

## Assessing the Medical Student's Knowledge and Awareness of MONA Protocol and Oxygen Therapy in Acute Myocardial Infarction: A Cross-Sectional Study

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### KEYWORDS

Acute Myocardial Infarction, MONA mnemonic, Oxygen therapy, Medical education, Hyperoxia, Healthcare awareness.

### ABSTRACT

**Introduction:** The mnemonic "MONA," comprising Morphine, Oxygen, Nitroglycerin, and Aspirin, has been a cornerstone in the initial treatment of Acute Myocardial Infarction (AMI) and has been ingrained in the education of medical students for generations. The inclusion of oxygen in this mnemonic is rooted in the concept that AMI arises from a disparity between myocardial oxygen demand and supply. This study aimed to assess the knowledge of medical students regarding AMI, the MONA mnemonic, and the specific role of oxygen in patients experiencing Acute Myocardial Infarction. **Material and Methods:** A cross-sectional study was conducted involving 188 medical students selected through purposive sampling. Participants were provided with a pretested structured questionnaire, and the gathered data was analyzed using SPSS 23. **Results:** The study showed satisfactory understanding among students regarding the presentation of AMI, its ECG findings, and the components of the MONA mnemonic was observed. Only 47% of participants were cognizant of the purpose of MONA, primarily for initial pain control. Moreover, a notable 23% of students were aware that oxygen does not contribute to the treatment of AMI in normoxemic patients. **Conclusion:** The study underscores a significant gap in the awareness of medical students concerning the role of oxygen in normoxemic patients with AMI.

## 1. Introduction

Acute Myocardial Infarction (AMI) results from decreased or complete cessation of blood flow to a segment of the myocardium, stemming from a mismatch between oxygen and substrate supply and demand. Consequently, supplemental oxygen has been integral to supportive care in cardiovascular medicine, as emphasized in the widely taught mnemonic "MONA" - Morphine, Oxygen, Nitroglycerin, and Aspirin [1]. Despite the effectiveness of Morphine, Nitroglycerin, and Aspirin, the role of oxygen remains controversial [2]. While proven beneficial for correcting hypoxemia, the use of supra-physiological oxygen levels lacks robust evidence of clinical efficacy.

Recent data indicates that even short durations of oxygen supplementation, as brief as 15 minutes, can lead to complications such as hyperoxia, increased coronary vascular resistance, reduced coronary blood flow and cardiac output, elevated oxygen free radicals, and disrupted microcirculation. These factors may contribute to heightened reperfusion injury and myocardial damage during acute coronary syndrome [3-5]. The historical reliance on the "MONA" protocol by clinicians, emergency personnel, and educators is now being challenged by emerging evidence. This study aims to bridge the knowledge gap among clinical medical students from various academic years regarding the controversial role of oxygen in the treatment of AMI. The main objectives of the study were to assess the awareness level among medical students regarding the role of oxygen in AMI patients and to compare this knowledge gap across different academic years.

## 2. Materials and Methods

This cross-sectional survey-based study was conducted between September 2022 and April 2023, involving consenting medical clinical students (Year 3-5) and interns at Ras Al Khaimah Medical and Health Sciences University. Preclinical students, those from allied specialties, non-respondents after two reminders, and non-consenting individuals were excluded. Purposive sampling was employed, and the minimal estimated sample

size of 188 students was calculated based on a total population of students as 364 in College of Medical Sciences at RAKMHSU, a confidence interval of 95%, confidence limits of 5%, and a population proportion of 50% [6]. The study received approval from the Institutional ethical committee of RAKMHSU. After obtaining consent, participants were administered a questionnaire via Google form or paper, assessing their knowledge of acute MI treatment and awareness of oxygen's role. The questionnaire underwent validation with faculty and piloting with students. Data were entered into Microsoft Office Excel and analyzed using SPSS version 23, employing descriptive analysis and relevant tests of significance for bivariate analysis.

### 3. Result

Of 364, 188 students filled out the questionnaire, with a response rate of 51.6%; 118 (63%) of which were females and 70 (37 %) were males. Fourth-year students represented a majority 68(35%), whereas interns 35(19%) represented minority.

Table 1 reveals the knowledge distribution among study participants regarding various aspects of oxygen use in the treatment of Acute Myocardial Infarction (AMI). Notably, 95% correctly identified the leading global cause of death, while 71% and 87% demonstrated accurate understanding of the classical presentation of AMI and expected ECG findings, respectively. Furthermore, 93% correctly identified the components of the "MONA" acronym, emphasizing its relevance in AMI treatment. However, a significant knowledge gap emerged concerning the role of MONA, with only 48% correctly attributing it to initial pain management. Regarding oxygen use, 39% acknowledged its limited applicability in AMI treatment, contrasting with 61% who perceived it as a universal modality. Additionally, a mere 23% correctly recognized the negligible role of oxygen in normoxemic AMI patients. Overall, while participants exhibited strong awareness of certain aspects, misconceptions persisted, indicating a need for targeted educational interventions to enhance comprehensive understanding and ensure evidence-based practices in AMI management. More than 50% of the students answered the questions involving the role of MONA and O<sub>2</sub> in the treatment of MI incorrectly; 52% were unaware of the role of MONA in the treatment of AMI (Initial pain management) 61% of students did not know that oxygen cannot always be used as one of the treatments of AMI, and 77% of students did not know that oxygen has absolutely no role in normoxemic patients presenting with AMI.

**Table 1. Distribution of study participants according to knowledge regarding different aspects of oxygen used**

Questions (Total response 188)	Correct	Incorrect
What is the leading cause of death worldwide?	179 (95%)	9 (5%)
Which of the following most closely resembles the classical presentation of AMI?	135 (71%)	53 (29%)
What ECG findings are expected in a patient presenting with signs and symptoms of AMI?	165 (87%)	23 (13%)
What does "MONA" stand for in the treatment of AMI?	175 (93%)	13 (7%)
What is the role of MONA in the treatment of AMI?	91 (48%)	97 (52%)
Do you think oxygen can ALWAYS be used as one of the treatment modalities of AMI?	74 (39%)	114 (61%)
What do you think oxygen does in normoxemic patients suffering from AMI?	43 (23%)	145 (77%)
How can AMI be prevented?	165 (87%)	23 (12%)

Tables 2a and 2b reveal variations in knowledge among medical students regarding the classical presentation of Acute Myocardial Infarction (AMI) and the use of oxygen as a treatment modality. Interns and Year 5 students demonstrate significantly higher knowledge in the classical presentation of AMI compared to Year 3 students ( $p < 0.05$ ), while Year 4 students show no significant difference from Year 3. In terms of oxygen as an AMI treatment, no significant difference is found between interns/Year 5 and Year 3, but Year 4 students exhibit better knowledge ( $p < 0.05$ ). No significant variations exist in knowledge about oxygen in normoxemic AMI patients across academic years. Targeted educational interventions are recommended to address these knowledge disparities and ensure a consistent understanding of AMI and its treatment modalities among medical students.

**Table 2a: Academic year-wise distribution of the knowledge of the use of oxygen in the treatment of MI among students of RAKMHSU**

QUESTIONS	Year	Correct	Incor- rect	Total	ODDS RATIO	$\chi^2$ value	p- value
Which of the fol- lowing most closely resembles the classical acute myocardial infarction (AMI)?	INTERN	32	3	35	8.30(2.23- 30.86)	12.19	0.0005
	5	30	7	37	3.33(1.22- 9.07)	5.83	0.01
	4	46	22	68	1.62(0.76- 3.45)	1.57	0.21
	3	27	21	48	1		
Do you think oxy- gen can always be used as one of the treatment modali- ties of AMI?	INTERN	12	23	35	1.14(0.45- 2.90)	0.08	0.77
	5	12	25	37	1.06(0.42- 2.55)	0.013	0.9
	4	35	33	68	2.33(1.07- 5.05)	4.7	0.03
	3	15	33	48	1		
What do you think oxygen does in normoxemic pa- suffering from AMI?	INTERN	7	28	35	0.95(0.32- 2.80)	0.01	0.92
	5	7	30	37	0.89(0.30- 2.55)	0.05	0.82
	4	19	49	68	1.47(0.61- 3.53)	0.75	0.38
	3	10	38	48	1		

**Table 2b: Year-wise Comparison of AMI Knowledge Questions**

Questions	Comparison Group	Knowledge Difference	Statistical Significance
1. Classical Presentation of AMI	Interns and Year 5 vs. Year 3	Interns and Year 5 > Year 3	p < 0.05
	Year 4 vs. Year 3	No significant difference	
2. Oxygen as AMI Treatment Modality	Interns and Year 5 vs. Year 3	No significant difference	
	Year 4 vs. Year 3	Year 4 > Year 3	p < 0.05
3. Oxygen in Normoxemic Patients with AMI	All Years	No significant difference	

Table 3 delves into gender-wise distribution, revealing that females outperform males in understanding the classical presentation of AMI. Males show lower odds of correctly identifying oxygen's role in AMI treatment and its impact on normoxemic patients, with statistical significance in the former case. Overall, these findings suggest potential areas for targeted educational interventions to enhance knowledge uniformity among medical students.

**Table 3: Gender-wise Distribution of Knowledge on Oxygen Use in MI Treatment**

Questions	Gender	Correct	Incorrect	Total	X <sup>2</sup>	Odds Ratio	p value
Classical Presentation of AMI	Male	48	22	70	0.5573	0.77 (0.41-1.49)	0.4474
	Female	87	31	118			
Do you think oxygen can al- ways be used in AMI?	Male	21	49	70	4.095	0.52 (0.28-0.98)	0.04301
	Female	53	65	118			
What does oxygen do in normoxemic AMI patients?	Male	17	53	70	0.1263	1.13 (0.56-2.28)	0.7223
	Female	26	92	118			

#### 4. Discussion

The findings of this study underscore a significant gap in the knowledge and understanding among medical students regarding the role of oxygen therapy in the treatment of Acute Myocardial Infarction (AMI). While the majority of participants demonstrated a sound grasp of the classical presentation of AMI and the components of the "MONA" acronym, misconceptions about the role and limitations of oxygen therapy were prevalent.

More than half of the students (61%) are uninformed that oxygen should not be universally employed in AMI treatment and should be avoided as a first-line management strategy unless specifically indicated. Furthermore, a substantial portion (77%) of the students lack knowledge about the insignificance of oxygen in treating normoxemic patients with AMI. Recent studies highlight the paradoxical effects of oxygen, including increased coronary vascular resistance and mortality, emphasizing the necessity to reevaluate its usage [7, 8]. The AVOID study, for instance, demonstrated that supplemental oxygen in normoxemic AMI patients was associated with increased myocardial injury, as evidenced by larger infarct sizes on follow-up cardiac MRI [9]. Similarly, a

meta-analysis by Cabello et al. found no clear benefit of routine oxygen therapy in AMI patients and suggested potential harm due to hyperoxia-induced coronary vasoconstriction and increased oxidative stress [10]. Despite these findings, our study found that a substantial proportion of students still believed that oxygen should always be used as part of AMI treatment, indicating a persistent gap between evolving evidence and medical education.

While recognizing that oxygen can be life-saving when administered judiciously to the appropriate patients, our results underscore a prevalent lack of understanding. Examining the distribution of knowledge across different academic years, interns and fifth-year medical students exhibited greater awareness of classical AMI signs than their third-year counterparts. This discrepancy may be attributed to the increased exposure of interns and fifth-year students to clinical cases in diverse hospital settings. Notably, despite clinical exposure, only a limited number of interns were cognizant that oxygen is not always a suitable treatment for AMI, indicating a knowledge gap even among this more experienced group.

Drawing on the insights from the DETO2X-AMI trial, which randomized over 6,600 Swedish patients suspected of myocardial infarction to receive supplemental oxygen or ambient air, it was discerned that routine oxygen supplementation did not yield discernible benefits in normoxic patients. The trial found no disparity in all-cause mortality or rehospitalization at one year between patients receiving oxygen and those breathing ambient air, leading to the conclusion that oxygen therapy might not be justified in this population. This conclusion gains further support from other recent studies suggesting potential harm from oxygen administration, coupled with the economic consideration that oxygen is not without cost [11].

This underscores the imperative to address the substantial knowledge gaps among students concerning the judicious use of oxygen in AMI treatment. The insights gained from our study and the corroborative evidence from the DETO2X-AMI trial advocate for a reconsideration of oxygen therapy practices, particularly emphasizing its indication only in hypoxic patients. This critical reassessment aligns with evolving guidelines and serves as a call to action for educational interventions to enhance awareness and ensure evidence-based practices in the medical community. To investigate the potential impact of routinely administering supplementary oxygen to patients with ST-elevation myocardial infarction (STEMI) in prehospital and early in-hospital settings, the AVOID trial was conducted [12]. The study enrolled 441 participants, randomly assigning oxygen to 218 and none to 223. Eligible patients exhibited oxygen saturation of  $\geq 94\%$ , STEMI symptoms for  $< 12$  hours, and ST-elevation  $\geq 2$  contiguous ECG leads. Results indicated that supplemental oxygen may pose harm to normoxic patients with mostly low-risk STEMI, evidenced by increased myocardial injury and recurrent myocardial infarction due to the detrimental effects of free radicals and superoxides [10]. Cardiac troponin I (cTnI) and creatinine kinase (CK) profiles revealed no reduction in symptoms or infarct size with routine oxygen delivery in normoxic individuals. Instead, the study suggested that frequent high-flow oxygen supplementation could be detrimental, evident in a significant rise in CK and a larger infarct size measured by cardiovascular magnetic resonance (CMR) at 6 months [8]. Subsequent evaluation led to a modification in the 2017 ESC Guidelines, emphasizing oxygen use exclusively in hypoxic patients ( $\text{SaO}_2 < 90\%$ ) [13]. Past studies, including a 2010 cross-sectional survey by Burils A et al. involving 524 emergency department, cardiology, and ambulance workers in the UK, highlighted widespread misinformation, with high percentages endorsing oxygen use in acute myocardial infarction (AMI) treatment, influenced by existing guidelines [14]. Systematic reviews underscored inconclusive evidence on oxygen's efficacy in AMI treatment and its potential to increase infarct size, emphasizing the need for cautious interpretation [15, 16].

Interestingly, our study also found differences in knowledge across different academic years, with senior students (interns and fifth-year students) demonstrating a better understanding of the classical presentation of AMI compared to third-year students. However, even among these senior students, misconceptions about oxygen therapy persisted. This is in line with findings from a study in Canada, where senior medical students showed better overall knowledge of AMI management but still harbored significant misunderstandings regarding oxygen therapy [7]. Such discrepancies highlight the need for curriculum updates to reflect the latest evidence and ensure that students at all levels are well-informed about best practices in AMI management.

Gender differences were also observed, with female students outperforming male students in their understanding of AMI management, particularly in recognizing the limited role of oxygen therapy. Similar trends have been noted in other studies, where female students often demonstrate better theoretical knowledge and test performance in clinical subjects [17]. However, the reasons behind these gender differences remain unclear and warrant further investigation.



Limitations include the study's exclusive focus on students from a single university, potentially limiting generalizability to all UAE.

## 5. Conclusions

In conclusion, our study reveals a notable lack of awareness among a significant proportion of university students regarding the appropriate use of oxygen in normoxemic patients with acute myocardial infarction (AMI). While a positive trend in knowledge is observed with advancing academic years, there remains a need for increased awareness. Collaborative efforts with professors are underway to enhance education on AMI signs, emphasizing detailed understanding over mnemonic reliance. Discussions with cardiologists highlight a reflexive tendency among students and junior emergency room doctors to administer oxygen, prompting future research extensions to the latter group. Our study's scope will broaden to multiple universities to assess nationwide misinformation prevalence. Future research will also scrutinize other MONA components, aiming to rectify potential misconceptions and promote evidence-based practices in the medical community. To disseminate awareness, we conducted a Google Meet session with clinical students, providing comprehensive insights on the topic. Additionally, we prepared and distributed pamphlets addressing the survey questions.

## 6. Study limitations:

1. The study was conducted at only one university (Ras Al Khaimah Medical and Health Sciences University), which may limit the generalizability of the findings to other institutions or medical schools in the UAE or internationally.
2. The reliance on self-reported knowledge through questionnaires may introduce bias. Participants may overestimate their understanding of oxygen therapy

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