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**Lalit Sehgal**  
Head, Department of Liver  
transplant Anaesthesia and  
Liver critical care, HCMCT  
Manipal Hospital, Dwarka,  
New Delhi, India

**Sakshi Gera**  
Specialist, Department of  
Anaesthesia, Rao Tula Ram  
Memorial Hospital, New Delhi,  
India

**Sumit Gupta**  
Specialist, Department of  
Anaesthesia, Medeor Hospital,  
Abu Dhabi, UAE

**Corresponding Author:**  
**Lalit Sehgal**  
Head, Department of Liver  
transplant Anaesthesia and  
Liver critical care, HCMCT  
Manipal Hospital, Dwarka,  
New Delhi, India

## A retrospective observational study on use of defasciculating dose of non-depolarising muscle relaxant before rapid sequence induction with succinylcholine in pandemic era: Our experience

Lalit Sehgal, Sakshi Gera and Sumit Gupta

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### Abstract

**Background:** In the pressing times of Covid pandemic, it was necessary to adopt safe anaesthesia practices for both, the patient and healthcare personnel. Rapid sequence induction and intubation (RSII) was the recommended practice for providing anaesthesia. Succinylcholine was neuromuscular blocking drug (NMBD) of choice for RSII, in our facility. Any inadvertent movement due to succinylcholine induced fasciculations can pose the risk of breach in airway barrier, injury to the patient and add to the concerns of airway handling personnel in sparsely staffed operation theatres. In this retrospective observational study, we outline the profile and our experience with consistent use of defasciculating dose of non-depolarising muscle relaxant (NDMR) before RSII.

**Methods:** The data of patients who underwent RSII, was retrospectively analysed over a three-month period of year 2020 in Covid pandemic. The anaesthesia technique and covid precautions were based on institutional protocols. The outcome was recorded as occurrence of fasciculations and any adverse effect due to defasciculating dose of NDMR. The data was analysed using Microsoft excel.

**Results:** Fasciculations occurred in 23 of these 116 patients (19.8%). Four patients complained of uneasiness after administration of defasciculating dose of NDMR.

**Conclusion:** Amid concerns of minimising personnel exposure to aerosol transmitted infections and adequate patient safety, pre-curarisation with NDMRs can be adopted as a uniform practice to facilitate the tracheal intubation using RSII with succinylcholine, without clinically apparent adverse events.

**Keywords:** Succinylcholine, fasciculations, airway management, pandemic

### Introduction

The CoViD-19 pandemic has vastly influenced the practice of medicine, with its implications being far-fetching in anaesthesia management. It was a period of profound concerns for limiting the aerosol spread and optimising the oxygenation of patients already infected with CoViD-19. Consistently, CoViD-19 screening was performed in all pre-operative patients in our hospital. However, that was not enough in ensuring safe conduct of anaesthesia. The sensitivity of CoViD-19 RTPCR peaks at 4-5 days post infection. So, there might still be certain patients who were capable of transmitting the infection despite not being detected. As a concern of paramount risk and adopting the uniform standard of practice at our facility we took all necessary precautions in all patients planned for anaesthesia and surgery. Worldwide, the concerns were felt and recommendations were made to prevent aerosol transmission in airway procedures. It was recommended and later adopted as guideline to practice Rapid sequence induction and intubation (RSII) in CoViD-19 patients [1, 2]. The same was adopted as a uniform practice in our hospital in majority of patients planned for general anaesthesia. Succinylcholine was utilized for RSII as rocuronium, at doses required for RSII would cause prolonged paralysis and all surgeries are not expected to last that long. Sugammadex, is expensive and may not be cost-effective for many centres [3]. Further, it was not available in our country during the initial three waves of pandemic.

Fasciculations or unsynchronised generalised skeletal muscle movements are known to occur in 90-94% of patients administered succinylcholine [4, 5]. Any such inadvertent movement can pose the risk of breach in airway barrier, injury to the patient and add to the concerns of

airway handling personnel in sparsely staffed operation theatres. Except a few patients, defasciculating dose of non-depolarising muscle relaxants (NDMR) was administered before succinylcholine to blunt fasciculations, in majority of patients. In this retrospective observational study, we outline the profile and our experience with use of defasciculating dose of NDMR, revisiting a technique described in 1970's [6].

## Methods

After obtaining Institutional ethics committee approval, the data was retrospectively analysed, of all the patients who underwent general anaesthesia with endotracheal intubation using RSII, over a period of three months from 1 April 2020 till 30 June 2020 using the electronic and printed patient records. The parameters age, sex, nature of surgery, ASA physical status, CoViD-19 status, comorbidities and duration of surgery were noted. The outcome was recorded as occurrence of fasciculations and any adverse effect due to defasciculating dose of NDMR, if given. The data was analysed using Microsoft excel. Quantitative variables were presented as mean. The incidence was calculated as percentage.

## Perioperative management

The patients were anaesthetised and tracheal intubation done using technique of RSII. In OT, after explaining the procedure to the patient and with ASA monitors in place, a transparent plastic drape sheet was placed over the patients head and upper torso. Pre-oxygenation was performed using closed circuit [7]. The opioids and induction agents were used according to the patient and surgery profile. Defasciculating dose of NDMR (0.05 mg/kg Atracurium; 0.01 mg/kg Vecuronium) was administered 3 minutes before induction, Succinylcholine in a dose of 1.5-2.0 mg/kg was administered after induction. The care was taken not to adopt this technique in patients with allergy or contraindication to any of the study drugs, hyperkalaemia, neurosurgical patients or patients with anticipated difficult airway. The intubations were performed using video laryngoscope (C-MAC Monitor 8403 ZX, Karl Storz™) in all patients. The plastic drape was not removed till the patient was extubated unless surgical access to the head and neck was required. All the airway manoeuvres were performed under the drape.

## Results

Out of 116 patients studied, all patients underwent RSII using succinylcholine except one in whom rocuronium was used. The demographic profile and clinical profile of the study group is outlined in the table 1 and 2 and figure 1. Average duration of surgery was 171 minutes (40-640 minutes). The cases posted belonged to departments, General surgery 49/116 (42%), orthopaedics 24/116 (20.6%), spine surgery 6/116 (5%), onco-surgery 19/116 (16.3%) and others. Laparoscopic cholecystectomy was the most commonly performed surgery (60/116, 51.7%). CoViD-19 status was not known in 8 cases and the rest 108 were tested negative for CoViD-19.

Defasciculating dose of atracurium was used in majority (110/116) patients and a small number with vecuronium (5/116). Rocuronium was administered for RSII in one patient. Bougie was used in two patients and all patients were successfully intubated.

Fasciculations occurred in 23 of these 116 patients (19.8%). Four patients complained of uneasiness before induction after administration of defasciculating dose of non-depolarising muscle relaxant. No patient developed desaturation or any other adverse event during the procedure.

## Discussion

Since its inception into clinical practice in 1951, succinylcholine was widely used neuromuscular blocker till it decreased in its popularity with advent of non-depolarising agents into practice. Many side effects were attributed to its clinical usage and its routine use was discouraged. With the introduction of sugammadex, its role in scenarios requiring RSII also kept waning. With RSII being the universally accepted practice in CoViD-19 patients, succinylcholine began to be used as routine for induction in areas where sugammadex was not introduced or not cost-effective. FDA approved the use of succinylcholine for intubation in CoViD-19 patients [8]. Many authors have raised concern over the possibility of renal involvement and prolonged immobilisation in ICU in CoViD-19 patients discouraging use of succinylcholine. The concerns for hyperkalaemia subsequent to succinylcholine in Covid 19 patients have been raised [9, 10]. However, we performed thorough pre-anaesthesia evaluation and such possible risk factors were ruled out before administering succinylcholine. One patient had serum potassium value >5.0 mEq/L and was planned for craniotomy for evacuation of intracranial haematoma, so rocuronium was administered for RSII. Similarly, patients who had history of reactive airway disease, atracurium was avoided and instead, vecuronium given for pre-curarisation. Precautions were implemented to prevent dispersal of aerosols during procedure of tracheal intubation. The patients were preoxygenated before RSII using the closed circuit. The use of transparent plastic drape over the patient's head and video laryngoscope for intubation to prevent dispersal of aerosols was routinely employed. However, preoxygenation is considered as high-risk aerosol-generating procedure (AGP) [11]. Similarly, during mask ventilation and tracheal intubation, significant dispersal of aerosols can be expected. It is recommended to reduce the number of personnel involved in airway management in CoViD-19 patients. Indian society of critical care medicine (ISCCM) recommends limiting the number of personnel managing the airway of CoViD-19 patients [11]. Due to these reasons and limited manpower available, number of personnel handling the airway was restricted to two, a doctor and an OT assistant. In such a scenario, occurrence of fasciculations due to succinylcholine was undesirable. Any exaggerated movement due to these unsynchronised skeletal muscle contractions might have resulted in patient injury in absence of adequate personnel to handle; or risk of accidental disruption of barrier in airway management. So, there was a felt need of eliminating this inadvertent superimposed risk by minimising the chances of fasciculations in these patients.

When a non-depolarising muscle relaxant (NDMR) is administered in 5 % to 10% of its ED95 dose, 2-4 minutes before succinylcholine, the fasciculations can be blunted [12]. The relative benefit of different NDMRs for pre-curarisation, as compared to placebo, have been described in a meta-analysis by Schreiber *et al* [5]. The number needed to treat (NNT) as compared to placebo was 1.2-2.5 with most

of the NDMRs. We administered sub-paralysing doses of primarily atracurium and also vecuronium in few patients to blunt fasciculations. Since metabolism of atracurium is least dependent on hepatic or renal excretion, it was used as primary agent. The use of NDMR was also subject to availability and individual preference of the anaesthetists. The relative benefit of atracurium and vecuronium for preventing fasciculations has been shown to be 7.4 and 13.3 respectively [5]. Other agents which have been shown to be efficacious to blunt succinylcholine induced fasciculations are magnesium and lidocaine. Recently, oral pregabalin has been shown to be efficacious to reduce fasciculations [4].

A pretreatment interval of three minutes was used for defasciculation. There is risk of potential adverse effects with defasciculating dose of NDMRs. In the meta-analysis by Schreiber *et al*, the occurrence of difficulty in breathing and swallowing was reported in 6.5% and 16% of patients who were administered defasciculating dose of any NDMR [5]. Besides, occurrence of diplopia, muscle weakness, heaviness of eyelids and blurred vision have been reported. To avoid this, it is recommended to use a shorter priming interval particularly when rocuronium is utilized [12]. There is a potential risk of aspiration of gastric contents after administration of defasciculating dose of NDMR [13]. In our study four patients complained of uneasiness after defasciculating dose of atracurium. However, oxygen saturation remained constant and there was no clinically significant adverse effect observed.

While administering the sub-paralysing dose of NDMR to blunt fasciculations, the dose of succinylcholine needs to be increased by about 70% [14]. The usual dose of succinylcholine required for intubation is 0.6-1.0 mg/kg providing adequate intubating conditions in 30-60 seconds. In authors' practice, the dose of succinylcholine administered was 1.5-2 mg/kg. Hochhalter has used succinylcholine 1.5 mg/kg after pretreatment with defasciculating dose of atracurium [15]. It has also been shown that the incidence of fasciculations and myalgias decrease with increasing dose of succinylcholine [5]. The incidence of fasciculations after administering the defasciculating dose of NDMR was 19.6% in our study. Fatemeh *et al* have reported 25.9 % incidence of fasciculations after defasciculating dose of atracurium with 1.5 mg/kg succinylcholine [16]. The lower incidence in our study could be because we used a higher dose of succinylcholine, up to 2 mg/kg, in some patients. Schreiber *et al* have reported that 65% and 40 % patients did not have fasciculations after pre-treatment with atracurium and vecuronium respectively [5].

Administration of depolarising dose of NDMR also decreases the incidence of post-operative myalgia, but it does not totally prevent it [14]. Although, Schreiber *et al* have found that there is no clear relation between fasciculations and myalgia [5]. Similarly, the rise in intragastric pressure due to contraction of abdominal muscles may be obtunded by defasciculating dose of NDMR. In a systematic review by Clancy *et al* it was inferred that defasciculating dose also reduces the increase in intracranial pressure secondary to succinylcholine [17]. However, pre-curarisation will not affect the occurrence of hyperkalaemia as the mechanism involves up regulation of extra-junctional receptors in susceptible patients.

Routine use of succinylcholine has long been a matter of debate. Recently, Schaefer *et al* have put forth that the use

of succinylcholine is associated with increased odds (adjusted OR 1.11) of postoperative pulmonary complications (POPC) based on the retrospective cohort study of 244850 patients [18]. It was dose dependent and in scenario where succinylcholine was used in conjunction with NDMR, the incidence was more in shorter duration surgeries. However, it is noteworthy and as pointed out by Kopman and Brull, the definition of POPC in above study included patients requiring tracheal intubation and ICU admission within seven days after the surgery [19]. Clearly, such events may have other causes other than residual neuromuscular block.

The use of succinylcholine continues to be a matter of contention and despite arguments against its use, it continues to hold its fort in special clinical scenarios. Its use in RSII during Covid era in resource limited settings has been such a scenario which required the anaesthesiologists to revisit the evanescent benefits of succinylcholine. Our hospital being such a setting, we routinely used succinylcholine for RSII and this formed the basis of our study.

The present study presents an endeavour to formulate and adopt a uniform practice for tracheal intubation in scenario of widespread CoViD-19 disease and other aerosols transmitted diseases using available resources especially in resource challenged regions. After the pandemic, various variants of CoViD-19 have been reported. Recently JN1 variant has been declared as variant of interest (VOI) by WHO [20]. Although they may not pose a public health concern on the similar scale, but the occurrence of co-pathogens may exacerbate the respiratory disease burden. This technique may hold good for anesthetizing patients with communicable respiratory ailments that pose a risk to care provider for both emergency & elective case scenario. We were successful in consistently employing the defasciculating dose of NDMR with RSII using succinylcholine in all eligible patients posted for elective surgery and subsequently adopt it as a standard of practice in our unit during Covid time.

Since there was no control group in our study, the statistical efficacy of our intervention could not be quantified in this group of patients. The inferences from the study can be applied to patients requiring elective tracheal intubation and may not be applicable to emergency or critical care scenarios, as such patients may not tolerate decrease in maximum ventilatory effort after defasciculating dose of NDMR. Retrospective nature of the study was another limitation. The various factors that would have affected the outcome of the study include small sample size, limited study period and lack of a control group. Further, a restricted contact with patients especially during first wave of pandemic might have affected the monitoring for postoperative myalgias. A randomized double-blind trial with monitoring of aerosol generation in a controlled OT environment (airflow, humidity) and administration of succinylcholine with and without defasciculating dose of NDMR would be warranted. In addition, a cost efficacy trial comparing succinylcholine preceded by defasciculating dose of NDMR with rocuronium-suggamadex combination would further augment the knowledge and may help establish the combination as more cost-effective alternative.

## Conclusion

During times of widespread prevalence of aerosol

transmitted diseases, succinylcholine may be the only available and feasible neuromuscular blocking drug for RSII. Pre-curarisation with NDMRs can be adopted as a uniform practice to facilitate the procedure, without clinically apparent adverse events.

### Conflicts of interest

Authors declare no conflicts of interest.

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