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Original Research Article

Difficult and Failed Tracheal Intubation in Cesarean Deliveries: A Review of 4330 Cases

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Abstract: *Difficult and failed tracheal intubation during cesarean delivery under general anesthesia represents a significant patient safety concern in obstetric anesthesia. Physiological changes during pregnancy increase airway management challenges and may lead to serious maternal and neonatal complications. Data from resource-limited settings remains limited.* ***Objective:*** *To determine the incidence of difficult and failed tracheal intubation during cesarean delivery under general anesthesia and to evaluate airway characteristics and management strategies.* ***Methods:*** *This retrospective observational study was conducted at Hameed Latif Hospital, Lahore, Pakistan. Medical records of women who underwent cesarean delivery under general anesthesia between January 2014 and December 2016 were reviewed. Out of 5,637 cesarean sections performed during the study period, 4,330 cases with complete anesthesia records were included. Data regarding demographic characteristics, comorbidities, airway assessment parameters, laryngoscopic view, and airway management techniques were extracted. Difficult intubation was defined as intubation requiring more than one attempt or additional airway adjuncts, while failed intubation referred to the inability to secure the airway during rapid sequence induction. Data were analyzed using SPSS version 22 and presented as mean ± standard deviation or frequencies and percentages.* ***Results:*** *A total of 4,330 patients were analyzed. The mean maternal age was 28.98 ± 4.52 years, and the mean BMI was 30.12 ± 5.16 kg/m². Most participants were classified as ASA II (98.5%), and 76.6% underwent elective cesarean section. Mallampati grade II was the most common airway classification (41.9%), and Cormack–Lehane grade I laryngoscopic view was observed in 68.2% of patients. Difficult or failed tracheal intubation occurred in 30 cases (0.69%). Difficult intubation was observed in 29 patients (0.67%), whereas failed intubation occurred in one patient (0.02%). Among difficult airway cases, airway management was successfully achieved using a stylet with BURP maneuver (17 cases), gum elastic bougie (6 cases), a second attempt by a senior consultant (4 cases), and fiberoptic bronchoscopy (2 cases).* ***Conclusion:*** *The incidence of difficult and failed tracheal intubation during cesarean delivery under general anesthesia was low in this cohort. Careful preoperative airway assessment, availability of airway adjuncts, and experienced anesthesiology supervision appear to contribute to successful airway management and improved maternal safety.*

Keywords: Cesarean Section, Tracheal Intubation, Difficult Airway, Obstetric Anesthesia, General Anesthesia, Airway Management, Rapid Sequence Induction, Maternal Safety

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Introduction

Cesarean delivery represents one of the most frequently performed surgical procedures worldwide, and the choice of anesthetic technique carries profound implications for both maternal and neonatal outcomes (1,2). While neuraxial anesthesia has emerged as the gold standard for cesarean delivery, general anesthesia (GA) remains indispensable in specific clinical scenarios, including maternal refusal of regional techniques, failed neuraxial blockade, and acute obstetric emergencies (1,3). Despite the widespread adoption of neuraxial techniques, GA is still required in approximately 6% of cesarean deliveries, with the majority of these cases being emergent in nature (4).

The obstetric airway presents unique anatomic and physiologic challenges that substantially elevate the risk of difficult and failed tracheal intubation compared to the non-pregnant population (5,4). Pregnancy-related physiological changes—including airway edema, reduced functional residual capacity, increased oxygen consumption, and elevated aspiration risk—collectively render airway management considerably more hazardous (6,7). The incidence of failed tracheal intubation in obstetric patients has been consistently reported to be higher than in the general surgical population, with estimates ranging from 1 in 224 to 1 in 390 general anesthetics for cesarean section (5,8). Failed intubation is not merely a technical failure; it is associated with serious sequelae, including hypoxemia, aspiration pneumonitis, emergency surgical airway, unanticipated intensive care admission, and maternal death (4,1).

Complications associated with GA for cesarean delivery extend beyond airway management difficulties. General anesthesia has been independently associated with higher rates of cardiac arrest, aspiration of gastric contents, surgical site infections, postpartum hemorrhage, and maternal mortality when compared to neuraxial techniques (9,10). Furthermore, neonatal outcomes are adversely affected, with lower Apgar scores and higher rates of neonatal intensive care unit (NICU) admission documented in infants delivered under GA (2,11). These risks have driven a global trend toward minimizing the use of GA in obstetric practice, with leading professional bodies recommending GA rates of no more than 5% for cesarean deliveries (10).

Despite global advances in obstetric anesthesia, the burden of difficult and failed tracheal intubation during cesarean deliveries remains a critical patient safety concern in resource-limited settings. Pakistan faces a constellation of healthcare system challenges that amplify the risk of difficult and failed intubation during cesarean deliveries. These include a shortage of trained obstetric anesthesiologists, limited availability of advanced airway management equipment such as videolaryngoscopes, and inadequate implementation of standardized difficult airway protocols (6,7). The high prevalence of obesity, preeclampsia, and eclampsia in the Pakistani obstetric population further compounds airway management risk, as these conditions are well-recognized independent predictors of difficult intubation (12,13). In resource-limited settings, GA is often used more frequently due to the unavailability of neuraxial expertise or equipment, thereby increasing the risk of airway-related complications (14).

To date, there is a paucity of large-scale, locally contextualized data on the incidence, risk factors, and outcomes of difficult and failed tracheal intubation during cesarean deliveries in Pakistan. This review of 4,330 cases aims to address this critical knowledge gap, providing evidence to inform the development of context-specific airway management protocols, training curricula, and quality improvement initiatives that can meaningfully reduce anesthesia-related maternal morbidity and mortality in the Pakistani healthcare setting.

Methodology

This retrospective observational study was conducted at Hameed Latif Hospital, Lahore, Pakistan, a tertiary care facility with a well-established electronic medical record system that maintains comprehensive perioperative and anesthesia-related patient data. The study analyzed records of obstetric patients who underwent cesarean delivery over three years from 1 January 2014 to 31 December 2016. Ethical approval for the study was obtained from the Institutional Ethical Committee of Hameed Latif Hospital (Ref: ECL/R&S/SM-2020). As the research involved a retrospective review of anonymized patient records, patient confidentiality was strictly maintained, and no direct patient contact was required.

During the study period, a total of 5637 cesarean sections were performed at the institution. Among these, 4733 procedures were carried out under general anesthesia, while 904 were performed under regional anesthesia. Only patients who received general anesthesia were considered eligible for the study. Cases were excluded if the anesthesia record was incomplete, particularly when essential variables such as preoperative airway assessment or laryngoscopic view were not documented. After excluding 403 incomplete records, 4330 patients were included in the final analysis.

Patient information was retrieved from the hospital's computerized medical record system and anesthesia charts. Data collected included demographic variables such as age, weight, height, and body mass index (BMI), as well as maternal comorbidities, including hypertension and diabetes mellitus. Clinical variables such as the American Society of Anesthesiologists (ASA) physical status classification and the type of cesarean section (elective or emergency) were also recorded. Preoperative airway assessment parameters included Mallampati classification, mandibular protrusion grading, and thyromental distance. Intraoperative airway findings were documented using the Cormack–Lehane laryngoscopic grading system (grades I–IV). Additional information regarding the number of intubation attempts and the use of airway adjuncts or maneuvers, including backward upward rightward pressure (BURP), stylet, gum-elastic bougie, fiberoptic bronchoscope, and laryngeal mask airway (LMA), was also obtained. All tracheal intubations were performed under the direct supervision of a consultant anesthesiologist, and the documentation recorded by the attending anesthetist was considered final.

The anesthetic management followed a standardized departmental protocol for obstetric general anesthesia. All patients were preoxygenated with 100% oxygen, followed by rapid sequence induction. General anesthesia was induced using intravenous propofol at a dose of 2–3 mg/kg and suxamethonium at a dose of 1–1.5 mg/kg as the neuromuscular blocking agent. Due to the unavailability of sugammadex during the study period, rocuronium was not used. Direct laryngoscopy was performed for endotracheal intubation in all cases.

Difficult intubation was defined as tracheal intubation requiring more than one attempt by an experienced anesthetist or requiring additional airway manipulation or adjunctive devices to facilitate successful intubation. Failed intubation was defined as the inability to achieve tracheal intubation during rapid sequence induction for obstetric anesthesia, necessitating initiation of a failed intubation management protocol.

All collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 22. Continuous variables were presented as means with standard deviations, while categorical variables were summarized as frequencies and percentages. The incidence of difficult and failed intubation was calculated, and 95% confidence intervals were reported where applicable.

Results

A total of 4330 patients undergoing cesarean delivery under general anesthesia were included in the final analysis. The mean maternal age was 28.98 ± 4.52 years, with an average weight of 78.29 ± 18.26 kg, height 162.14 ± 7.28 cm, and a mean BMI of 30.12 ± 5.16 kg/m². Most patients had normal BMI (60.2%), while 26.0% were class I obese, 10.0% class II obese, and 3.9% class III obese. The majority had no hypertension (82.4%) or diabetes (84.8%). According to the ASA classification, most participants were ASA II (98.5%). Regarding the type of surgery, 76.6% of cesarean sections were elective and 23.4% were emergency procedures (Table 1).

Preoperative airway assessment showed that Mallampati grade II (41.9%) was the most common classification, followed by grade I (29.5%), grade III (20.9%), and grade IV (5.0%). Most patients had mandibular protrusion grade A (79.2%) and thyromental distance <6 cm (96.0%). During laryngoscopy, Cormack–Lehane grade I was observed in 68.2% and grade II in 28.9%, whereas grade III and IV views were relatively rare (Table 2).

Overall, 30 patients (0.69%) experienced difficult or failed intubation. Difficult intubation occurred in 29 cases (0.67%), while failed intubation occurred in one case (0.02%) (Table 3).

In difficult airway cases, airway management was achieved using various adjuncts. The stylet with BURP maneuver was used in 17 cases, gum elastic bougie in 6 cases, second attempt by a senior consultant in 4 cases, and fiberoptic bronchoscopy in 2 cases, resulting in successful airway management in all patients (Table 4).

Table 1: Demographic and Clinical Characteristics of Patients (n = 4330)

Variable	Category	Value
Age (years)	-	28.98 ± 4.52
Weight (kg)	-	78.29 ± 18.26
Height (cm)	-	162.14 ± 7.28
BMI (kg/m²)	-	30.12 ± 5.16
BMI Category	Normal BMI	2606 (60.2%)
	Class I obesity	1126 (26.0%)
	Class II obesity	433 (10.0%)
	Class III obesity	169 (3.9%)
Hypertension	None	3568 (82.4%)
	Pregnancy-induced hypertension	637 (14.7%)
	Preeclampsia	30 (0.7%)

	Essential hypertension	95 (2.2%)
Diabetes	None	3672 (84.8%)
	Gestational diabetes mellitus	615 (14.2%)
	Type I diabetes	43 (1.1%)
ASA Physical Status	II	4265 (98.5%)
	III	61 (1.4%)
	IV	4 (0.1%)
Type of Cesarean Section	Emergency	1014 (23.4%)
	Elective	3316 (76.6%)

Table 2: Airway Characteristics and Intraoperative Findings (n = 4330)

Variable	Category	n (%)
Mallampati Score	I	1277 (29.5%)
	II	1814 (41.9%)
	III	905 (20.9%)
	IV	216 (5.0%)
Mandibular Protrusion	Grade A	3430 (79.2%)
	Grade B	741 (17.1%)
	Grade C	26 (0.6%)
Thyromental Distance	<6 cm	4157 (96.0%)
	≥6 cm	173 (4.0%)
Cormack–Lehane Laryngoscopy Grade	I	2953 (68.2%)
	II	1251 (28.9%)
	III	119 (2.7%)
	IV	7 (0.2%)

Table 3: Incidence of Difficult and Failed Intubation

Variable	Category	n (%)
Difficult Intubation	Yes	29 (0.67%)
	No	4301 (99.33%)
Failed Intubation	Yes	1 (0.02%)
	No	4329 (99.98%)

Table 4: Airway Management Techniques Used in Difficult Intubation (n = 29)

Variable	Category	n
Airway Maneuver	Stylet with BURP maneuver	17
	Gum elastic bougie	6
	Second attempt by the senior consultant	4
	Fiberoptic bronchoscope	2

Discussion

The present study identified a difficult intubation rate of 0.67% and a failed intubation rate of 0.02% among 4,330 cesarean deliveries performed under general anesthesia. These figures are notably lower than those reported in several landmark investigations. Reale et al., in a large multicenter retrospective cohort of 14,748 cesarean deliveries, reported a difficult intubation rate of approximately 2.04% and a failed intubation rate of 0.12%, both considerably higher than our findings (15). Similarly, Pintarič cited a UK national survey reporting a failed intubation rate of 1 in 224 general anesthetics for obstetric cases, and noted that Kinsella and colleagues reported a stable incidence of 2.6 per 1,000 anesthetics over four decades (5). Bonnet et al. reported difficult intubation in 4.5% and failed intubation in 0.56% in a prospective, multicenter French study (16), while Toker et al. reported a difficult intubation incidence of 4.7% in obstetric patients (17). The comparatively lower rates in our cohort may reflect the predominantly elective nature of the surgical caseload (76.6%), the relatively low-risk ASA profile (98.5% ASA II), and the predominance of favorable airway characteristics, including Mallampati grade I–II in 71.4% of patients and Cormack–Lehane grade I–II in 97.1%. Preoperative airway assessment findings in our cohort are broadly consistent with established predictors of difficult intubation. Mushambi et al. identified a thyromental distance of less than 6 cm, a Mallampati score of 3–4, and limited jaw protrusion as key risk factors for difficult airway in parturients (18). These findings are partly reflected in our data, in which 96.0% of patients had a thyromental distance of less than 6 cm. Yet the overall difficult intubation rate remained low, suggesting that individual predictors in isolation have limited discriminative power. Reale et al. similarly demonstrated that increased BMI, Mallampati III/IV, a small hyoid-to-mentum distance, and limited jaw protrusion were associated with the highest odds of difficult intubation (15). In our cohort, 39.9% of patients were obese (BMI ≥30 kg/m²), and 25.9% had Mallampati III/IV. Yet, the incidence of difficult intubation remained low, which may reflect the protective effect of systematic preoperative airway assessment and preparedness. Reed et al. reported that Mallampati

grade 3 or 4 was present in 29% of their South African obstetric cohort, with a failed intubation rate of 1% (19).

Among the 29 cases of difficult intubation, the stylet with BURP maneuver was the most frequently employed adjunct, followed by gum elastic bougie, escalation to a senior consultant, and fiberoptic bronchoscopy. Yu et al. demonstrated that the BURP maneuver significantly improved laryngoscopic views, reducing the rate of difficult laryngoscopy from 21.1% to 6.1% (20). Bonnet et al. similarly described the use of a gum elastic bougie as a standard rescue technique in their multicenter cohort (16). The use of fiberoptic bronchoscopy aligns with recommendations by Mushambi et al. and Šklebar, who advocate fiberoptic intubation when multiple predictors of difficult airway coexist or when conventional laryngoscopy fails (18,21). Importantly, all difficult and failed intubation cases in our series were successfully managed without maternal mortality, consistent with improved outcomes when structured difficult airway algorithms are implemented (5,21).

Bishop et al. reported a failed intubation rate of 1 in 73 in South African hospitals, substantially higher than our rate of 1 in 4,330 (22). Bhattarai et al. documented a high rate of general anesthesia use in a rural Nepalese tertiary center, with eclampsia as the leading indication (14). Bisri and Bisri reported only six difficult intubations among 7,131 elective cesarean deliveries under general anesthesia in Indonesia, a rate comparable to ours (23). These comparisons underscore that institutional protocols, operator expertise, and case selection profoundly influence airway outcomes in obstetric practice (5,15,18).

The study was conducted in a single tertiary care hospital, and therefore, the findings may not be fully generalizable to other healthcare settings. In addition, the retrospective design relied on existing anesthesia records, which may be incomplete and subject to information bias.

Conclusion

Difficult and failed tracheal intubation during cesarean delivery occurred infrequently in this cohort of obstetric patients. Systematic airway assessment, preparedness with airway adjuncts, and involvement of experienced anesthesiologists may reduce airway-related complications and improve maternal outcomes during obstetric general anesthesia.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-HLHL-98-14)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Manuscript drafting, Study Design,

MZ

Review of Literature, Data entry, Data analysis, and drafting articles.

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Conception of Study, Development of Research Methodology Design,

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Study Design, manuscript review, critical input.

AT

Manuscript drafting, Study Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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