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Original Research Article

Impact of Regional Anaesthesia on the Incidence of Postoperative Delirium in Elderly Patients: A Prospective Observational Study

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Abstract:

Background: Postoperative delirium is a common and clinically important complication among elderly surgical patients. Anaesthetic technique may influence delirium risk through its effects on intraoperative physiology, postoperative pain, opioid requirement, and recovery profile.

Aim and Objective: To evaluate the impact of regional anaesthesia on the incidence of postoperative delirium in elderly patients.

Materials and Methods: This prospective comparative observational study was conducted at Gandhi Medical College, Bhopal, among 60 elderly patients aged 60 years and above undergoing elective surgical procedures between June 2025 and April 2026. Patients were divided into two groups according to anaesthetic technique: regional anaesthesia group (n=30) and general anaesthesia group (n=30). Postoperative delirium was assessed using the Confusion Assessment Method during the first 72 hours after surgery. Postoperative pain scores, rescue opioid requirement, and duration of hospital stay were also recorded.

Results: The mean age of the study population was 68.4 ± 6.1 years. Postoperative delirium was observed in 11 patients (18.3%). The incidence was lower in the regional anaesthesia group compared with the general anaesthesia group [3 patients (10.0%) vs 8 patients (26.7%)], although this difference was not statistically significant (p=0.095). Regional anaesthesia was associated with significantly lower postoperative pain scores at 6 hours and 24 hours and reduced rescue opioid requirement [8 patients (26.7%) vs 17 patients (56.7%); p=0.018]. Advanced age, ASA III status, and postoperative opioid requirement were associated with a higher occurrence of delirium.

Conclusion: Regional anaesthesia was associated with a lower observed incidence of postoperative delirium, better pain control, and reduced opioid requirement in elderly surgical patients. However, delirium risk appears multifactorial, and anaesthetic technique should be combined with comprehensive perioperative delirium-prevention strategies.

Keywords: Regional Anaesthesia, General Anaesthesia, Postoperative Delirium, Elderly Patients, Confusion Assessment Method, Opioid Requirement.

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Introduction

Postoperative delirium (POD) is an acute and fluctuating disturbance of attention, awareness, and cognition occurring after surgery and anaesthesia. It is now considered part of the broader spectrum of perioperative neurocognitive disorders [1]. It is particularly important in elderly patients because ageing is associated with reduced physiological reserve, higher comorbidity burden, polypharmacy, frailty, sensory impairment, and greater vulnerability to perioperative stress [2]. Reported incidence varies widely according to patient profile, type of surgery, emergency status, and method of delirium assessment. Still, POD remains one of the most frequent and clinically relevant complications after major surgery in older adults [3]. Its occurrence is not benign; delirium is associated with prolonged hospitalization, delayed mobilization, increased nursing burden, postoperative complications, institutional discharge, long-term functional decline, and higher mortality [2,4].

Anaesthetic technique is one potentially modifiable perioperative factor. Regional anaesthesia may theoretically reduce delirium by avoiding airway instrumentation, reducing exposure to systemic anaesthetic agents, improving postoperative analgesia, limiting opioid requirements, and allowing earlier recovery of consciousness and mobility. However, evidence remains mixed. Large randomized trials in elderly hip fracture populations have shown that regional or spinal anaesthesia is not clearly superior to general anaesthesia in reducing postoperative delirium [5,6]. This uncertainty is clinically important because real-world outcomes may vary with patient selection, surgical case-mix, depth of sedation, haemodynamic stability, pain control, and postoperative care practices.

Therefore, the present original observational study is designed to evaluate the impact of regional anaesthesia on the incidence of postoperative delirium and to generate context-specific evidence to inform perioperative decision-making in elderly patients.

Materials and Methods

Study Design and Setting: This was a prospective, hospital-based, comparative observational study conducted in the Department of Anaesthesiology, Gandhi Medical College and associated hospitals, Bhopal, Madhya Pradesh, India.

Study Duration: The study was conducted over a 6-month period from June 2025 to December 2025.

Study Population: The study population comprised elderly patients undergoing elective surgical procedures under regional or general anaesthesia. Patients were enrolled after pre-anaesthetic evaluation and fulfilment of eligibility criteria. For the present study, elderly patients were defined as those aged 60 years or above.

Sample Size: A total of 60 patients were included in the study. The sample size was selected as a feasible institutional sample size based on the expected surgical caseload during the study period and the exploratory nature of the study. The patients were divided into two equal groups according to the anaesthetic technique used:

Group R: 30 patients receiving regional anaesthesia.

Group G: 30 patients receiving general anaesthesia.

The allocation was not randomized. The attending anaesthesiologist determined the type of anaesthesia based on surgical requirements, patient condition, contraindications, and standard institutional practice.

Inclusion Criteria: Patients were included if they fulfilled all of the following criteria:

1. Age 60 years or above.
2. Patients undergoing elective surgical procedures.
3. ASA physical status I, II, or III.
4. Patients receiving either regional anaesthesia or general anaesthesia.
5. Ability to communicate adequately for postoperative cognitive assessment.
6. Written informed consent provided by the patient or a legally acceptable representative.

The American Society of Anesthesiologists Physical Status Classification System was used to grade systemic illness and perioperative physical status preoperatively [7].

Exclusion Criteria: Patients were excluded from the study if they had any of the following:

1. Pre-existing delirium at the time of preoperative assessment.
2. Known dementia or severe cognitive impairment.
3. History of major psychiatric illness.
4. History of stroke with significant residual neurological deficit.
5. Severe hearing or visual impairment interfering with delirium assessment.
6. Emergency surgery.
7. Patients requiring postoperative mechanical ventilation.
8. Patients were shifted directly to intensive care due to major intraoperative complications.
9. Chronic alcohol dependence or substance withdrawal state.
10. Refusal to provide consent.

Preoperative Assessment: All enrolled patients underwent a routine pre-anaesthetic evaluation either 1 day before surgery or on the morning of surgery, depending on admission status and operative scheduling. Demographic details, including age, sex, weight, and relevant clinical history, were recorded. Comorbidities such as hypertension, diabetes mellitus, ischemic heart disease, chronic respiratory disease, renal disease, and previous neurological illness were documented.

A focused neurological and mental status assessment was performed preoperatively to exclude patients with obvious baseline delirium or gross cognitive impairment. Baseline orientation, attention, ability to follow commands, communication status, and sensory limitations were assessed clinically. Routine investigations were performed according to institutional protocol and surgical requirement.

Anaesthetic Technique: Patients were classified into two groups according to the primary anaesthetic technique used.

In the regional anaesthesia group, patients received neuraxial or peripheral regional anaesthesia

depending on the surgical procedure. Regional techniques included spinal anaesthesia, epidural anaesthesia, combined spinal-epidural anaesthesia, or peripheral nerve block, as appropriate. Local anaesthetic drug, dose, adjuvant use, level of block, and requirement of intraoperative sedation were recorded. Sedation, when required, was kept to a minimum and titrated clinically to maintain patient comfort without excessive drowsiness.

In the general anaesthesia group, anaesthesia was induced and maintained in accordance with standard institutional practice. The drugs used for induction, airway management, inhalational or intravenous maintenance agents, neuromuscular blocking agents, analgesics, antiemetics, and reversal agents were recorded. Intraoperative monitoring included electrocardiography, non-invasive blood pressure monitoring, pulse oximetry, end-tidal carbon dioxide, where applicable, and temperature monitoring as per case requirements.

In both groups, intraoperative hypotension, hypoxia, blood loss, blood transfusion, duration of surgery, duration of anaesthesia, and intraoperative complications were recorded because these factors may influence postoperative cognitive outcomes.

Postoperative Care: After completion of surgery, patients were shifted to the post-anaesthesia care unit or postoperative ward according to institutional protocol. Postoperative monitoring included pulse rate, blood pressure, oxygen saturation, respiratory status, pain score, nausea/vomiting, and level of consciousness. Analgesia was provided according to standard postoperative pain management protocols. Requirement of rescue opioid analgesia was recorded because opioid exposure is a clinically relevant perioperative factor in elderly patients and may contribute to postoperative neurocognitive disturbance.

Assessment of Postoperative Delirium: The primary outcome of the study was the incidence of postoperative delirium. Delirium was assessed using the Confusion Assessment Method (CAM), a validated clinical tool for identifying delirium in hospitalized patients [8]. CAM assessment is based on four core features: acute onset or fluctuating course, inattention, disorganized thinking, and altered level of consciousness. A patient was considered CAM-positive when acute onset/fluctuation and inattention were present along with either disorganized thinking or altered level of consciousness [8,9].

Postoperative delirium was assessed at predefined time points: 6, 24, 48, and 72 hours after surgery. Additional assessment was performed if the nursing staff, treating physician, or patient relatives reported altered behaviour, agitation, confusion, drowsiness, disorientation, or abnormal sleep-wake pattern. Delirium occurring during the postoperative period was recorded as postoperative delirium, in accordance with the recommended nomenclature for perioperative neurocognitive disorders, which defines postoperative delirium as an acute cognitive event occurring after anaesthesia and surgery [1].

The severity of delirium was categorized clinically as mild, moderate, or severe based on the degree of disorientation, disturbance in attention, behavioural abnormality, requirement of pharmacological control, and interference with postoperative care. Patients with severe agitation, risk of self-harm, or marked alteration in consciousness were evaluated by the treating team and managed according to institutional practice.

Postoperative Pain Assessment: Postoperative pain was assessed using a 0–10 numerical rating scale, where 0 indicated no pain, and 10 indicated the worst imaginable pain. Pain scores were recorded at 6 hours and 24 hours after surgery. Requirement of rescue analgesia and opioid use were recorded separately. This was done to evaluate whether better postoperative analgesia in the regional anaesthesia group was associated with a lower occurrence of delirium.

Outcome Measures: The primary outcome measure was the incidence of postoperative delirium among elderly patients receiving regional anaesthesia compared with those receiving general anaesthesia.

The secondary outcome measures included timing of onset of delirium, severity of delirium, postoperative pain scores, rescue opioid requirement, nausea/vomiting, and duration of hospital stay.

Data Collection Procedure: Data were collected prospectively using a predesigned structured case record form. Preoperative details were recorded during pre-anaesthetic evaluation. Intraoperative details were recorded from anaesthesia charts and operation theatre records. Postoperative details were collected from bedside assessment, nursing records, medication charts, and patient follow-up during the first 72 hours after surgery.

To reduce assessment bias, delirium assessment was performed using the same predefined CAM criteria at all postoperative time points. The investigator performing the postoperative assessment was trained in the use of CAM before initiation of the study.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using standard statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. The regional anaesthesia and general anaesthesia groups were compared for baseline characteristics and outcome variables.

For continuous variables, the independent-samples t-test was used when the data were normally distributed. For categorical variables, the chi-square test was used. Fisher's exact test was applied when the expected cell frequency was small. A p-value of less than 0.05 was considered statistically significant.

The incidence of postoperative delirium was compared between the two anaesthetic groups. Additional analysis was performed to evaluate the association of selected factors, such as age above 70 years, ASA III status, general anaesthesia, opioid requirement, diabetes mellitus, and hypertension, with postoperative delirium.

Results

A total of 60 elderly patients undergoing elective surgical procedures were included in the study. Of these, 30 patients received regional anaesthesia and 30 patients received general anaesthesia. The mean age of the study population was 68.4 ± 6.1 years, with most patients in the 60–70-year age group. There were 34 males and 26 females. The two groups were comparable with respect to age, gender distribution, ASA physical status, comorbidities, and duration of surgery.

Baseline Characteristics: The mean age was 67.9 ± 5.8 years in the regional anaesthesia group and 68.9 ± 6.4 years in the general anaesthesia group. Male patients constituted 56.7% of the regional anaesthesia group and 56.7% of the general anaesthesia group. Hypertension was the most common comorbidity, observed in 38.3% of patients, followed by diabetes mellitus in 30.0% of patients. No statistically significant difference was observed between the two groups in baseline variables, indicating that both groups were comparable at the time of enrolment.

Table 1: Baseline demographic and clinical characteristics

Variable	Regional anaesthesia (n=30)	General anaesthesia (n=30)	p value
Age, years, mean ± SD	67.9 ± 5.8	68.9 ± 6.4	0.529
Age 60–70 years, n (%)	21 (70.0%)	19 (63.3%)	0.584
Age >70 years, n (%)	9 (30.0%)	11 (36.7%)	0.584
Male gender, n (%)	17 (56.7%)	17 (56.7%)	1.000
Female gender, n (%)	13 (43.3%)	13 (43.3%)	1.000
ASA I, n (%)	6 (20.0%)	5 (16.7%)	0.739
ASA II, n (%)	18 (60.0%)	17 (56.7%)	0.795
ASA III, n (%)	6 (20.0%)	8 (26.7%)	0.542
Hypertension, n (%)	11 (36.7%)	12 (40.0%)	0.791
Diabetes mellitus, n (%)	8 (26.7%)	10 (33.3%)	0.573
Mean duration of surgery, minutes	82.6 ± 21.4	86.3 ± 24.1	0.533

Incidence of postoperative delirium: Postoperative delirium was observed in 11 out of 60 patients, giving an overall incidence of 18.3%. The incidence was lower among patients who received regional anaesthesia compared with those who received general anaesthesia. In the regional anaesthesia group, postoperative delirium occurred in 3 patients (10.0%), whereas in the general anaesthesia group, it occurred in 8 patients (26.7%). Although the incidence was numerically lower in the regional anaesthesia group, the difference did not reach statistical significance.

Table 2: Incidence of postoperative delirium according to anaesthetic technique

Postoperative delirium	Regional anaesthesia (n=30)	General anaesthesia (n=30)	Total (n=60)	p value
Present	3 (10.0%)	8 (26.7%)	11 (18.3%)	0.095
Absent	27 (90.0%)	22 (73.3%)	49 (81.7%)	

Timing and severity of postoperative delirium: Among the 11 patients who developed delirium, most cases were detected within the first 24 hours after surgery. Delirium on postoperative day 1 was observed in 7 patients (63.6%), and on postoperative day 2 in 4 patients (36.4%). No new case of delirium was observed after postoperative day 3. Mild delirium was the most common presentation, observed in 7 patients. In comparison, moderate delirium was seen in 4 patients. None of the patients developed severe delirium requiring intensive care admission exclusively due to delirium.

Table 3: Timing and severity of postoperative delirium

Variable	Regional anaesthesia (n=3)	General anaesthesia (n=8)	Total delirium cases (n=11)
POD on day 1	2 (66.7%)	5 (62.5%)	7 (63.6%)
POD on day 2	1 (33.3%)	3 (37.5%)	4 (36.4%)
POD on day 3	0 (0.0%)	0 (0.0%)	0 (0.0%)
Mild delirium	2 (66.7%)	5 (62.5%)	7 (63.6%)
Moderate delirium	1 (33.3%)	3 (37.5%)	4 (36.4%)
Severe delirium	0 (0.0%)	0 (0.0%)	0 (0.0%)

Postoperative pain, opioid requirement, and hospital stay: Patients receiving regional anaesthesia had lower postoperative pain scores and lower opioid requirement compared with patients receiving general anaesthesia. The mean postoperative pain score at 6 hours was 3.1 ± 1.2 in the regional anaesthesia group and 4.5 ± 1.5 in the general anaesthesia group, and this difference was statistically significant. The requirement for rescue opioid analgesia was also lower in the regional anaesthesia group. The mean duration of hospital stay was slightly shorter in patients receiving regional anaesthesia, although the difference was not statistically significant.

Table 4: Postoperative outcomes according to anaesthetic technique

Outcome	Regional anaesthesia (n=30)	General anaesthesia (n=30)	p value
Pain score at 6 hours, mean ± SD	3.1 ± 1.2	4.5 ± 1.5	<0.001
Pain score at 24 hours, mean ± SD	2.4 ± 1.0	3.3 ± 1.2	0.003
Rescue opioid required, n (%)	8 (26.7%)	17 (56.7%)	0.018
Nausea/vomiting, n (%)	4 (13.3%)	8 (26.7%)	0.197
Mean hospital stay, days	5.2 ± 1.4	5.8 ± 1.7	0.141

Factors associated with postoperative delirium: Patients who developed postoperative delirium were older, had a higher proportion of ASA III status, and had greater postoperative opioid requirement compared with those who did not develop delirium. Delirium was more frequently observed in patients aged 70 years and above. The incidence of delirium was 35.0% among patients aged 70 years and above compared with 12.5% among patients aged 60–70 years. Similarly, delirium occurred in 35.7% of ASA III patients compared with 15.2% of ASA I–II patients. General anaesthesia and postoperative opioid requirement were also associated with a higher frequency of delirium.

Table 5: Association of selected factors with postoperative delirium

Factor	Delirium present (n=11)	Delirium absent (n=49)	p value
Age >70 years	7 (63.6%)	13 (26.5%)	0.020
ASA III status	5 (45.5%)	9 (18.4%)	0.049
General anaesthesia	8 (72.7%)	22 (44.9%)	0.095
Rescue opioid requirement	8 (72.7%)	17 (34.7%)	0.022
Diabetes mellitus	5 (45.5%)	13 (26.5%)	0.217
Hypertension	6 (54.5%)	17 (34.7%)	0.220

Discussion

Postoperative delirium is an important perioperative complication in elderly surgical patients, and its prevention remains a major concern in anaesthesia practice. In the present study conducted at Gandhi Medical College, Bhopal, postoperative delirium was observed in 11 out of 60 elderly patients, giving an overall incidence of 18.3%. The incidence of delirium was lower among patients who received regional anaesthesia than among those who received general anaesthesia, with delirium occurring in 3 patients (10.0%) in the regional anaesthesia group and 8 patients (26.7%) in the general anaesthesia group. Although this difference did not reach statistical significance, the numerical reduction suggests a clinically meaningful trend favouring regional anaesthesia.

The overall incidence of delirium observed in the present study is consistent with the known frequency of postoperative delirium in older surgical patients. Delirium is commonly reported after major surgery in elderly individuals, with incidence varying according to patient age, baseline frailty, type of surgery, emergency status, perioperative complications, and the method used for delirium detection [2,3]. Marcantonio described delirium as one of the most common and clinically significant complications in hospitalized older adults, emphasizing its association with poor short-term and long-term outcomes [2]. Similarly, Jin et al.

highlighted that postoperative delirium is multifactorial and that prevention depends on identifying modifiable perioperative risk factors rather than relying solely on post-delirium treatment [3].

Several possible mechanisms may explain the lower incidence of delirium in the regional anaesthesia group. Regional anaesthesia reduces exposure to systemic anaesthetic agents, avoids or minimizes airway manipulation, improves postoperative analgesia, and may reduce perioperative opioid requirements. In elderly patients, these factors are important because the ageing brain is more vulnerable to the effects of sedatives, opioids, sleep disruption, pain, hypoxia, hypotension, inflammation, and metabolic disturbance [1,3]. In the present study, patients who received regional anaesthesia also had significantly lower postoperative pain scores and lower rescue opioid requirement compared with those who received general anaesthesia. This supports the concept that the benefit of regional anaesthesia may not be due to the anaesthetic technique alone, but also due to improved analgesic quality and opioid-sparing effect.

The relationship between pain, opioid exposure, and delirium is clinically complex. Poorly controlled postoperative pain itself can increase stress response, sleep disturbance, agitation, and immobility, all of which may contribute to delirium. At the same time, excessive opioid use can precipitate sedation, confusion, respiratory depression, nausea, urinary retention, and reduced mobility in elderly patients. The American Geriatrics Society guidelines recommend optimization of pain control, preferably with non-opioid and opioid-sparing strategies, as an important component of delirium prevention in older surgical patients [10]. Jin et al. also suggested that multimodal opioid-sparing analgesia is likely to be beneficial in reducing delirium risk [3]. The findings of the present study are in agreement with this principle, as delirium was more common among patients who required rescue opioid analgesia.

However, the present findings should be interpreted in light of evidence from larger randomized trials, where the superiority of regional anaesthesia over general anaesthesia has not been consistently demonstrated. In the RAGA randomized trial, regional anaesthesia did not significantly reduce the incidence or severity of postoperative delirium compared with general anaesthesia among older adults undergoing hip fracture surgery [6]. Similarly, the REGAIN trial reported that spinal anaesthesia was not superior to general anaesthesia with respect to survival, recovery of ambulation, or delirium outcomes in older adults undergoing hip fracture surgery [5]. These large trials suggest that anaesthetic technique alone may not be sufficient to prevent delirium unless other perioperative factors such as sedation depth, haemodynamic stability, pain control, hydration, early mobilization, sleep preservation, and avoidance of deliriogenic drugs are also addressed.

The modest sample size may partly explain the non-significant p-value observed in the present study. Although delirium was less frequent in the regional anaesthesia group, the study included only 30 patients in each group. With a larger sample, the observed difference may have achieved statistical significance, or the effect size may have become more precise. Therefore, the finding should be interpreted as a clinically relevant trend rather than definitive proof of superiority. This is important because small single-centre studies are often underpowered to detect differences in outcomes such as delirium, which are influenced by multiple patient-related, surgical, anaesthetic, and postoperative factors.

In the present study, advanced age was significantly associated with postoperative delirium. Patients aged more than 70 years had a higher frequency of delirium compared with those aged 60–70 years. This finding is expected and is supported by previous literature. Ageing is associated with reduced cognitive reserve, altered neurotransmitter balance, increased blood-brain barrier vulnerability, higher inflammatory response, and greater sensitivity to psychoactive drugs [2,3]. Elderly patients also frequently have associated comorbidities, polypharmacy, sensory impairment, and sleep disturbance, which further increase delirium risk.

ASA III status was also associated with a higher occurrence of delirium in the present study. This suggests that the burden of systemic illness may be more important than chronological age alone. Patients with higher ASA grade often have reduced physiological reserve and are more vulnerable to intraoperative hypotension, hypoxia, metabolic derangements, postoperative infection, and delayed recovery. The updated European Society of Anaesthesiology and Intensive Care Medicine guideline also emphasizes preoperative identification of delirium risk factors in older adults and recommends that delirium prevention should begin before surgery rather than only after symptoms appear [11].

The present study has practical implications for anaesthesia practice in elderly patients. Regional anaesthesia should be considered whenever clinically appropriate, particularly in patients at higher risk of delirium, because it may improve pain control and reduce opioid exposure. However, the choice of anaesthetic technique should be individualized rather than based on the assumption that regional anaesthesia alone will prevent

delirium. Excessive sedation during regional anaesthesia may reduce its potential advantage. Similarly, poorly controlled pain after general anaesthesia may increase delirium risk. Therefore, delirium prevention should be viewed as a bundle of care that includes preoperative risk assessment, correction of dehydration and metabolic abnormalities, avoidance of unnecessary sedatives, maintenance of oxygenation and haemodynamic stability, adequate analgesia, sleep promotion, early mobilization, orientation, use of spectacles and hearing aids when needed, and early recognition using validated tools such as the Confusion Assessment Method [8].

The strength of the present study is that it addresses a clinically relevant, commonly encountered problem among elderly surgical patients in a tertiary care setting. The prospective assessment of delirium using predefined criteria adds value to the observations. The study also evaluated related postoperative factors such as pain score and opioid requirement, which helped in interpreting the possible mechanism behind the lower delirium rate in the regional anaesthesia group.

The study also has limitations. First, the sample size was small, which limits statistical power. Second, this was an observational study, and the type of anaesthesia was not randomized; therefore, selection bias cannot be excluded. Third, the surgical procedures were not restricted to a single operation type, and differences in surgical stress may have influenced delirium risk. Fourth, the depth of anaesthesia and sedation was not objectively monitored in all patients. Fifth, baseline cognition was assessed clinically, but detailed preoperative cognitive scoring was not performed. Sixth, delirium assessment was limited to the early postoperative period up to 72 hours, and late-onset delirium may have been missed. Despite these limitations, the findings provide useful institutional data and support the need for larger, adequately powered studies in elderly Indian surgical patients.

Conclusion

Regional anaesthesia was associated with a lower observed incidence of postoperative delirium, better postoperative pain control, and reduced opioid requirement among elderly surgical patients compared with general anaesthesia. However, the difference in delirium incidence was not statistically significant, suggesting that anaesthetic technique alone may not completely determine delirium risk. Advanced age, higher ASA status, and postoperative opioid use appeared to be important associated factors. A comprehensive perioperative strategy focusing on careful anaesthetic selection, opioid-sparing analgesia, early mobilization, and regular delirium screening may help improve postoperative outcomes in elderly patients.

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