



A Comparative Study of Extubation in Prone and Supine Position in Patients Undergoing Lumbar Spine Surgery in Prone Position

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: In case of surgeries done in prone position, patients are rolled to supine during extubation which is associated with loss of monitoring and hemodynamic change. Also, incidence of coughing and bucking are noted. Several studies have shown that prone position extubation is associated with reduced frequency of coughing and monitor disconnection in prone position surgeries. The purpose of this study was to compare the safety and efficacy of patients extubated in prone and supine posted for lumbar spine surgery.

Study Design: 60 patients varying from age 18 - 65 years and posted for lumbar spine surgery under general anaesthesia in prone position were randomly allocated to any one of the two groups Group P - In this group extubation was done in prone position at the end of surgery or Group S – In this group extubation was done in supine position at the end of surgery.

Place and Duration of Study: Jawaharlal Nehru Medical College, DMIMS (DU), Acharya Vinoba Bhave Rural Hospital (AVBRH), Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha over the period of 1 year (2019 - 2020).

Methods: A double blinded randomized controlled comparative study was conducted on 60 patients with primary objective to measure incidence of coughing and severity of coughing in prone vs supine extubation. Patients were anesthetized with fentanyl, nitrous oxide, sevoflurane, and

vecuronium. Neuromuscular blockade was reversed in prone position and all patients had spontaneous ventilation at the conclusion of surgery. At time 0, patients were randomly divided into group P or group S. Patients in the group S were then rolled over, while those in the prone position remained undisturbed. Frequency of cough, monitor disconnection and changes in heart rate (HR) and mean arterial pressure (MAP) were noted during extubation. Patient were extubated on purposeful behaviour and eye opening.

Results: Frequency of coughing was significantly less in prone patients in comparison to supine group (6 vs. 24 coughs) monitor disconnections dysconnectivity was also fewer ($p < 0.001$), little change in haemodynamics was noted during extubation. Time to extubation from time 0 was comparatively more in Group S. Airway rescue was not needed.

Conclusions: Extubation in prone position is associated with lesser frequency of coughing, disruption of monitors and significantly less hemodynamic changes as compared to supine position extubation he abstract should be concise and informative. It should not exceed 300 words in length. It should briefly describe the purpose of the work, techniques and methods used, major findings with important data and conclusions. Different sub-sections, as given below, should be used. No references should be cited in this part. Generally non-standard abbreviations should not be used, if necessary they should be clearly defined in the abstract, at first use.

Keywords: Airway; coughing; lumbar surgery; prone extubation; safety; unconventional.

1. INTRODUCTION

Prone position is being used frequently with the involvement of surgical techniques to facilitate surgical access for e.g., lumbar spine surgery, laparoscopic assisted oesophagectomy, posterior cranial fossa surgery etc. It has also been found to improve oxygenation in patients with adult respiratory distress syndrome.

Extubation in supine position for patients undergoing surgery in prone position has been associated with loss of monitoring during the interval when the patients are being rolled from prone to supine position [1]. It also predisposes bronchospasm and coughing in patients. Supine position extubation has also been correlated to the hemodynamic changes [2]. These changes are undesirable as they can lead to myocardial ischemia, increased surgical loss of blood and increase in intracranial, intraocular and abdominal pressure [3]. Patients who have underlying heart disease are at risk of reduction in ejection fraction. Therefore, prevention of coughing and airway reflexes must be done to promote hemodynamic stability and adverse effects of supine extubation.

Various drugs have been used in the past to diminish airway and circulatory reflexes during supine position extubation such as I.V esmolol, fentanyl, lidocaine and alpha agonists such as dexmedetomidine [4,5].

However certain studies proved that intravenous administration of lignocaine resulted in delayed

emergence and incidence of coughing might not be reduced if awake extubation is done in these patients [6]. This study concluded that the amount of plasma lignocaine required to significantly cause reduction in the incidence and frequency of coughing was very high. Hence, alternate techniques need to be sought after which includes undisturbed extubation in prone position which will reduce incidence and severity of coughing by avoiding the turning that often leads to tracheal extubation and hence more hemodynamic stability.

But very few studies have been done that compare prone VS supine extubation and their effects on hemodynamic and airway response during and after extubation. Extubation in prone has always been seen to have a calmer and smooth transformation from surgery to complete wakefulness.

In the quest for reduction in the hemodynamic response, lower incidence and frequency of coughing and fewer monitor disconnection along with safety and efficacy of extubation in prone position, we compare extubation in prone position and supine position in patients undergoing lumbar spine surgery in prone position taking into consideration maintenance of patent and safe airway.

1.1 Aim

To compare the safety and efficacy of patients extubated in prone and supine posted for lumbar spine surgery.

1.2 Primary Objectives

- Incidence of coughing between the two groups.

1.3 Secondary Objectives

- Comparison of time for extubation among the two groups.
- Comparison of haemodynamics during extubation among the two groups.
- Incidence of monitor disconnections

2. MATERIALS AND METHODS

A prospective comparative study was conducted on patients admitted to Acharya Vinobha Bhave Hospital (AVBRH) Sawangi, Wardha over a period of 1 year from March 2020 to March 2021.

After discussion of anaesthetic options to the patient/ relatives, written preoperative consent was obtained from the patients and relatives.

2.1 Sample Size and Design

60 patients varying from age 18 - 65 years and posted for lumbar spine surgery under general anaesthesia in prone position were randomly allocated to any one of the two groups by computer generated random number table:

1. Group P - In this group, extubation was done in prone position at the end of surgery
2. Group S – In this group, extubation was done in supine position at the end of surgery

2.2 Sample Size Calculation

The sample size was calculated as 60 by using www.openepi.com to have at least 80 % power and an alpha of 0.05 to detect the expected difference between the two groups in accordance to previously published studies concluding the incidence of coughing as 9 % in prone as compared to 40 % in patients extubated in supine position [7].

2.3 Inclusion Criteria

- Patients aged between 18 - 65 years
- Patients weighing 40 - 80 kg
- American Society of Anaesthesiologists (ASA) class I & II patients
- Patients undergoing lumbar spine surgery
- All the patients willing to give informed written consent

2.4 Exclusion Criteria

- Patients suffering from fever, drug allergy, thyroid disease and neuromuscular diseases
- Predicted difficult intubation Cormack Lehane grade 3 & 4
- Several intubation attempts
- Patients who are obese (Body mass index > 35 kg/m²)
- Patients with upper respiratory infection, sore throat and chronic cough
- Patients with renal disease and hepatic dysfunction
- Patients needing post-operative ventilator support
- Surgeries lasting for more than 240 minutes

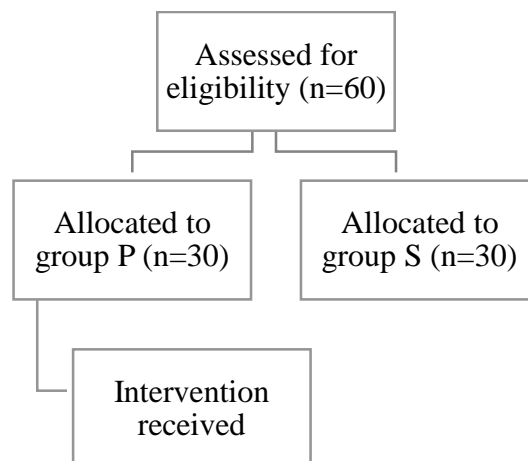


Fig. 1. Flowchart of assesment

For patients undergoing elective surgery, thorough history and examination was done. All the patients were kept fasting according to fasting protocol.

On arrival of the patient to the operation theatre, patients were connected to the multi parameter monitors in supine position. Venous cannula was inserted and ringer lactate drip was initiated. In all patients, premedication was done with midazolam intravenously (0.05 mg/kg), glycopyrrolate intravenously (0.04/kg/mg), and fentanyl intravenously (2 mcg/kg) and preoxygenated with 100 % oxygen for 4 minutes.

Propofol IV (2 mg/kg) followed by vecuronium IV (0.1 mg/kg) was used for induction. Under direct laryngoscopic view, endotracheal intubation was performed with appropriately sized flexo-metallic tube.

The endotracheal tube was secured and eye lubrication was applied. Maintenance of anaesthesia was done by sevoflurane (0.4 - 0.7 vol%), nitrous oxide: oxygen 1 : 1 and vecuronium. Patients were then rolled facing downwards onto a level operation theatre table, supported on pair of bolsters. Head support was given by foam head ring and positioned at 45 degree.

Thirty minutes prior to the ending of surgery, all patients received paracetamol 1g intravenously for post-operative analgesia. Sevoflurane was reduced to 0.2 % during closure of skin and was discontinued after the completion of surgery and the drapes removed.

Myo-pyrolate 0.05 mg/kg was used for reversal of the remaining muscle relaxation marking the beginning of our study. Patients were allocated in either Group P or Group S. Incidence and duration for which patients remained unmonitored during repositioning to supine was noted.

Patients were extubated after complete reversal of neuro muscular blockade and when patients were able to follow, verbal command or spontaneous eye opening was present. Patients in prone position were immediately turned to supine position after extubation.

Incidence and severity of coughing at extubation was recorded. Assessment of severity of coughing was done based on the following criteria: as none, mild (single cough), moderate

(more than one cough but unsustained coughing), and severe (sustained \geq five seconds of coughing) [8].

Heart rate and mean arterial pressure were also recorded before induction of anaesthesia, immediately prior to extubation and one minute after extubation. Need for suction was also noted at the time of extubation. The adverse effects such as nausea, vomiting, laryngospasm, sore throat were noted. Number of patients who required re-intubation were also recorded. All the precautions to maintain airway in prone position were taken before extubation in the prone position. For the immediate turning of the patient, trolley was kept ready on the side. Safe airway management cart and re-intubation trolley was kept ready with laryngeal mask, endotracheal tubes and laryngoscope

2.5 Statistical Analysis

Patient's characteristics were compared among both the groups. Fisher's exact test was used to compare incidence, severity of coughing and incidence of monitor disconnections. Unpaired t-test was used to compare haemodynamics (heart rate and mean arterial pressure) among the group P and group S. P value = .05 was statistically significant and P value < 0.0001 was regarded as to have high significance. Data was summarized as mean along with standard deviation, incidence and range.

3. RESULTS AND DISCUSSION

The time frame of anaesthesia and of surgery, American society of Anaesthesiologist physical status, duration of surgery and demographic data was comparable among the two groups as shown in Table 1.

Coughing occurred in 27 (90 %) patients in group S in comparison to 6 (20 %) in patients extubated in prone position [relative risk 4.5]. P value < 0.001 (highly significant) as calculated by fisher's exact test as shown in Fig. 1. Episodes of coughing and severity of coughing was higher in Group S as shown in Fig. 2.

The extubation time was 3.2 ± 1.4 min in group P as compared to 6.3 ± 3.2 min in the other group (P < 0.001). Rise in heart rate was significant at extubation in comparison to baseline in both the groups.

Mean arterial pressure was significantly higher a minute after extubation compared with baseline

in Group S (16 ± 2.2) in comparison to Group P (4.2 ± 2.1) as calculated by unpaired t test as shown in Table 2.

Incidence of monitor disconnection was more in Group S. There was no loss of monitoring in Group P as calculated by fisher exact test as shown in Fig. 3.

The need for suction after extubation in prone position was significantly reduced as compared

to extubation in supine position. No events of fall in saturation, loss of airway reflexes were noticed in either group.

No event of laryngeal spasm was noted after extubation in either group. Number of patients complaining of nausea, vomiting or pruritis were similar in both the groups. Incidence of sore throat was higher in patient's extubated in supine as compared to prone extubation as shown in Table 3.

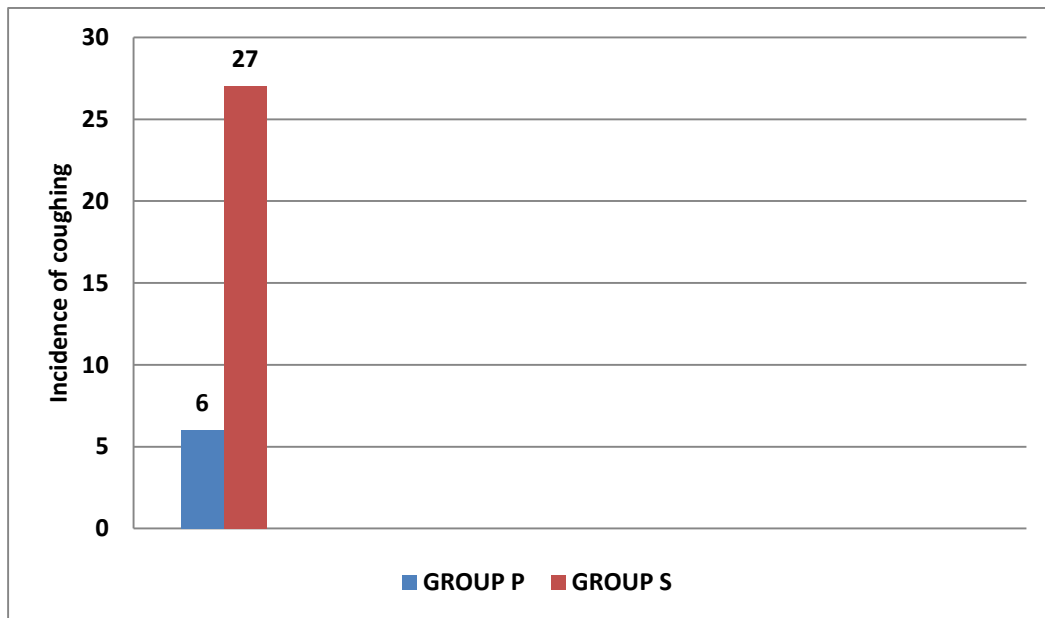


Fig. 1. Comparison of incidence of coughing

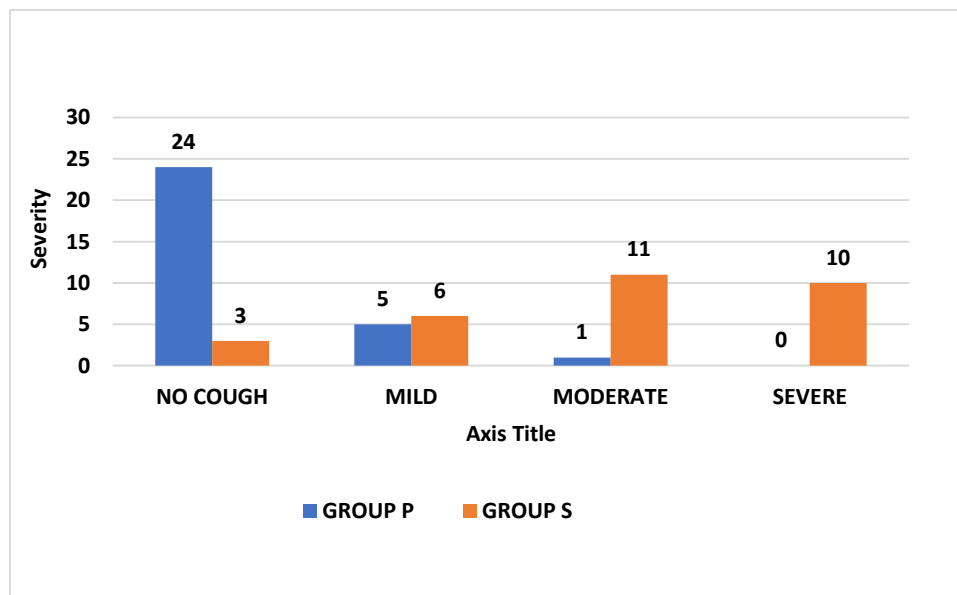


Fig. 2. Comparison of Severity of Cough among the Two Groups

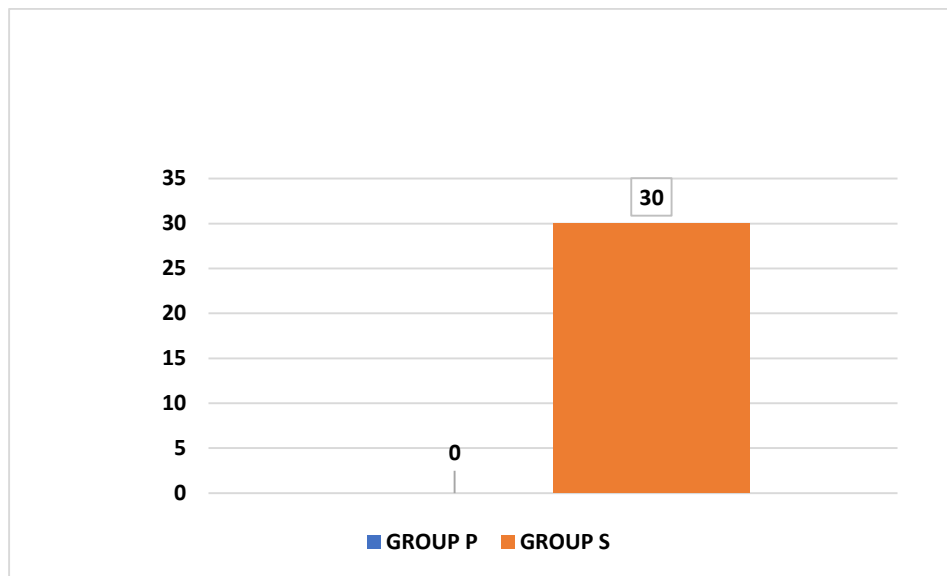


Fig. 3. Comparison of incidence of monitor disconnection among both the groups

Table 1. Patient characteristics in both the groups

| Parameter | Group S | Group P | P Value |
|-----------------------|---------------|---------------|---------|
| Age (years) mean ± SD | 50.65 ± 8.41 | 54.98 ± 10.62 | .132 |
| Gender (male/female) | 16/14 | 18/12 | .100 |
| Height (cm) mean ± SD | 164.21 ± 7.82 | 163.13 ± 7.02 | .132 |
| Weight (kg) mean ± SD | 59.24 ± 9.28 | 57.45 ± 8.76 | .126 |
| Duration of surgery | 82.13 ± 8.2 | 76.24 ± 9.4 | .102 |
| Group s – supine | | | |
| Group p – prone | | | |

Table 2. Hemodynamic changes in both the groups immediately before and 1 min after extubation

| Hemodynamic parameters | Baseline | Before extubation | 1 Minute After Extubation |
|------------------------|---------------|-------------------|---------------------------|
| HR | | | |
| Group S | 86.43 ± 10 | 94.15 ± 14.21 | 94.29 ± 12.56 |
| Group P | 82.15 ± 12 | 88.39 ± 11 | 86.24 ± 8.9 |
| MAP | | | |
| Group S | 90.44 ± 9.34 | 114.74 ± 11 | 106.52 ± 7.1 |
| Group P | 90.35 ± 10.34 | 98.34 ± 7 | 94.64 ± 8.12 |

P Value = .05 (Unpaired t Test between Supine and Prone Groups)

Group S - Supine; Group P – Prone

HR - Heart Rate

MAP - Mean Arterial Pressure

Table 3. Adverse events comparison among the two groups

| Outcome | Group S | Group P |
|----------------------------|-----------|-----------|
| Time for extubation | 6.3 ± 3.2 | 3.2 ± 1.4 |
| Incidence of re-intubation | 0 | 0 |
| Nausea / Vomiting | 0 | 0 |
| Sore throat | 6 | 2 |

Lumbar spine surgeries are performed in prone position which allows the anaesthesiologists to have a choice to extubate either in prone position or supine. However, this choice has to be made keeping in mind to allow minimum to nil obstacle after extubation. Hemodynamical changes, respiratory complication including hypoxemia and coughing, aspiration and obstruction of the airway are some of the common issues during extubation [9]. In our study we primarily focused on incidence of monitor disconnection, coughing and changes in haemodynamics as primary concern of supine extubation. This deserves attention in patients with cardio-vascular disease, raised intracranial pressure (ICP), and asthma or chronic obstructive pulmonary disease. Extubation as a general principle should be done when patient starts following commands.

There is reduced cardiovascular stimulation and incidence of coughing when patients are extubated under deep anaesthesia. Though there is increased incidence of respiratory complications when patients are extubated under deep anaesthesia.

All our patients were extubated after neuromuscular blockade was completely reversed and has tidal volume of 6 – 8 ml/kg with respiratory rate of 12 - 20/minute, spontaneous opening of the eye and following of command was noticed. Prone position extubation in surgeries done in prone position may be of advantage. It maintains the airway patent, hence significantly protecting it from aspiration, but if required it is the most challenging position for reintubation and laryngoscopy. The extubation time was also higher in group S compared to group P mostly because of time consumed in making the prone patient supine for extubation and also to reconnect the monitors.

Patients who are at the risk of difficult intubation – Body mass index > 35 kg/m², chronic respiratory diseases are not suitable candidates for this study. The comparative ease of reintubation in supine position does justify its use in these patients. 10 – 30 % rise in heart rate and mean arterial pressure during extubation which last for 10–15 minutes. Significantly least changes were observed in arterial pressure and heart rate in patient's extubated in prone position. This can be the result of increase tracheal irritation during turning of patients from prone to supine position in case of supine extubation. The same explanation can be given to correlate the lower incidence of coughing and

sore throat as observed in the group P. It is of utmost importance to maintain the multi parameter monitor connectivity at the time of extubation as it reduces time consumption in reconnecting. This can be preserved by extubation in prone position and there by immediate treatment of any change in vitals can be executed. Disruption of monitors were noted while turning to supine position and had to reconnect immediately. Extubation in prone position was done with utmost care to protect and maintain airway.

There is rise in HR and MAP during extubation which usually lasts for 15 – 20 minutes. Patients have underlying heart disease, experience loss of ejection fraction by 45 - 55 %.

Increase in adrenaline and noradrenaline is reported during and after tracheal extubation [10]. Even though the exact mechanism of increase in heart rate and hypertension after tracheal extubation is yet to be known, these changes are thought to be the result of the release of catecholamines which occurs during the stressful period. Elimination of the need to do direct laryngoscopy and oral suctioning and minimized disturbance of tracheal tube in prone extubation during emergence leads to significant reduction in sympatho-adrenal stimulation [11].

Supine and prone position differ in respiratory physiology. There is increased functional residual capacity and changes in ventilation and perfusion within the lungs. These changes are thought to fasten recovery in prone position by causing improvement in oxygenation and avoiding atelectasis [12].

Few studies have been done supporting extubation in prone position. Olympia et al. [13]. conducted study which included patients with reactive airway and smokers and patients with difficult airway and body mass index > 35 kg/m² were excluded. The study was conducted on patients undergoing lumbar spine surgery in prone position and prone emergence was studied. Fewer number of coughs and monitor disconnection along with little hemodynamic change in prone emergence and extubation with very few adverse effects. Another study Yorukoglu et al. [14]. compared with or without prior injection of lidocaine in extubation in prone position with extubation in supine and concluded that prone emergence results in decreased incidence of coughing and monitor disconnection and offers less hemodynamic changes.

Srivastava et al. [15]. conducted a study to compare heart rate and mean arterial pressure in hypertensive patients posted for PCNL surgery and concluded that before and after extubation HR and MAP was significantly more in supine hypertensive patients vs prone. A randomized clinical trial was conducted by Kumar et al. [7]. which included 60 patients who underwent spine surgery in prone position. Patients having underlying co morbidities such as cardiovascular disease, chronic obstructive pulmonary disease, body mass index > 30 kg/m² or OSA were not included in the study. At the conclusion of surgery, 20 ml of 0.25 % bupivacaine was injected along the line of incision. Patients were extubated after spontaneous return of ventilation. Incidence and severity of coughing were the primary objectives. Secondary aim included heart and MAP changes and adverse event were noted. He concluded that incidence and severity of coughing was lower in prone position when compared to supine and no significant hemodynamic parameters were noted. Time difference between the extubation were not noted.

4. CONCLUSION

Our study demonstrated that prone extubation should be considered over the conventional supine extubation in carefully selected group of patients. It understandably provides the advantages of lower number of coughs, monitoring without discontinuation and hemodynamic stability. It also helps in the maintenance of patent airway. Extubation in prone offers an added advantage of continued monitoring and treatment on time in case of any change. Though various complications are associated with prone extubation.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study was conducted after obtaining approval from the ethics and screening committee of Jawaharlal Nehru Medical College, DMIMS (DU), Acharya Vinoba Bhave Rural Hospital (AVBRH), Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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