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Research Article

Pediatric Emergency Fellow Physician's Perception Toward Using Mechanical Ventilation in Saudi Arabia during 2021

Amal Yousif*

Pediatric Emergency Consultant, Department of Pediatric Emergency KKUH-KSUMC-KSU, KSA

***Corresponding Author:** Amal Yousif, Pediatric Emergency Consultant, Department of Pediatric Emergency KKUH-KSUMC-KSU, KSA.

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Abstract

Introduction: The effective management of mechanically ventilated (MV) patients in emergency medicine remains a complex challenge, requiring comprehensive training and practical skills among clinical residents. This cross-sectional study aimed to evaluate the knowledge and experience of pediatric emergency medicine (PEM) fellows in the Kingdom of Saudi Arabia regarding the use of mechanical ventilation.

Methodology: An online survey questionnaire was distributed to participants from training centres and hospitals in the Eastern, Central, and West regions. 55 PEM fellows and 2 consultants who had experience treating ventilated patients participated in the study. Convenience sampling was employed, and the questionnaire was adapted as needed. The survey was administered through Google Forms, assigning a unique serial number to each participant.

Results: Of the 55 participants, 31 (54.39%) were male and 26 (45.61%) were female. The majority of Central Region PEM fellows (84.21%) gave the maximum response rate compared with other regions. Only 20(35%) participants attended their class, while the rest never attended. PEM fellows (47.37%) reported assisting with 1-3 ventilated patients per month during their fellowship. Notably, respiratory therapists (49.12%) were primarily responsible for adjusting and modifying MV parameters. Among the 55 PEM fellows, only 13 (22.81%) were comfortable using the MV in their center. In terms of MV knowledge, 25 participants (43.86%) correctly figured out assist control and pressure support. Regarding optimal minute ventilation, 87.72% recognized the adjustment of tidal volume and respiratory rate. In identifying conditions necessitating higher PEEP for recruiting collapsed alveoli, 68.42% chose ARDS, surpassing asthma (14.04%) and bronchiectasis (15.79%).

Conclusion: This study underscores the importance of targeted educational initiatives to improve PEM fellows' understanding of mechanical ventilation principles. Such efforts aim to establish a more consistent and accurate knowledge base among healthcare professionals in this crucial domain.

Keywords: Pediatric Emergency; Physician's Perception; Mechanical Ventilation; Saudi Arabia

Introduction

Recent studies have shown how technological advances in mechanical ventilators reduced mortality rates in the emergency department [1]. However, despite ample knowledge and widespread access to clinical recommendations, little is translated into improved therapeutic outcomes. Evidently shown in the underuse of protective mechanical ventilation in cases of Acute Respiratory Distress Syndrome (ARDS) [2,3]. Additionally, research reveals that only 41% of mechanical ventilators' settings are compliant with clinical recommendations [4]. These findings demonstrate the need for more clinical knowledge regarding the use of Mechanical Ventilators and the need for MV training for clinical residents.

In the emergency department, PEM deal with many cases requiring mechanical ventilation, but the overall training they receive in handling MV cases is not sufficient [5]. The role of mechanical ventilation in the management of patients encountered in the ER department cannot be understated. For example, patients with Asthma are susceptible to high rates of complications and are prone to deterioration once they are intubated [6]. Additionally, MV has been shown to lower the mortality rate among patients who are suffering from ARDS [7].

Moreover, proper management and care for patients suffering from traumatic brain injury have improved outcomes when done using mechanical ventilators [8,9]. Increased ward traffic and hospital crowding ER physicians are responsible for prolonged management of ventilated patients[10,11,12] and ventilation-induced lung damage can happen in as little as 20 minutes [13].

The Airway management using mechanical ventilators is a tricky, resource exhaustive, and skill requiring clinical tool with numerous advantages and fallbacks [14]. The proper use of mechanical ventilators has a clear positive impact [15]. But unfortunately, these safe proper recommendations are not consistently applied [16]. Thus there exists a variance between study analytical evidence and clinical application by physicians [17]. This gap is partially induced by inadequate clinical training, represented in physicians who went through subspecialty training are more likely to apply safer and more proper techniques than no specialists [18].

This is further enhanced by the fact that many mechanical ventilator interventions are patient- specific and require case-by-case analysis to implement the right intervention, and also requires an understanding of various evidence-based practices and disease pathophysiology to reach the best therapeutic outcome. However, the majority of patients who receive care via mechanical ventilation are cared for by physicians who haven't gone through formal training in mechanical care [19]. This trend if not halted will likely worsen with time, given the expectant increase in demand for mechanical ventilators in the future [20].

The role of mechanical ventilators and the importance of proper handling of them is further stratified by the novel coronavirus disease (COVID-19) pandemic which is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The virus has crippled numerous healthcare systems and the World Health Organization reports a 3.9% mortality rate caused by the virus [21,22]. The care for COVID patients is evolving at a fast pace [23], and therapies such as remdesivir and dexamethasone are promising [24]. However, mechanical ventilators remain the mainstay of treatment in most cases.[25] Early invasive mechanical ventilation was encouraged early to counter the effects of hypoxemia encountered in COVID patients [26,27].

Our study aim is to use a survey to measure PEM fellows' knowledge and experience regarding the use of Mechanical ventilation. We are looking to quantify how frequently PEM fellows receive education and training in MV, how frequently they care for patients under MV and how confident they are in using MV and in their knowledge in various MV settings. Our hypothesis is that Fellows' training, knowledge, and experience will positively impact their performance in the knowledge assessment tool.

Methodology

This is a cross-sectional study conducted on PEM fellows. In this study, an online survey questionnaire was sent to participants through email. We chose those PEM fellow physicians as participants who treated patients with mechanical ventilation. The cover page of the questionnaire includes a short introduction regarding the objectives, procedures, the voluntary nature of participation, declarations of confidentiality, and anonymity. In this, we have tried to include all the fellow training centres and hospitals in the Kingdom of Saudi Arabia (Eastern, Central, and West regions) via email. A total of 55 PEM fellows and 2 consultants participated in this study. Convenience sampling techniques were used with the en-

tire group of participants, and we have modified our questionnaire according to the requirements. We used a validated questionnaire, which is used in previously published studies. The questionnaire was modified to fit our criteria. Then, it was validated using a pilot study on fellow physicians. The questionnaire was converted to an online version using Google Forms. Each participant had a unique serial number. Studied variables include demographics (age, gender, and age) and questions assessing physicians' perceptions of mechanical ventilation in terms of their overall knowledge and experience with mechanical ventilation.

Data analysis

Google form data was converted to a Microsoft excel spreadsheet. For analysis, data was further converted from an Excel sheet to SPSS. For categorical data, the terms percentage and frequency was utilised, while mean and standard deviation was employed for numerical data. All the statistical analyses were performed by using the statistical package for social sciences (SPSS) version 20.0. Data was presented as mean ± SD and proportions as appropriate. The Chi-square test or Fisher's exact test was used to compare categorical data. The statistical significance level is set at $p < 0.05$.

Results

Characteristics of the Study subjects

The survey was distributed and answered by 55 PME Fellows of the first and second years and two consultants).The response rate was not calculated due to the inaccessibility of the survey. There were a total of 31 (54.39%) males and 26 (45.61%) female participants. The response to the survey was relatively equally distributed between first-year 28 (49.12%) and second-year 27 (47.37%). In regards to response rate according to region, the majority was from Central Region 48 (84.21%), followed by Eastern Region 6 (10.55%), and lastly North Region 1 (1.75%), South Region 1 (1.75%), and West Region 1 (1.75%). (Table 1).

Current Professional level	Response (%)
Fellow	28 (49.12%)
Fellow 2	27 (47.37%)
Consultant	2 (3.51%)
Gender	
Male	31 (54.39%)
Female	26 (45.61%)
Region of current centre	
North	1 (1.75%)
South	1 (1.75%)
Centre	48 (84.21%)
East	6 (10.53%)
West	1 (1.75%)

Table 1: Current profession level, gender, and region of the EM fellowship centre.

Education managing experience of ventilating machine

The table 2 shows the attendance and response frequency with which participants dedicate time to learning about mechanical ventilation during their Fellowship. 20 (35%) participants attended the classes during their fellowship while majority of participant were never attendant their theoretical or practical classes on mechanical ventilation during their Fellowship.

However 10% participants were not sure about this. Further their responses were distributed across a scale of 0 to 10, with 0 indicating no time spent and 10 representing a significant amount of time invested. Notably, the distribution reveals that the largest percentage, 28.07% (16 respondents), allocated a score of 2, signifying a moderate engagement with learning activities. On the other hand 8.77% (5 respondents) assigned a score of 0, suggesting no time spent on learning, while 15% (9 respondents) and 17% (9 respondents) assigned scores of 4 and 5, respectively, indicating a more dedicated approach to understanding mechanical ventilation.

Additionally, how many mechanically ventilated patients were assisted by the fellows during their fellowship was also reported. The majority of participants 27 (47.37%) reported helping one to three ventilated patients per month during their fellowship. Furthermore, 17 (29.82%) reported that they have never been involved in helping mechanically ventilated patients during fellowship. However, 9(15.79%) fellows attended more than four ventilated patients per month (Table 3).

As per table 3 it has been found that mainly respiratory therapist (28(49.12%)) was responsible for modulating and changing MV parameters. EM department physician in charge and those not related to EM department (ICU staff, Nurses and pulmonologist)

Did you attend theoretical or practical classes on mechanical ventilation during your Fellowship?	Response (%)
Yes	20 (35.09)
No	31 (54.39)
Maybe	6 (10.53)
How often do you spend time learning about mechanical ventilation during? your Fellowship? (Articles, journal clubs, conferences/lectures. etc)	
0	5 (8.77%)
1	1 (1.75%)
2	16 (28.07%)
3	10 (17.54%)
4	9 (15.79%)
5	10 (17.54%)
6	2 (3.51%)
7	3 (5.26%)
8	1 (1.75%)
9	0 (0.00%)
10	0 (0.00%)

Table 2: Fellow engagement with MV Education in terms of theory classes and learning activities during the fellowship.

were also involve in combination or individually, in 4%,3%,7% and 4% of cases. Only one percentage was not sure about who was responsible for MV parameter modulation.

Most of the fellows evaluated their own experience with mechanical ventilation during fellowship as very unsatisfying and unsatisfying, with 17 (29.82%) and 15 (26.32%) respectively. Only 9 (15.79%) answered satisfying, and only 1 (1.75%) answered very satisfying. 15 (25.32%) were neutral about their experience. Looking ahead to their current comfort level with using mechanical ventilation, respondents exhibited varying degrees of confidence. Approximately 13 (22.81%) were comfortable, 19 (33.33%) were not, and 25 (43.86%) expressed uncertainty, suggesting a mixed sentiment among participants about their proficiency with mechanical ventilation in their centres (Table 3).

Ventilator management knowledge

How many patients on mechanical ventilation did you help during your fellowship? (Participated in treatment, discussed or followed changes in ventilation parameters, or changed the parameters yourself without supervision)?	Response (%)
Never	17 (29.82)
Rarely (1 to 3 patients/month)	27 (47.37)
Occasionally (4 to 9 patients/month)	9 (15.79)
Frequently (over 10 patients per month)	1 (1.75)
I don't know	1 (1.75)
Who initiates and introduces changes in the mechanical ventilation where you work?	
Nurse	0
Physician in charge of the emergency department	3 (5.26)
Resident who is training in the emergency department	0 ()
Physician who is not related to the emergency department (ICU staff, pulmonologist, etc.)	3 (5.26)
Respiratory therapist	28 (49.12)
Physician in charge of the emergency department, Physician who is not related to the emergency department (ICU staff, pulmonologist, etc.), Respiratory therapist	6 (10.53)
Physician who is not related to the emergency department (ICU staff, pulmonologist, etc.), Respiratory therapist	10 (17.54)
Physician who is not related to the emergency department (ICU staff, pulmonologist, etc.), I dont know	1 (1.75)
Physician in charge of the emergency department, Respiratory therapist	3 (5.26)
Nurse, Physician in charge of the emergency department, Respiratory therapist	1 (1.75)
Physician in charge of the emergency department, Physician who is not related to the emergency department (ICU staff, pulmonologist, etc.)	2 (3.51)
I don't know	0
Overall, how do you evaluate your experience with Mechanical ventilation during fellowship?	
Very unsatisfying	17 (29.82)
Unsatisfying	15 (26.32)
Neutral	15 (26.32)
Satisfying	9 (15.79)
Very satisfying	1 (1.75)
Are you comfortable to use Mechanical ventilation in your current center?	
Yes	13 (22.81)
No	19 (33.33)
Maybe	25 (43.86)

Table 3: Experience in MV with regards to how many MV patients handled, who initiated the MV, overall experience, and how comfortable they were during the fellowship.

Table 4 shows overall response: 23 (43.86%) received on the difference between assist-control and pressure support. By citing assist-control, the patient receives a set volume or pressure with each breath; with pressure support, the patient can adjust the volume they receive via their effort. After that, notable responses were also received in other options, like 12 (21% of participants) choosing option 1 and 10 (17%) choosing options 3 and 4. Tidal volume and respiratory rate are adjusted to achieve optimal minute ventilation, and the majority of 50 (87.72%) correctly identified this. While 7 (12.22%) failed in this. Another knowledge assessment was conducted by asking participants "which conditions require a higher PEEP to be applied in recruiting collapsed alveoli." ARDS was chosen by 39 participants (68.42%), while asthma was chosen by 88 participants (14.04%), and bronchiectasis by 9 participants (15.79%).

Discussion

What is the difference between assist- control and pressure support?	Fellow 1	Fellow 2	Overall Response (%)
With assist control, the patient cannot trigger the ventilator; with pressure support, the patient triggers each breath.	6	5	12 (21.05)
With assist control, the patient always receives the same PEEP; with pressure support, the patient can adjust the PEEP via their effort.	4	6	10 (17.54)
With assist control, the patient receives a set volume or pressure with each breath; with pressure support, the patient can adjust the volume they receive via their effort.	13 (46.42%)	11 (40.74%)	25 (43.86)
With assist control, the patient triggers each breath; with pressure support, the patient cannot trigger the ventilator.	5	5	10 (17.54)
What are the Ventilator Parameters adjusted to maintain the optimum Minute Ventilation?			
FiO2 and PEEP	2	5	7 (12.28)
Tidal Volume and Respiratory Rate	26 (92.85%)	22 (81.48%)	50 (87.72)
Which of the following conditions require a higher PEEP to be applied in recruiting collapsed alveoli?			
Ashma	2 (7.14%)	6 (22.2%)	8 (14.04)
Acute Respiratory Distress Syndrome	20 (71.42%)	18 (66.6%)	39 (68.42)
Emphysema	0 (0%)	1 (3.7%)	1 (1.75)
Bronchiectasis	6 (21.42%)	2 (7.4%)	9 (15.79)

Table 4: MV knowledge in EM fellow by asking fact related to EM patient handling.

In the aftermath of the COVID-19 pandemic, substantial transformations have been witnessed in clinical settings, prompting programmatic alterations in medical curricula [28]. The ongoing rise in mechanically ventilated (MV) patients can be attributed to factors such as overpopulation and the surge in life-threatening diseases [29]. Notably, it has been observed that patient outcomes are directly influenced by decisions related to ventilator management. In the ED, situations involving asthma, acute respiratory distress syndrome (ARDS), and traumatic brain injury present elevated risks [30,31]. Ventilated patients in the ED are in a precarious and life-threatening position, requiring increased attention. Our findings indicate that emergency medicine residents have moderate knowledge and limited training in terms of practical and theoretical knowledge. Other studies also found that PEM fellows have mod-

erate knowledge of MV and their performance is correlated with their self-reported comfort with caring for ventilated patients. Additional hours of education on mechanical ventilation boost scores on the basic knowledge test, leading to increased comfort among PEM fellows. However, real- world experience with critically ill patients proves that this is not the sole affecting factor [32,33]. In this study, an assessment tool was developed with educational goals for the management of patients with MV. It assessed knowledge in real-world clinical scenarios that EM fellows frequently face during their training. This tool resembles a previously validated test and was pilot tested to optimize psychometric and performance characteristics [34]. The majority of participants (47%) reported helping 1-3 ventilated patients per month during their fellowship.

Furthermore, more than 27% reported to have never been involved in helping mechanically ventilated patients during fellowship. The responsibility for modulating and changing mechanical ventilation parameters varied among healthcare professionals. Respiratory therapists were the most commonly identified group, with 29% of respondents attributing this role to them. When evaluating their experience with mechanical ventilation during their fellowship, a small percentage of PEM fellows (15%) were satisfied with their training. This variability in exposure may contribute to the observed gaps in knowledge and underscore the importance of standardized training experiences for all emergency medicine residents [35]. Studies have shown that training programs lacking specific MV aims guide to higher discontent among trainees. The identified objectives cover various aspects of MV, including respiratory physiology, ventilation modes, noninvasive ventilation, monitoring, complications of MV, removal of MV, management of invasive devices, understanding of sedation and analgesia principles, and use of multiple ventilator types (fellow-level) [36]. Decisions regarding ventilator management can directly influence the prognosis of critically ill patients.

While a significant percentage accurately identified the difference between assist-control and pressure support modes, citing that in assist control, patients receive a set volume or pressure, and in pressure support, they can adjust the volume via their effort, there were notable instances of misconceptions in other response options. In terms of ventilator parameters for maintaining optimum minute ventilation, a substantial portion correctly identified tidal volume and respiratory rate, suggesting a reasonable grasp of this fundamental concept. However, the lower percentage of correct responses indicates potential areas for improvement in understanding these crucial parameters. The question on higher PEEP application to recruit collapsed alveoli produced a notable correct response for acute respiratory distress syndrome, but varying responses for other conditions suggest a need for further clarity in comprehending PEEP adjustments in specific respiratory pathologies. In conclusion, these findings emphasize the importance of targeted educational efforts to enhance participants' understanding of mechanical ventilation principles, thereby ensuring a more uniform and accurate knowledge base among healthcare professionals in this critical domain.

Limitation

This study sheds light on the knowledge and training gaps among emergency medicine residents in the management of mechanically ventilated patients. This study has some limitations that are also important to acknowledge. First, the study's sample size may impact the broader applicability of its findings. Furthermore, while the knowledge assessment tool used in the study aligns with real-world clinical scenarios, its ability to comprehensively capture the complexities of emergency medicine practice, including practical skills and real- time decision-making, may be limited. The study also did not establish a causal relationship between the identified knowledge gaps and patient outcomes. These limitations highlight areas for improvement in future research to enhance the understanding of mechanical ventilation training challenges in PEM fellows and may be need to include EM residents program too.

Conclusion

Understanding MV is critical for patients with life-threatening diseases. This cross-sectional study focused on the importance of a targeted educational curriculum. PEM fellows' understanding of MV theories and comfort with MV handling is required for the overall outcome of patients. This effort establishes a more consistent and accurate knowledge base among PEM fellows in this crucial domain.

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