

Does curarisation beforehand improve ventilation by face mask? A Prospective randomised study

ABSTRACT

Prior verification of the efficiency of face mask ventilation before curarisation is most often dogmatic. It is often considered a safety factor. The main aim of our study was to investigate the effect of prior curarisation on face mask ventilation conditions.

Materials and methods: A prospective, randomised, double-blind study was carried out in the operating theatre of the Mohammed V military training hospital in Rabat. The inclusion criteria were: patients aged over 18 years, with an American Society of Anesthesiologists (ASA) I and II score, scheduled for surgery under general anaesthesia and requiring tracheal intubation. Exclusion criteria were: the presence of gastro-oesophageal reflux, the need for rapid sequence induction, the presence of criteria for face mask ventilation or difficult intubation and the need for vigorous intubation. The patients included were randomised into two groups: the rocuronium group, in whom curarisation with rocuronium prior to verification of the efficacy of VMF was performed, and the control group, in whom an equal volume of 0.9% saline was administered. Improvement in face mask ventilation was our primary endpoint. It was assessed using the HAN face mask ventilation difficulty score and tele-expiratory volume (TEV) during mask ventilation manoeuvres.

Results: A significant improvement in the Han score was noted at 2 min after administration of rocuronium (1.40 ± 0.50 vs 2 min: 1.17 ± 0.38 , $p=0.017$). There was also a significant improvement in TEV at 1 min (117.9 ± 41.41 vs 289.33 ± 78.63 , $p=0.004$) and at 2 min after early curarisation (167.57 ± 59.7 vs 388.67 ± 38.85 , $p=0.008$).

Conclusion: Prior curarisation improves face mask ventilation in patients with an easy planned airway. Several studies with different methodologies found similar results.

Key words: pre-curarisation, face mask ventilation, HAN score, improved ventilation

1. INTRODUCTION

Prior verification of the efficiency of face mask ventilation (FMV) before curarisation is often dogmatic. It is often considered a safety factor. However, an inadequate level of anaesthesia during induction is a frequent cause of difficulty with FMV, and many authors have therefore questioned the validity of this practice, given its potentially positive effects of increasing thoraco-pulmonary compliance and reducing upper airway muscle tone^[1].

However, this beneficial role of curarisation is poorly studied. The main objective of our study is to investigate the effect of prior curarisation on VMF conditions.

2. MATERIALS AND METHODS

After obtaining the approval of our ethics committee and the informed consent of the patients. A prospective, randomised, double-blind study was conducted in the operating theatre of the Mohammed V Military Training Hospital in Rabat. Patients included were over 18 years of age, with ASA I and II scores scheduled for scheduled surgery under general anaesthesia and requiring tracheal intubation. Exclusion criteria were: the presence of gastro-oesophageal reflux, the need for rapid sequence induction, the presence of criteria for VMF or difficult intubation and the need for vigorous intubation. The patients included were randomised into two groups: the rocuronium group, in whom curarisation was performed prior to checking the efficiency of FMV, and the control group, in whom an equal volume of 0.9% saline was administered. In the operating theatre, all patients were premedicated (2 mg midazolam). Standard monitoring was applied (electrocardiogram, heart rate, non-invasive blood pressure, pulse oximetry). The anaesthesia machine was checked and calibrated before use for each patient. After 3 min of pre-oxygenation, the aim was to achieve an expired oxygen fraction of over 90%. General anaesthesia was induced with fentanyl 2-3 μ g/kg and propofol 2-3 mg/kg. Thirty seconds

after loss of the ciliary reflex, either rocuronium (0.6 mg/kg) or an equal volume of 0.9% saline was administered. Improvement in FMV was our primary endpoint. It was assessed using the HAN FMV difficulty score (Table 1) and the teleexpiratory volume (TEV). Hemodynamic variations and the occurrence of desaturation were the secondary endpoints. The Han score and the reference TEV were recorded 30 seconds after the loss of the ciliary reflex and then every 30 seconds for 2 min.

Table 1. HAN FMV difficulty score

Classification	Description
Grade 1	Mask only ventilation
Grade 2	Difficulty ventilating, oropharyngeal cannula inserted
Grade 3	Mask ventilation with mandibular mobilisation, external laryngeal manoeuvres and two-hand technique
Grade 4	Mask ventilation not possible

The data were entered using SPSS 20.0 software. Qualitative variables were expressed as headcount and percentage, and quantitative variables as mean and standard deviation or median and quartiles. Pearson's χ^2 test was used to compare percentages and the Student t test and Mann Whitney test to compare quantitative variables according to their distribution. A value of $p < 0.05$ was considered the threshold of significance.

3. RESULTS

A total of sixty patients were included (thirty patients in each group). Demographic characteristics, comorbidities and criteria for difficult intubation were comparable between the two groups (Table 2).

Table 2. Basic characteristics

	All patients (n=60)	Control group (n=30)	Rocuronium group (n=30)	P
Age	55.27±13.64	56±14.43	54.53±13	0.468
Men	36(60)	19(52.8)	17(47.2)	0.598
Woman	24(40)	11(45.8)	13(54.2)	
Body mass index (kg/m ²)	25.4±2.45	25±1.74	25.8±2.97	0.203
ASA score				
ASA I	41(68.3)	19(46.3)	22(53.7)	0.405
ASA II	19(31.7)	11(58)	8(42.1)	
High blood pressure	12(20)	7(58.3)	5(41.7)	0.52
Diabetes	10(16.7)	6(60)	4(40)	0.488
Asthma	4(6.7)	1(25)	3(75)	0.301
Mouth opening (mm)	33.08±2.45	33.5±2.33	32.67±2.53	0.064
Thyromental distance (mm)	64.08±2	64.17±1.9	64±2	0.744
Mallampati Class				
Class 1	11(18.3)	16(61.5)	10(38.5)	0.118
Class 2	49(81.7)	14(41.2)	20(58.8)	
Neck circumference (cm)	40.02±3.55	39.76±4.14	40.40±2.47	0.058

FMV was improved after prior curarisation, with a significant improvement in the Han score at 2 min after administration of rocuronium (basal: 1.40 ± 0.50 vs 2 min: 1.17 ± 0.38, $p=0.017$) (table 3).

Table 3. Effect of prior curarisation on face mask ventilation (Modification of HAN FMV difficulty score)

	Control group (n=30)		P
	Basal	2 min	
Han's score	1.60±0.56	1,40±0.50	0.151

	Rocuronium group (n=30)		P
Han's score	Basal	2 min	
	1.40±0.50	1.17±0.38	0.017

There was also a significant improvement in TEV at 1 min (117.9 ± 41.41 vs 289.33 ± 78.63 , $p=0.004$) and at 2 min after early curarisation (167.57 ± 59.7 vs 388.67 ± 38.85 , $p=0.008$) (Table 4).

Table 4. Effect of prior curarisation on face mask ventilation (Variations in mean tidal-expiratory volume TEV)

	Control group (n=30)	Rocuronium group (n=30)	P
Basal	72.40±13.43	80.60±10.72	0.426
1 min	117.9±41.41	289.33±78.63	0.004
2 min	167.57±59.7	388.67±38.85	0.008

The incidence of hypertension and tachycardia was comparable between the two groups with ($p=0.640$) and ($p=0.554$) respectively. Only one patient experienced desaturation in the rocuronium group compared with 2 patients in the control group ($p=0.554$). (Table 5)

Table 5. Haemodynamic and respiratory variations

	Control group (n=30)	Rocuronium group (n=30)	P
Desaturation	2(66.7 %)	1(33.3 %)	0.554
Tachycardia	2(66.7%)	1(33.3 %)	0.554
Bradycardia	1(100%)	0	0.313
Hypertension	3(60%)	2(40%)	0.640

4. DISCUSSION

The main finding of our study was a significant improvement in FMV after prior curarisation as measured by the HAN score and TEV. Several studies with different methodologies found similar results. Sachdeva and al. in a prospective study of 125 patients, found a significant improvement in FMV after early curarisation. They noted a significant 12 per cent increase in TEV. FMV was performed two-handed under pressure-controlled ventilation (inspiratory pressure at 15 cmH₂O). The same result was also observed in the group of obese patients with a body mass index (BMI) ≥ 30 kg/m² [2].

In the same context, Ikeda and al. used a FMV separating the oral and nasal routes. He demonstrated a significant increase in oral and nasal tidal volumes after administration of succinylcholine. Dilatation of the upper airway, observed endoscopically during pharyngeal fasciculations, was suggested as the main mechanism for the improvement in FMV [3]. However, there are some reservations about this study. It was a non-randomised study, only 31 patients were included, and FMV was performed with the head in the neutral position, without additional manoeuvres to optimise ventilation. The target tidal volume was low (2 ml/kg) and endoscopy was only performed in six patients receiving succinylcholine. Furthermore, the reference values for oral and nasal tidal volumes differed between patients receiving rocuronium and succinylcholine.

In their prospective randomised study of 90 patients, Warters and al. used another score to assess FMV after curarisation. They concluded that early administration of rocuronium significantly improved FMV, even in the subgroup of patients with difficult initial mask ventilation (Warters score ≥ 3). However, there was no change in the Han score [4].

In our study, we used the Han score to assess FMV, as we found it less complex and easier to use than the Warters score, which is in line with the study by Richard H and al [5].

To our knowledge, there is only one study in which curarisation did not improve FMV, and the authors used a ratio of expired to tidal volumes as the endpoint. However, the ability of this ratio to

reflect the efficacy of FMV was questioned by El-orbany M and al. in their review of FMV. Indeed, it can be affected by leaks in the respiratory system [6,7].

Despite differences in methodology and criteria for judging the efficacy of FMV. The results of our study as well as previous studies agree that prior curarisation before testing the efficacy of FMV is safe practice. Consequently, many authors have questioned the appropriateness of testing the efficiency of FMV prior to curarisation [8-10]. Indeed, Amathieu et al, using succinylcholine in patients with difficult FMV before curarisation, found that the quality of FMV never deteriorated but improved in the majority of cases [11]. Furthermore, this practice is becoming less supported by experienced anaesthetists, in an online survey of 136 anaesthetists working in Central London School of Anaesthesia hospitals. Broomhead and al. found that only 57% of anaesthetists reported checking the efficiency of FMV before curarisation [12]. Our study has several limitations. The sample size was small. Patients with difficult intubation and FMV criteria were excluded. Our patients were manually ventilated and therefore the tidal expiratory volumes collected could be affected by leaks. The Han score was used to assess the efficiency of FMV, but the interpretation of the degree of difficulty is subjective and depends on the operator.

5. CONCLUSION

Prior curarisation improves face mask ventilation for patients with an easy upper airway, but this technique should be reserved for patients without criteria of difficult ventilation or intubation, and carried out by senior anaesthesiologist.

CONSENT

As per international standard or university standard, patient's consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

REFERENCES

1. Priebe HJ. Should anaesthesiologists have to confirm effective facemask ventilation before administering the muscle relaxant? *J Anesth.* 2016 Feb;30(1):132-7.
2. Sachdeva R, Kannan TR, Mendonca C, Patteril M. Evaluation of changes in tidal volume during mask ventilation following administration of neuromuscular blocking drugs. *Anaesthesia.* 2014 Aug;69(8):826-31.
3. Ikeda A, Isono S, Sato Y, Yogo H, Sato J, Ishikawa T and al. Effects of muscle relaxants on mask ventilation in anesthetized persons with normal upper airway anatomy. *Anesthesiology.* 2012 Sep;117(3):487-93.
4. Warters RD, Szabo TA, Spinale FG, DeSantis SM, Reves JG. The effect of neuromuscular blockade on mask ventilation. *Anaesthesia.* 2011 Mar;66(3):163-7.
5. Richard H, Kevin K, Tremper, Sachin K, Michael O. Grading Scale for Mask Ventilation. *Anesthesiology* 2004; 101:267.
6. Goodwin MW, Pandit JJ, Hames K, Popat M, Yentis SM. The effect of neuromuscular blockade on the efficiency of mask ventilation of the lungs. *Anaesthesia.* 2003 Jan;58(1):60-3.
7. El-orbany M, Woehlck HJ. Difficult mask ventilation. *Anesth Analg.* 2009 Dec;109(6):1870-80.
8. Calder I, Yentis SM. Could 'safe practice' become compromising safe practice? Should anaesthetists have to demonstrate that face mask ventilation is possible before giving a neuromuscular blocker? *Anaesthesia.* 2008 Feb;63(2):113-5.
9. Calder I, Yentis S, Patel A. Muscle relaxants and airway management. *Anesthesiology.* 2009 Jul;111(1):216-7; author reply 218-9.
10. Gordon RJ. Anesthesia dogmas and shibboleths: barriers to patient safety? *Anesth Analg.* 2012 Mar;114(3):694-9.
11. Amathieu R, Combes X, Abdi W, Housseini LE, Rezzoug A, Dinca A and al. An algorithm for difficult airway management, modified for modern optical devices (Airtraq laryngoscope; LMA

CTrach™): a 2-year prospective validation in patients for elective abdominal, gynecologic, and thyroid surgery. *Anesthesiology*. 2011 Jan;114(1):25-33.

12. Broomhead RH, Marks RJ, Ayton P. Confirmation of the ability to ventilate by facemask before administration of neuromuscular blocker: a non-instrumental piece of information? *Br J Anaesth*. 2010 Mar;104(3):313-7.