susceptibilities or risk factors within the Saudi population.[19,20] The most frequently reported symptoms included high body temperature (84.4%), elevated end-tidal carbon dioxide ($EtCO_2$) levels (84.4%), tachycardia (65.6%), and muscle rigidity or spasms (40.6%). These clinical signs align with established diagnostic criteria for MH, underscoring the importance of vigilance during perioperative care.[21-24]

Additionally, the survey identified sevoflurane (50%), isoflurane (18.8%), and halothane (9.4%) as the most common triggering agents for MH episodes. These findings highlight the potential role of specific volatile anesthetics in precipitating MH and emphasize the need to carefully select and monitor anesthetic agents in at-risk patients.[20,21,25,26]

In MH crises, the survey found that 43.8% of cases utilized rocuronium, 15.6% used atracurium, 15.6% used suxamethonium, and 21.9% did not require muscle relaxants. This reflects a preference for non-depolarizing neuromuscular blockers, favoured for their safety profiles and ability to avoid hyperkalaemia, a complication associated with depolarizing agents like succinylcholine.[27,28] Non-depolarizing blockers provide prolonged muscle relaxation, essential during MH crises, and their reversibility with cholinesterase inhibitors supports faster recovery.[29]

Treatment strategies among the responding anesthesiologists included discontinuation of inhaled anesthetics (96.9%), active cooling methods (93.8%), and administration of 100% oxygen (87.5%), aligning with international guidelines.[20,21] However, while 81.3% of cases received dantrolene, only 65.6% received the drug within 30 min. This highlights a critical need for improved readiness. Despite these interventions, the in-hospital mortality rate was 12.5%.

Additionally, only 21.9% of cases were reported or published, suggesting significant underreporting and a lack of comprehensive data collection.

The survey revealed disparities in dantrolene awareness, with consultants and experienced anesthetists demonstrating greater familiarity than junior practitioners. This underscores the need for targeted educational initiatives to enhance awareness among all anesthesia team members. Furthermore, while most hospitals had MH crisis card checklists, many lacked dedicated MH support centres. Establishing centralized resources and expertise could enhance coordination and improve patient outcomes during emergencies. The findings also highlight a consensus among anesthetic professionals for establishing a dedicated MH diagnosis and management centre in Saudi Arabia.

4.1. Global MH Testing and Regional Challenges

Globally, MH diagnostic testing remains limited. Genetic testing requires stored specimens, while in vitro contracture testing necessitates fresh muscle biopsies and specialized laboratories. These facilities are available only in select centres worldwide, making them expensive and time-consuming. This limits many patients, including those in Saudi Arabia, to living with presumed MH susceptibility due to barriers like affordability, eligibility, and border control issues. Establishing accessible MH diagnostic facilities is critical for our time.[9]

5. RECOMMENDATIONS

Preoperative evaluations should include screening for conditions and syndromes associated with MH risk. Immediate recognition of MH and timely administration of dantrolene are crucial for favourable outcomes. Hospitals must ensure the availability of MH management carts, dantrolene stocks, and vaporizer-free anesthesia machines in every operating suite. Clear signage indicating the availability of dantrolene within operating rooms and cities is essential. Hospitals with inadequate monitoring or supply gaps should be informed and encouraged to meet these critical requirements.

6. LIMITATIONS

The study's results must be interpreted cautiously, as the data were collected from anesthesiologists rather than official databases. Retrospective data retrieval from several years ago may be subject to inaccuracies. Additionally, the response rate is uncertain due to the inclusion of few anesthesiologists from outside the targeted regions, and the online distribution of the survey could have allowed for multiple submissions by the same individual.

7. CONCLUSION

Malignant hyperthermia (MH) incidents are a recognized occurrence in Saudi Arabia. They are anticipated to rise with the increasing influx of multinational populations choosing to work and live in the Kingdom. This highlights the critical importance of addressing dantrolene availability and enhancing hospital preparedness for managing MH emergencies. By identifying significant gaps in essential medication supplies and raising awareness among healthcare professionals, this study offers valuable insights to guide targeted interventions and improve patient safety.

Establishing a dedicated MH management and database centre is a pressing need. The current low number of reported MH cases should not be used as a justification to delay such an initiative, particularly given the absence of accurate statistics for this rare yet serious anesthetic emergency and its potential association with musculoskeletal disorders that can trigger MH. This survey has shed light on susceptible MH cases in Saudi Arabia that remain unpublished or insufficiently shared on a broader scale.

Moreover, the study demonstrates variability in hospital preparedness for MH emergencies, which needs to be addressed urgently. Hospitals with inadequate monitoring systems or insufficient dantrolene supplies should be informed and encouraged to meet the required standards to ensure optimal patient safety.

Finally, anesthesiologists must be well-versed in recognizing syndromes linked to MH risk during preoperative evaluations. Proactively identifying these risk factors and comprehensive preparation are essential for mitigating MH-related complications and improving patient outcomes.

8. Data availability

The numerical data generated during this research is available with the authors.

9. Conflict of interest

All authors declare that there was no conflict of interest.

10. Funding

The study utilized the hospital resources only, and no external or industry funding was involved.

11. Authors' contribution

All authors took part in the preparation of the study protocols, conducting survey online, collection and analysis of the data, concluding the results and preparation of this manuscript.

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