1-1-2020

A multicenter cross-sectional questionnaire-based study to know the practices and strategies of ventilatory management of COVID-19 patients among the treating physicians

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ORIGINAL RESEARCH

A Multicenter Cross-sectional Questionnaire-based Study to Know the Practices and Strategies of Ventilatory Management of COVID-19 Patients among the Treating Physicians

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Abstract

Introduction: COVID-19 has been declared a pandemic by the World Health Organization (WHO). Many of the COVID-19 patients develop acute respiratory distress syndrome (ARDS) and require ventilatory support based on their severity for which conventional strategies are being used along with few newer strategies. We conducted this multicenter survey to know the physician's current ventilation strategies adopted for the care of COVID-19 patients.

Materials and methods: The survey was conducted after taking the ethical committee clearance. The web-based multicenter, cross-sectional questionnaire study was sent to physicians, who were involved in the management of COVID-19 patients. The questionnaire was segregated into three parts: part one consisted of general information and consent form, part two was concerned regarding demographic characteristics, and part three was concerned about their practices and strategies for ventilation of COVID-19 patients.

Results: A total of 223 responders replied for the questionnaire; 190 participated in the study saying that they are involved in the management of COVID-19 patients. The answers to the questionnaires were expressed as a percentage of total responses. 86% of the respondents said they have a designated intensive care unit (ICU) and 89% of the responders said they have an intubation/extubation protocol for suspect/confirmed COVID-19 patients. The responses of junior residents (JRs), senior residents (SRs), assistant professors/junior consultants, and professors/consultants were analyzed separately, and a few significant differences were observed. 39% of JRs were aware of prone ventilation as the most effective rescue ventilation strategy compared to 69% of consultants/professors. Extracorporeal membranous oxygenation (ECMO) strategy was also more significant in consultants/professors (40%) vs JRs (12%). The responders were also diverged based on medical college and corporate hospitals, and their responses were noted. Most commonly, responders in the corporate hospitals had a facility to ventilate COVID-19 patients in a negative pressure isolation facility compared to a nonnegative pressure room isolation facility in medical colleges.

Conclusion: Most of the responders were practicing ventilation strategies in a standard manner. JRs need to undergo further training in a few aspects of the ventilatory management, and also, they need to update themselves with newer treatment modalities as they keep evolving. Medical colleges are providing at par facility compared to corporate hospitals except for few advance care facilities.

Clinical significance: This study highlights the current practice of ventilatory management of COVID-19 patients, which is satisfactory. The survey can be used to develop study tools, to educate resident doctors, to further improve quality of care of critical COVID-19 patients.

Keywords: COVID-19, Endotracheal intubation, Intensive care unit, Ventilation management.

Indian Journal of Critical Care Medicine (2020): 10.5005/jp-journals-10071-23516

Introduction

COVID-19 (coronavirus disease-2019) has been declared a pandemic by World Health Organisation on March 11th 2020.[1] As the total cases are on the rise, various preventive and management strategies are being proposed.[2] The management of COVID-19 patients is still evolving and there is no clear evidence for the same. Many of the COVID-19 patients develop ARDS, who require some kind of ventilatory support based on their severity.[3] Newer strategies for ventilation along with the other conventional strategies for ARDS are being proposed and are being used for patient mangement.[4–6]

Presently, as the management of COVID-19 subjects is evolving, protocols are being formed at the institutional level but there is a lack of evidence for the same. We designed this multicenter survey to know the physician's current ventilation strategies adopted for the care of COVID-19 patients. This survey would help us to understand the current status of patient management and give multicenter inputs, which would help us to develop teaching tools and form standard protocols.

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How to cite this article: Maddani SS, Deepa HC, Rao S, Chaudhuri S. A Multicenter Cross-sectional Questionnaire-based Study to know the Practices and Strategies of Ventilatory Management of COVID-19 Patients among the Treating Physicians. Indian J Crit Care Med 2020;24(8):643–648.

Source of support: Nil

Conflict of interest: None

Materials and Methods

This was a web-based, multicenter, cross-sectional questionnaire study, conducted over six weeks (May/June 2020). Institutional ethics committee clearance was obtained before the start of the study (IEC: 295/2020). The questionnaires were sent to physicians presumed to be involved in the care of COVID-19 patients.

Study Design

The study was designed by members of the ICU using a web-based platform. The questions were selected to identify the responder's demographic characters, their practices, and strategies for the ventilatory management of patients. The content of the questionnaire was based on the literature review, and the questions were further validated by five experts who were involved in the care of COVID-19 subjects. The comments from the experts were analyzed, and modification was made in the questionnaire. The questionnaire was then sent to 10 doctors to know whether they could appropriately interpret the questionnaire. Their response was examined, and relevant changes were made in the questionnaire.

The drafted questionnaire was sent as an e-mail link to the physician intensivists all over India who were presumed to be involved in COVID-19 patient care. The physicians were allowed to take part in the survey only if they consented for the same after reading the participant information sheet. The questionnaire had 18 questions and was segregated into three parts. Part one consisted of questionnaire general information and consent form. Part two was concerned regarding the responder's demographic characteristics. Part three was concerned about their strategies for ventilation of COVID-19 patients. Answer choices were determined based on the type of question, and a range of discrete options were used to assess demographics and ventilatory management. Participants were allowed to enter their own responses wherever it was appropriate. A responder was allowed to take the survey only once; repeated attempts were not allowed.

Statistical Analysis

No previous study in this subject matter and no standard treatment guidelines are available presently; hence, it was not possible to calculate the sample size. The data collected through web platform were entered into Microsoft excel. The categorical variables were expressed as frequency (percentage). A Chi-square test was applied to the demographic profile of respondents to correlate it with their ventilatory management strategies.

Results

This multicenter web-based survey was sent to all physician intensivists presumed to be involved in the management of COVID-19 patients. Two hundred and twenty three physicians participated in the survey and 190 completed the survey saying they are presently involved in the management COVID-19 patients. Thity three were excluded as they said they were not involved in the patient management or had incomplete responses

Demographics of Respondents

The responders were JRs, SRs, assistant professors/junior consultants, associate professor's/associate consultants, and professors/consultants (Table 1). Among the responders, 72% were male and 28% were females. Predominant responders were male with an age group of 20–35 years. The distribution of the responders is described in Table 1.

Table 1: Demographic characteristics of responders, *n* (%)

Gender	Male	137 (72)
	Female	53 (28)
Age (years)	20–35	140 (73)
	36–50	44 (23)
	51–65	4 (2)
	>65	2 (1)
Designation	Junior resident	51 (27)
	Senior resident	35 (18)
	Assistant Professor/ Junior Consultant	52 (28)
	Associate Professor/ Associate Consultant	13 (7)
	Professor/Consultant	39 (20)

Table 2: Ventilatory management strategies. Data expressed as *n* (%)

Questionnaire	*Yes*	*No*
Are you involved in the management of suspect or confirmed COVID-19 patients in ICU?	190	33
Does your hospital have a designated suspect/confirmed COVID-19 ICU?	163 (86)	27 (14)
Do you have an intubation/extubation protocol for suspect/confirmed COVID-19 patients?	170 (89)	20 (11)
Are you planning to titrate your ventilation strategies according to "H" and "L" phenotype categories?	104 (55)	86 (45)
Are you routinely practicing sedation withhold during the initial period of ventilation in these patients?	35 (18)	150 (79)*
Are you practicing or planning prone ventilation in suspect/confirmed patients as a rescue ventilation strategy?	128 (67)	62 (33)
Are you planning to use ECMO in suspect/confirmed COVID-19 patients?	40 (21)	140 (79)**

*44% said no due to high ventilatory requirement; 35% said no to prevent accidental extubation

**116 (61%) said no because they do not have the facility; 34 (18%) said no because they think it is not effective

Ventilator Management Strategies

A total of 190 responders mentioned that they are involved in the management of COVID-19 patients. 86% of the respondents opined that their hospital had a designated ICU for COVID-19 patient management and 14% did not have a designated ICU for the same (Table 2). When the responders were asked about their ventilation strategies for patients who had hypoxia even with oxygen supplementation with face mask, 48% mentioned they would do early intubation, 19% said they would consider high-flow nasal oxygen cannula (HFNC) trial, 17% said they would continue oxygen supplementation with nonrebreathing mask (NRBM), 13% opined they would consider noninvasive ventilation (NIV) trial (Fig. 1). Regarding intubation/extubation protocols for COVID-19 patients, 89% said they have a protocol and 11% responders said they do not have a protocol at their hospital (Table 1).

Regarding measures taken to limit aerosol generation during endotracheal (ET) intubation, using polyvinyl sheets to cover

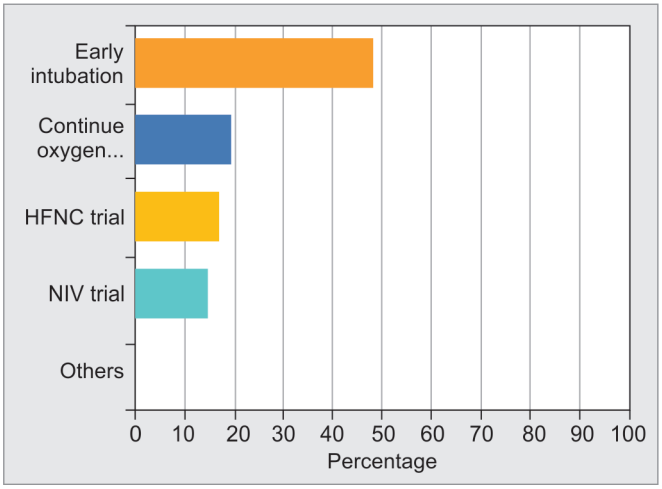

Fig. 1: Ventilation strategy for patients who have hypoxia even with oxygen supplementation with face mask

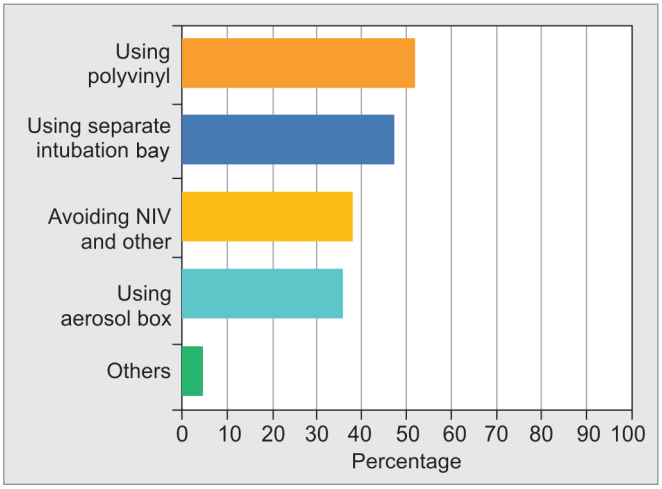

Fig. 2: Measures used to limit aerosol generation during endotracheal intubation

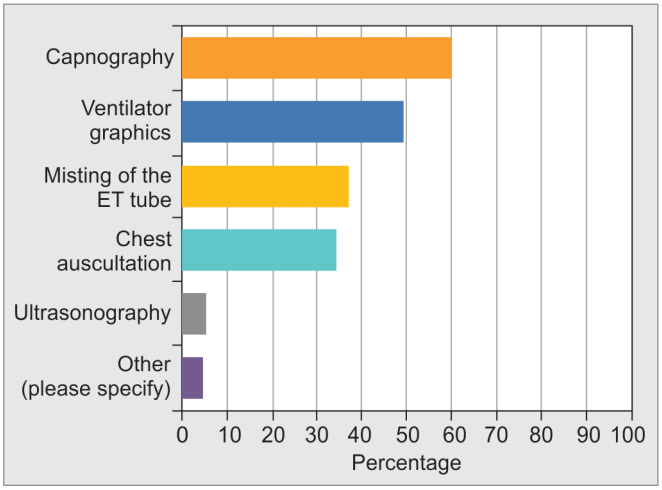

Fig. 3: Immediate methods used to confirm endotracheal intubation

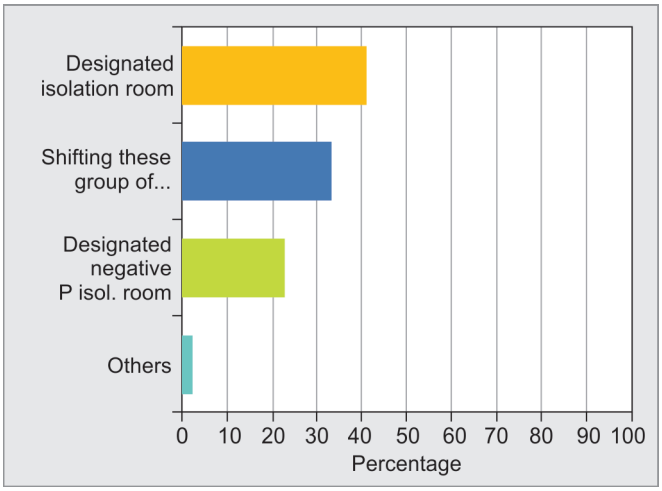

Fig. 4: Location of ventilation of the confirmed COVID-19 patients

patients during the procedure was the most common measure (51%), using separate intubation bay at ICU (47%) was the second most common technique, using an aerosol box (40%), and avoiding positive pressure measures before intubation (39%) were the other commonest measures (Fig. 2). When asked regarding what immediate methods were used to confirm ET intubation, capnography (58%) was the most common response, observing ventilator graphics (49%) was second most common, chest auscultation (38%), misting of ET tube (35%), and ultrasonography (6%) was the other most common technique (Fig. 3).

Mechanically ventilated suspect/confirmed COVID-19 patients were managed at isolation room without negative pressure facility in 42% of responder's hospital, 35% of responders mentioned shifting patients to designated COVID-19 centers/hospital outside their hospital, 21% said they manage patients in the negative pressure isolation room at their hospital (Fig. 4). When questioned regarding sedation practices during the early period of ventilation, 79% respondents said they would not withhold sedation during the early phase (44% said so because of high ventilatory support and 35% said so to prevent accidental extubation), only 18% said they would consider sedation withhold in the initial period of ventilation (Table 2). Regarding "H" and "L" phenotypes categories, 54% of respondents said they would use this distinction to titrate ventilation strategies and 46% said they would not use this distinction (Table 2).

61% of the responders said prone ventilation is the most effective rescue ventilation strategy, followed by 18% said other recruitment maneuvres, 11% said ECMO, and 9% said other techniques (Fig. 5). Regarding the practice of prone ventilation strategy, 67% said they are using or planning to use prone ventilation, whereas 33% said they are not using the same (Table 2). Among the prone ventilation users, 43% said they would prone for 16–20 hours duration, 42% said they would use it for 12–16 hours, 9% said they would use it for 12-16 hours, and only 5% said they would use it for >20 hours (Fig. 6). Regarding the use of ECMO, 21% said they would use ECMO, whereas 61% said they would not use ECMO because they do not have the facility and 18% said they would not use ECMO because it might be ineffective (Table 2).

When the responses of physicians were compiled based on their designation, there were notable differences in a few of the responses (Tables 3 and 4). Only 39% of the JRs were aware of prone ventilation as the most effective rescue ventilation vs 71% of SR, 62%

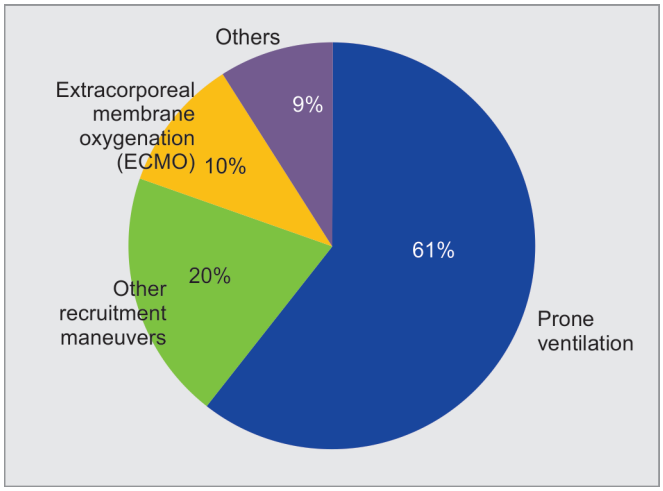

Fig. 5: Opinion regarding the most effective rescue ventilation strategy

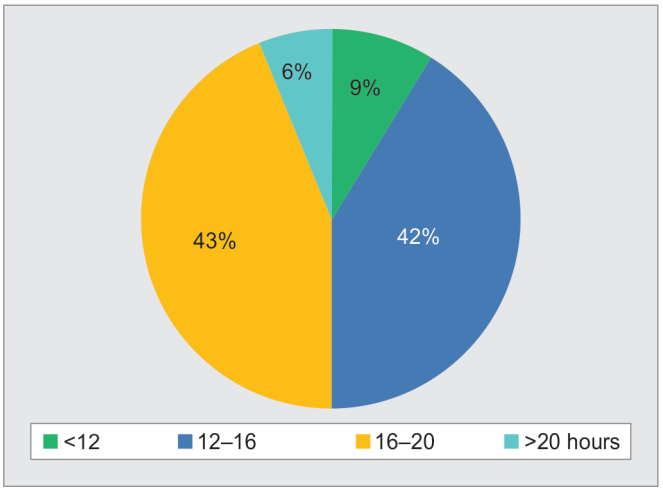

Fig. 6: The average duration of prone ventilation (in hours)

Table 3: Most common responses of the physicians for COVID-19 ventilatory management, according to their designation

	Junior Resident (n = 51)	*Senior Resident (n = 35)*	*Junior Consultant/Asstt. Professor (n = 52)*	*Professor Consultant (n = 52)*	*p value*
Designated ICU for COVID-19 patients	Yes (88%)	Yes (82%)	Yes (86%)	Yes (86%)	0.20
Protocol for intubation and extubation	Yes (100%)	Yes (86%)	Yes (83%)	Yes (89%)	0.09
Practice of sedation withhold during the initial period of ventilation	No (82%)	No (85%)	No (73%)	No (74%)	0.56
Titration of ventilation strategies according to "H" and "L" phenotypes	Yes (55%)	Yes (57%)	Yes (55%)	Yes (54%)	0.38
Practice/planning of prone ventilation	Yes (52%)	Yes (71%)	Yes (70%)	Yes (74%)	0.27
Plan for use of ECMO	Yes (12%)	Yes (15%)	Yes (21%)	Yes (40%)	<0.05

of junior consultants/assistant professors, and 69% consultants/professors. Regarding the practice of prone ventilation in COVID-19 patients, 52% of JRs were planning/practicing prone ventilation, 71% of SR, 70% of junior consultants/assistant professors, and 74% of consultants/professors were planning/practicing prone ventilation. Regarding the use of ECMO, 40% of the consultant/professors were planning to use ECMO, whereas only 12% of JRs, 15% of SR, and 21% of junior consultants/assistant professors were planning to use the same. This response was statistically significant at $p < 0.05$.

There were also varied responses among the physicians for questions with multiple answers (Table 4). The most common ventilation strategies for patients who had hypoxia even with oxygen supplementation with face mask deferred among physicians: JRs most commonly wanted to continue treatment with oxygen supplementation with NRBM, SR, and junior consultants/assistant professors most commonly planned for early intubation, whereas consultants wanted to give HFNC trial before intubation. Regarding measures taken to limit aerosol generation during ET intubation, JR and SR most commonly wanted to use polyvinyl sheets to cover patients, whereas junior consultants/assistant professors most commonly wanted to use separate intubation bay, and consultants/professors were most commonly planning to use an aerosol box to limit aerosol generation. All the responders were most commonly planning to use capnography to confirm ET intubation, which is the standard recommendation.

The responses of the physicians working in medical colleges were compared to physicians working in corporate hospitals (Tables 5 and 6). There was a significant variation in a few of the responses, but most of the other responses had a similar opinion. Even though early intubation was the most common response of both the groups, but there was statistically significant differences between both the groups (p value < 0.05). There were statistically significant differences in the use of ECMO between medical college and corporate hospitals (p value < 0.05). Regarding the ventilation of confirmed cases, the most common response of medical college physicians was isolation room without negative pressure, whereas physicians in corporate hospitals had a facility of isolation room with negative pressure.

Discussion

The symptoms of the COVID-19 viral infection vary from asymptomatic presentation to severe ARDS. Few of the patients who develop ARDS require ICU care, and based on the severity

Table 4: Most common responses among the physicians for COVID-19 ventilatory management according to their designation

	Junior Resident (n = 51)	*Senior Resident (n = 35)*	*Junior Consultant/ Asstt. Professor (n = 52)*	*Professor/Consultant (n = 52)*
Ventilation strategy for patients who have hypoxia, even with oxygen supplementation with face mask	Continue oxygen with NRBM (30%)	Early intubation (71%)	Early intubation (79%)	HFNC (40%)
	Early intubation (27%)			Early intubation (26%)
Measures taken to limit aerosol generation during ET intubation	Using polyvinyl sheets to cover patients (61%)	Using polyvinyl sheets to cover patients (54%)	Using separate intubation bay (66%)	Using aerosol box (46%)
Immediate methods you are using to confirm ET intubation	Capnography (61%)	Capnography (61%)	Capnography (59%)	Capnography (69%)
Location of ventilating the patients	Shifting the patient to designated COVID centers outside the hospital (44%)	Isolation room without negative pressure (43%)	Isolation room without negative pressure (57%)	Isolation room without negative pressure (38%)
Opinion regarding the most effective, rescue ventilation strategy	Prone ventilation (39%)	Prone ventilation (71%)	Prone ventilation (62%)	Prone ventilation (69%)

Table 5: Comparing most common responses of the physicians in medical colleges and corporate hospitals

	Medical college (n = 100)	*Corporate hospital (n = 90)*	*p value*
Designated ICU for COVID-19 patients	Yes (87%)	Yes (78%)	0.17
Protocol for intubation and extubation	Yes (89%)	Yes (88%)	0.44
Practice of sedation withhold during the initial period of ventilation	No (74%)	No (75%)	0.58
Titration of ventilation strategies according to "H" and "L" phenotypes	Yes (58%)	Yes (52%)	0.28
Practice/planning of prone ventilation	Yes (60%)	Yes (75%)	0.48
Plan for use of ECMO	No (91%)	No (67%)	0.01

Table 6: Comparing most responses of the physicians in medical colleges and corporate hospitals

	Medical college (n = 100)	*Corporate hospital (n = 90)*
Ventilation strategy for patients who have hypoxia, even with oxygen supplementation with face mask	Early intubation (57%)	Early intubation (38%)
Measures taken to limit aerosol generation during ET intubation	Polyvinyl sheets to cover patients (66%)	Aerosol box (47%)
Immediate methods you are using to confirm ET intubation	Capnography (57%)	Capnography (73%)
Location of ventilating the patients	Isolation room without negative pressure facilities (55%)	Isolation room with negative pressure facilities (37%)
Opinion regarding the most effective, rescue ventilation strategy	Prone ventilation (54%)	Prone ventilation (68%)

of illness, they need ventilatory support in the form of NIV, HFNC, or ET intubation. Mild-to-moderate ARDS patients are initially given NIV or HFNC trial.[7–11] Few of the patients stabilize on these support and a few require ET intubation. The results of the study indicate that most of the physicians were well aware of various strategies for the ventilation of COVID-19 patients, but there were few differences among the physicians. Early intubation for hypoxic patients was predominantly chosen by JR, SR, assistant professor/junior consultant as their most common strategy, but most consultants mentioned they would consider HFNC before intubating those patients (Table 3). The risk of aerosol generation is more with NIV and HFNC, and the early data regarding COVID-19 patient management by Zou et al. and Meng et al. suggested that early intubation is beneficial in these groups of patients.[6,12] This would have prompted them to choose early intubation over other measures, but recent evidence from the United States of America (USA) and other countries shows a paradigm for delayed intubation and support using other noninvasive measures before ET intubation.[13–15] This indicates the JR and other junior staff need to keep upgrading their knowledge as evidence for COIVD-19 patient keep emerging. There were variations in the methods to limit aerosol generation among physicians, but all were appropriate considering that there is no standard technique. Most junior consultants in equal proportion said they would use capnography and ventilator graphics to confirm the ET tube position. This might be, because in their setup, they would lack capnography.

Regarding sedation practices, most of the responders opined that they do not practice sedation withhold in the initial period of ventilation against the standard practice of daily withhold.[14,15] Newer ventilatory strategies have been proposed by Gattinoni et al. and Marini et al for handling COVID-19 patients, which includes "H" (high elastance) and "L" (low elastance) phenotypes, based on their ventilatory dynamics.[16,17] Most of the responders were aware of this classification and were planning to titrate their ventilation according to the above phenotype.

Prone ventilation is one of the effective rescue strategies in severe acute respiratory disorder (ARDS) patients and is also recommended to be used in COVID-19 patients with severe ARDS.[5,18] Most of the responders said that prone ventilation is the most effective rescue measure, and most of them were planning to use the same as the most common rescue ventilation strategy. Even though more than half of JRs were planning prone ventilation strategy, but there was a significant difference between them and professors/consultants regarding prone ventilation. This suggests even though JRs are planning/practicing prone ventilation, they need further training regarding benefits of prone ventilation. ECMO is used as a rescue ventilation therapy in severe ARDS with refractory hypoxia. There is mixed evidence for its use, CESAR trial claiming its benefits, whereas the EOLIA trail suggested no benefits compared to conventional ventilation.[19,20] Similarly, in our study, the use of ECMO had mixed results, a significant percentage of consultants wanted to use it (40%) in COVID-19 patients, but the rest of the other group of responders was not in favor of its use. Similarly, ECMO was significantly preferred by physicians in corporate hospitals compared to medical colleges; this may be because of better equipment availability in the former centers.

Our study had few limitations, mainly, it did not cover all aspects of ventilatory management. The treatment of COVID-19 keeps evolving and the recommendation keeps changing; hence, few of the responses and recommendations might change over the course of the study, compared to the initiation of the study during which questionnaires were formed.

Conclusion

Most of the responders were practicing ventilation strategies in a standard fashion. Junior residents need to undergo further training in a few aspects of the ventilatory management, and also, they need to update themselves with newer treatment modalities as they keep evolving. Medical colleges are providing at par facility compared to corporate hospitals, and further quality of care at college ICUs can be increased by the deployment of new equipment.

Clinical Significance

This study highlights the current practice of ventilatory management of COVID-19 patients, which is satisfactory. The survey can be used to develop study tools to educate resident doctors and to further improve the quality of care of the critical COVID-19 patients.

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