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Anaesthesia-related complications in patients with Down syndrome: A cross-sectional study from Tripoli-Libya

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المضاعفات المرتبطة بالتخدير لدى المرضى المصابين بمتلازمة داون: دراسة مقطعية من طرابلس - ليبيا

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Abstract Patients with Down syndrome present unique challenges during general anesthesia due to their anatomical and physiological characteristics. This cross-sectional study investigates the rate and nature of anesthesia-related complications in 30 Down syndrome patients across three hospitals in Tripoli-Libya. The findings reveal high rates of congenital heart defects (70%), intraoperative awareness (66.7%), and intubation difficulties (43.3%). Sevoflurane and propofol were the most commonly used anesthetic agents. The study highlights the need for specific anesthesia protocols and enhanced preoperative assessment to reduce risks in this vulnerable population.

Keywords: Down syndrome, anesthetic complications, congenital heart defects, intraoperative awareness, Libya

الملخص:

يواجه مرضى متلازمة داون تحديات فريدة أثناء التخدير العام بسبب خصائصهم التشريحية والفيزيولوجية. تهدف هذه الدراسة المقطعية إلى التحقيق في معدل وطبيعة المضاعفات المرتبطة بالتخدير لدى 30 مريضًا من متلازمة داون في ثلاثة مستشفيات في طرابلس– ليبيا. كشفت النتائج عن معدلات مرتفعة من العيوب الخلقية في القلب (70٪)، والوعي أثناء العملية (66.7٪)، وصعوبات في التنبيب (43.3٪). كان السيفوفلوران والبروبوفول من أكثر العوامل المخدرة استخدامًا. تسلط الدراسة الضوء على الحاجة إلى بروتوكولات تخدير خاصة وتحسين التقييم قبل الجراحة لتقليل المخاطر في هذه الفئة الضعيفة من المرضى.

Introduction

Down syndrome (DS) is a genetic disorder, also known as Trisomy 21, is the most prevalent chromosomal abnormality among live births, occurring in about 1 in 700-800 births. The syndrome is associated with a wide range of medical concerns that include intellectual disability, associated phenotypic features, and

a high incidence of system-wide comorbidities. Due to these associated comorbidities, the likelihood of requiring surgical and diagnostic procedures under general anesthesia is increased for individuals with DS throughout their lives. For example, congenital heart disease (CHD), which occurs at a high incidence of 40-60% of infants with DS, often requires surgical intervention in infancy or early childhood, and this type of surgical intervention has been a primary determinant in survival since the middle of the 20th century (National Down Syndrome Society). Other congenital problems include esophageal, gastrointestinal, and urine tract issues that also require surgical intervention to some degree(NDSS, Surgery & Down Syndrome). As the individual ages, they may present for various noncardiac procedures, such as orthopedic, ophthalmologic, and dental procedures, often under general anesthesia due to behavioral and cognitive reasons (Aboud et al., 2023).

As a result of increased exposure to anesthesia and the unique physiological characteristics associated with Down syndrome, a predictable and distinctive anesthetic risk profile emerges, specifically in the setting of critical respiratory and cardiovascular events. These events are not random occurrences, but rather direct consequences of the underlying pathophysiology of Trisomy 21. While some recent large-scale retrospective studies suggest the overall complication rate for non-cardiac surgery is similar to the greater pediatric population, the nature and magnitude of the complication is differentand requires focused perioperative planning(Tsao et al., 2025). Therefore, a "one-size-fits-all" anesthetic approach is inadequate and could have deleterious effects. Safe and effective care are determined by a thoughtful preoperative assessment, a plan for how the patient will intraoperatively, and finally, postoperatively, the means in which we will monitor that the patient will have in the postoperative period is ultimately dictated by a solid understanding of the potential risk.

Although the incidence of DS in Libya (1 in 516 live births) is relatively high(Verma et al.,1990) & According to the *World Population Review* (2025), Libya has an estimated Down syndrome rate of 40.5 per 100,000 population, with a lower bound of 31.3 and an upper bound of 52.3, it is alarming that there is no independent research on complications of anesthesia in this group. The lack of research in this area reveals such significant gaps as: No published studies assessing post-general anesthesia complications in Libyan DS patients, Unknown anesthetic management protocols used for DS patients in Libyan health care areas, No description of perioperative outcomes in DS patients undergoing surgery in Libyan hospitals, No reference to airway management dilemmas specific to Libyan DS patients, No local anesthesia guidelines regarding the specific anesthesia challenges presented by DS patients.

Materials and Methods

A cross-sectional study was conducted between December 2024 and January 2025 at Tripoli University Hospital, Abuslim Accident Hospital, and Maitiga Military Hospital.

Thirty Down syndrome patients of varying age groups and both sexes were included.

Data were collected via anesthesiologist-administered questionnaires and patient record reviews. Statistical analysis was performed using SPSS.

Results

The total patients that participate in this study were 30 cases, they distributed into 3 age groups as shown in the Table1& Figure1.

Table1: the distribution of the participants by age group

Age	Frequency	Percentage
0 to 15	**23**	**76.7**
16 to 30	**5**	**16.7**
31 to 45	**2**	**6.7**
Total	**30**	**100.0**

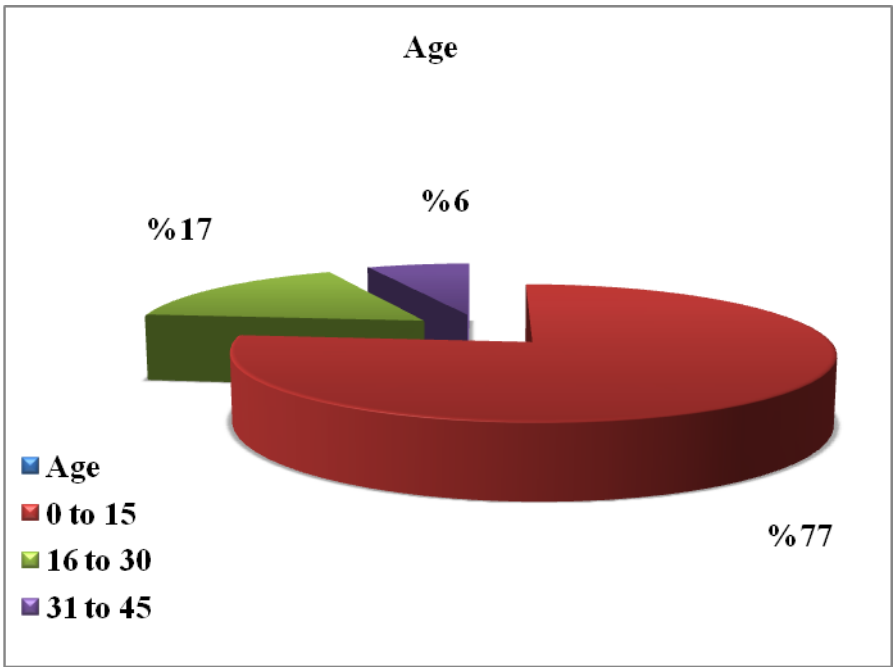

Figure 1: the distribution of the participants upon age group.

Table2: the distribution of the participants by Gender.

Gender	Frequency	Percentage
male	18	60.0
female	12	40.0
Total	30	100.0

Demographics: 76.7% of patients were aged 0–15 years; 60% were male as seen in table1 &2.

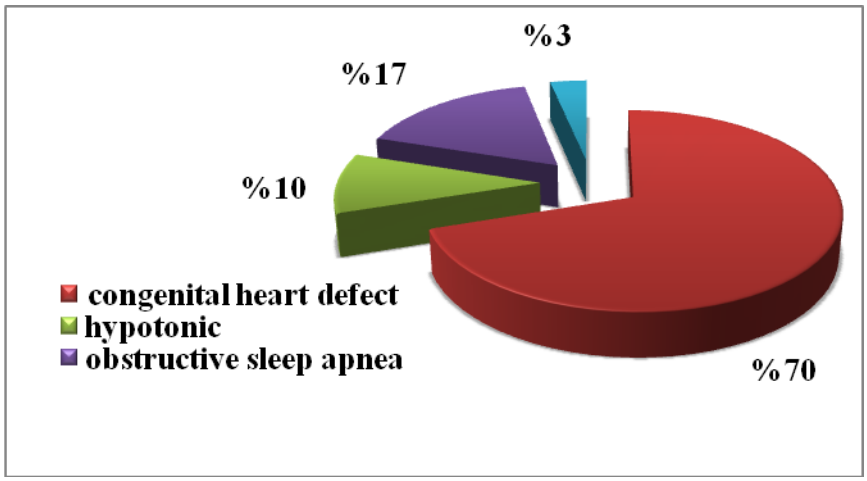

Figure 2: Distribution of patients according to the presence of any other disorders.

Comorbidities: 70% of the participants had congenital heart defects, 17% obstructive sleep apnea; 16.7% had obstructive sleep apnea, 10% were hypotonic and 3% were suffring from other medical conditions as shown in figure 2.

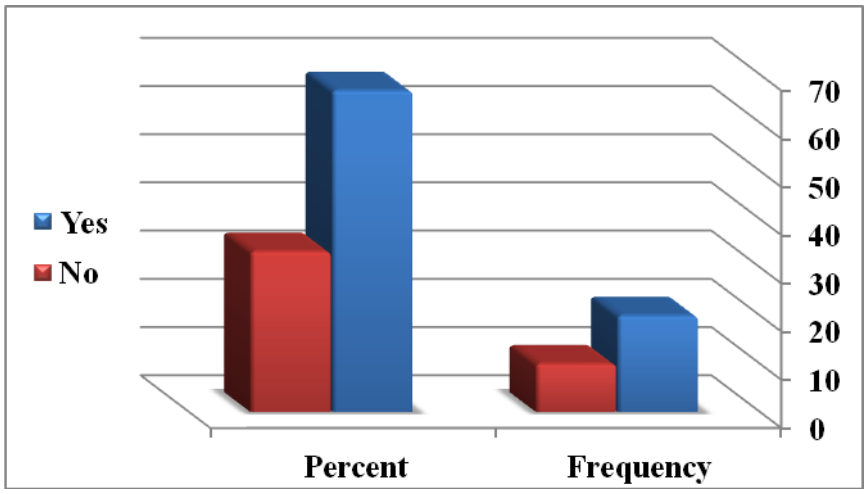

Figure 3: Distribution of patients according to pre-anesthesia assessment.

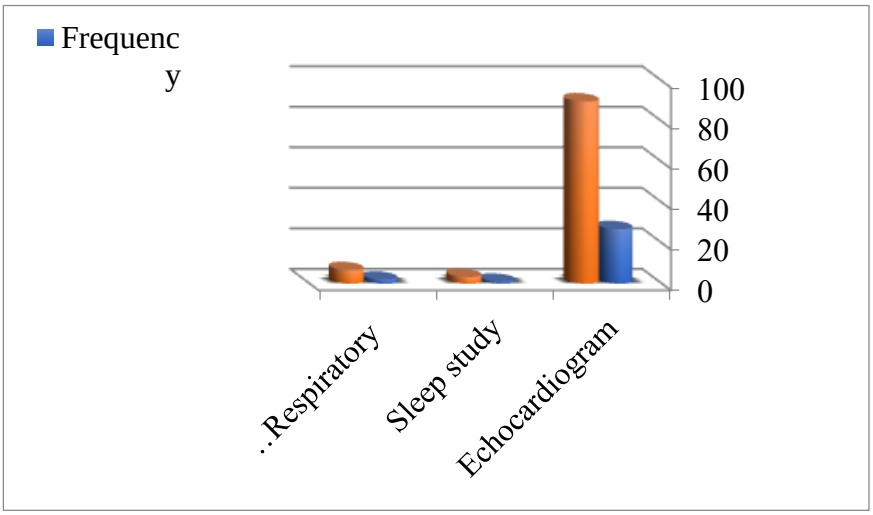

Figure 4: Distribution of patients according to any surgical evaluation was performed.

Preoperative Evaluation: 66.7% of patients underwent pre-anesthesia assessment as shown in figure 3 ; 90% of patients echocardiograms was done for them and respiratory evaluation was done only for 6.7% of them, while 3.3% of all patients sleep study was done to them before surgery as shown in figure 4.

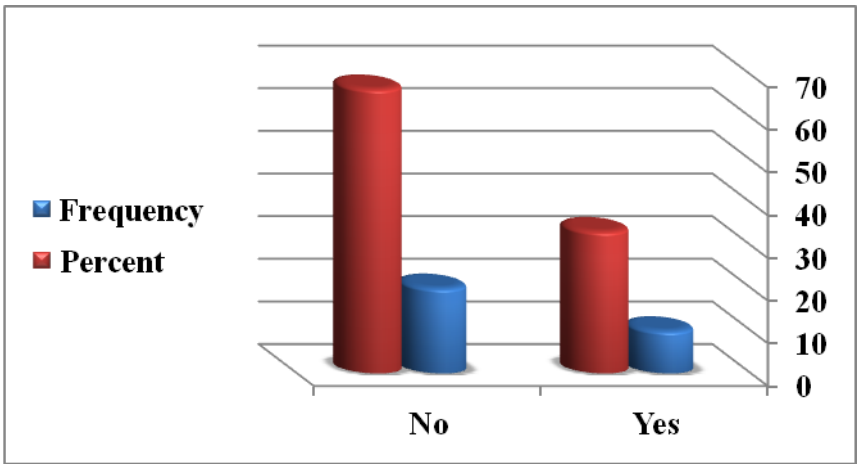

Figure 5: Distribution of patients according to the medications received before surgery.

Figure 5 shows that 66.7 of patients didn't receive any medications before surgery and 33.3% they received medications before surgery.

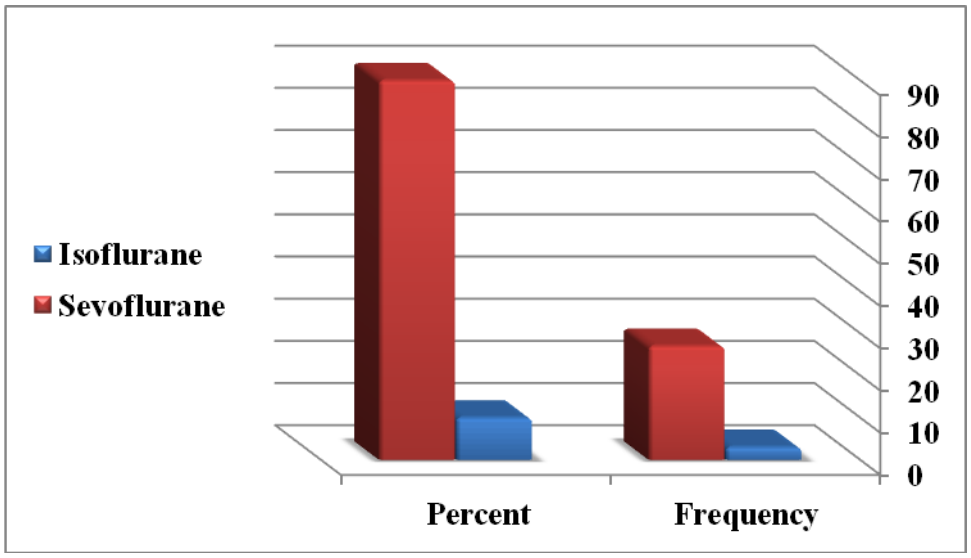

Figure6: Shows the distribution of patients according to the type of inhalation anesthesia given

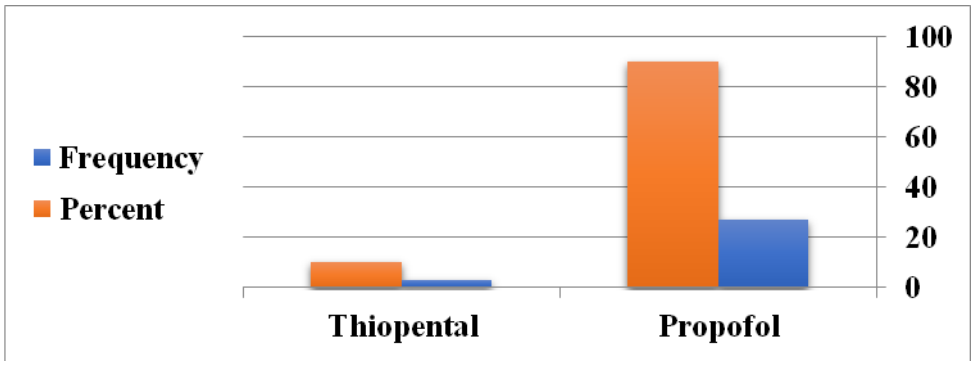

Figure 7: Distribution of patients according to the type of intravenous anaesthesia given.

Anaesthetic Agents: Sevoflurane (90%) and propofol (90%) were predominantly used as inhalational and intravenous anaesthetic drug respectively as shown in figure 6 & 7.

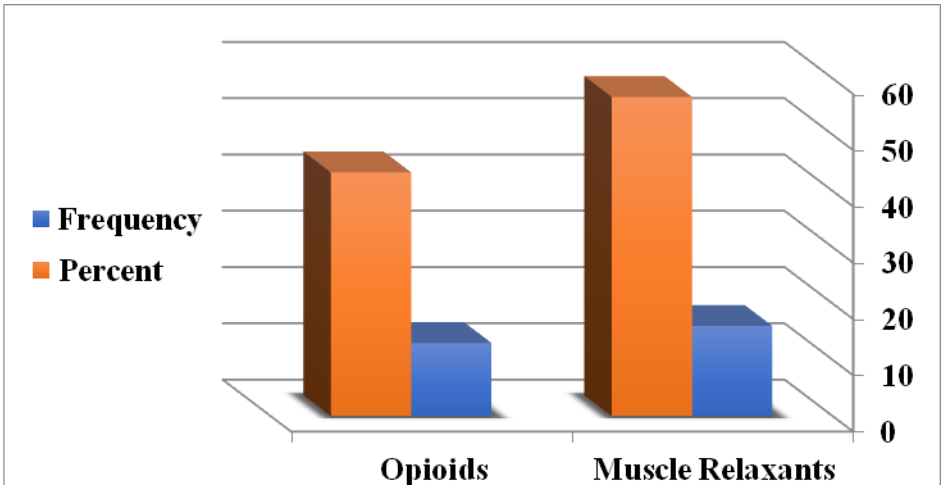

Figure 8: Distribution of patients according to drugs used during induction.

57% of patients received muscle relaxant during induction & 43% received opioids as shown in figure8.

Table 3: Shows the distribution of patients according to any difficulties in intubation during the operation.

Were there any difficulties with intubation during the procedure	Frequency	Percentage
yes	13	43.3
no	17	56.7
Total	30	100.0

Regarding presence of any difficulty in intubation during operation 34.3% of patients were difficult to be intubated as shown in table3.

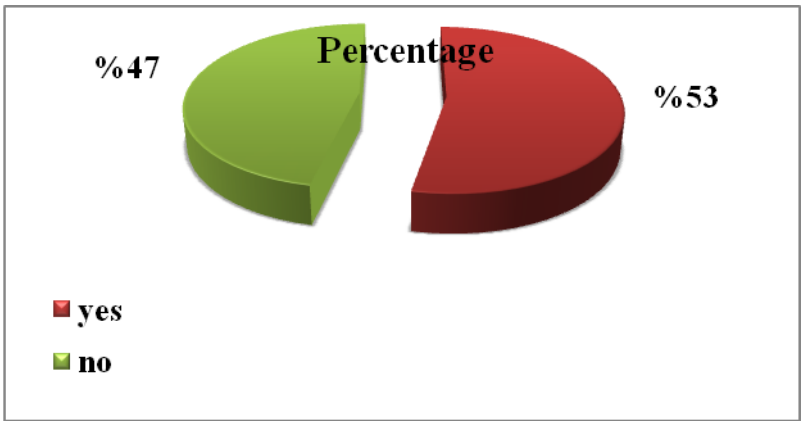

Figure9: Shows the distribution of patients according to if a combination of anaesthetic agents given or not.

Nearly half of patients under the study, combination of anaesthetic agents were used during operation as shown in figure9.

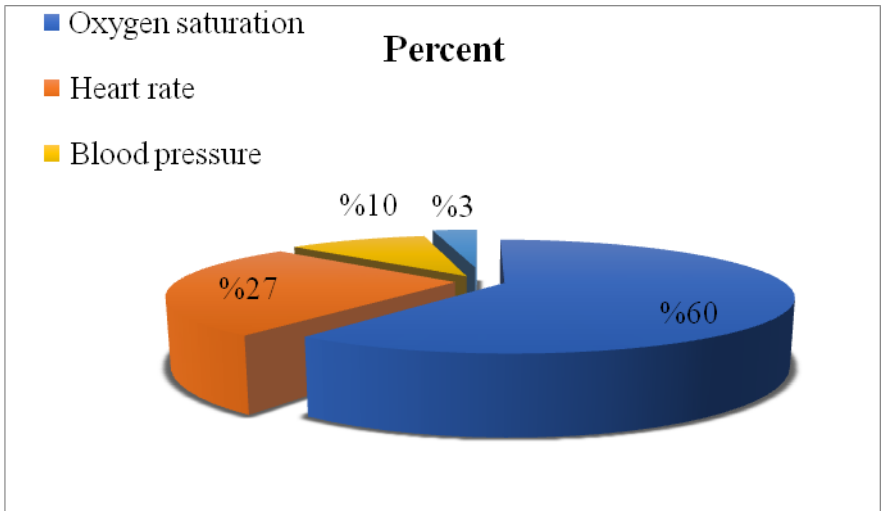

Figure 10: Shows the distribution of patients according to the monitoring of O2 saturation, heart rate, blood pressure, or end-tidal CO2 during surgery.

When we ask about monitoring during surgery, we found that 60% of patients, their O2 saturation were monitored and 27% of them their heart rate also was monitored, while 10% were their blood pressure was monitored, and only 3% of them the monitoring was done for end-tidal carbon dioxide as it's demonstrated in figure 10.

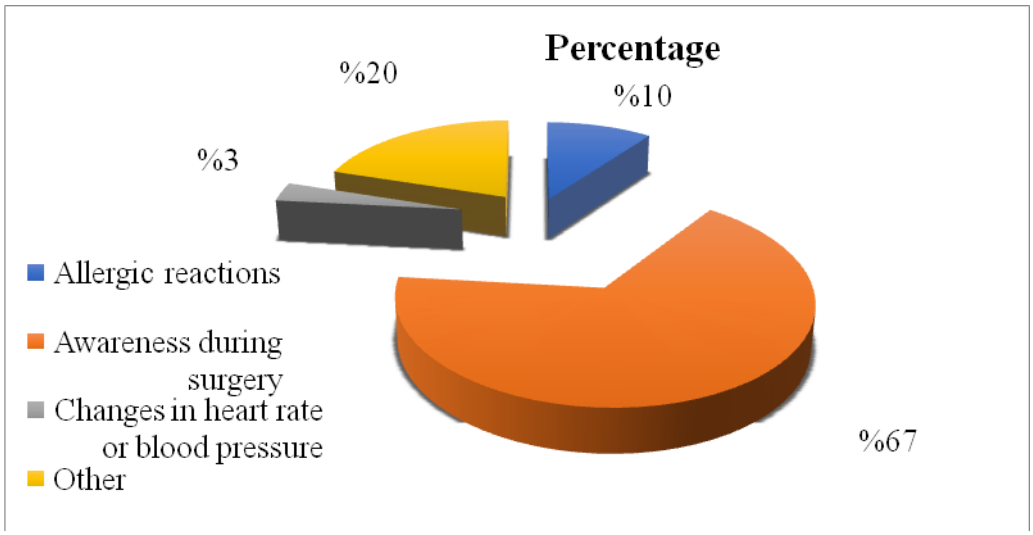

Figure 11: Shows the distribution of patients according to the occurrence of complications during surgery.

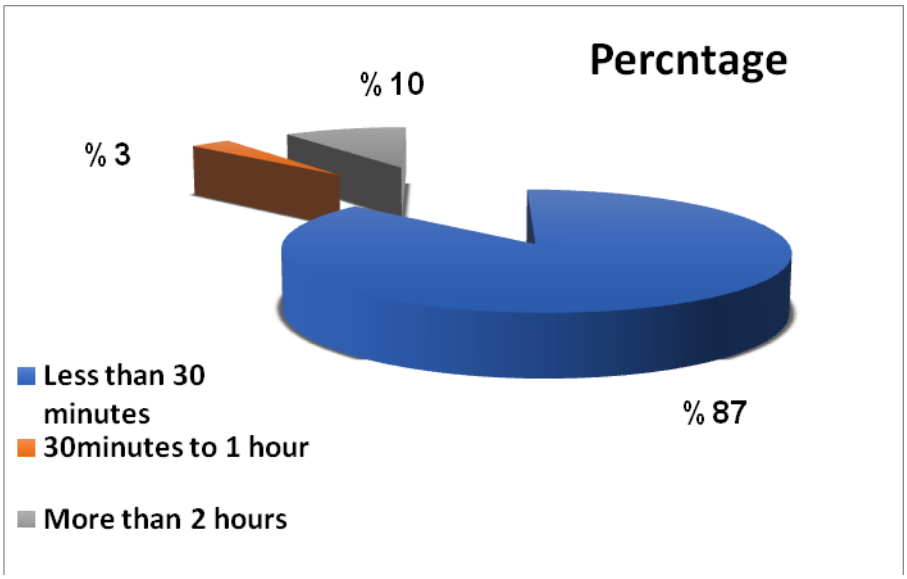

Figure 12: Shows the distribution of patients according to the time to regain consciousness.

Intraoperative awareness occurred in 67% of patients during surgical procedure, 10% had allergic reaction and 3% had changes in heart rate or blood pressure as that seen in figure 11, while figure 12 showing that 87% of patients under the study regain their consciousness in less than 30 minutes.

Table 4: Shows the distribution of patients according to the occurrence of any behavioral changes after surgery.

Did the patient experience any behavioral changes after surgery	Frequency	Percentage
yes	4	13.3
no	26	86.7
Total	30	100.0

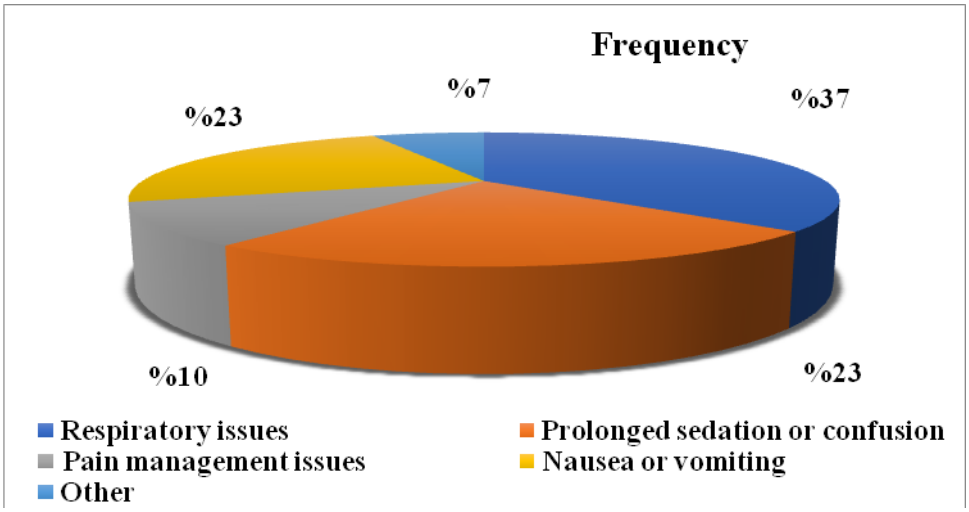

Figure 13: Shows the distribution of patients according to their exposure to any complications in the operating room.

Table 5: Shows the distribution of patients according to the any medical intervention during the recovery period.

Was any medical intervention required during recovery	Frequency	Percentage
yes	7	23.3
no	23	76.7
Total	30	100.0

Table 4 shows that 86.7% of patients were not suffering from any behavioural changes after surgery, and figure 13 telling us that 37% of patients experienced respiratory problem during operation, 23% had suffer either from nausea and vomiting or from prolonged sedation and confusion, while table 5 shows that 23.3% of patients need medical intervention during recovery.

Table 6: Distribution of patients according to the occurrence of any cardiovascular complications

Were there any cardiovascular complications	Frequency	Percentage
Bradycardia	7	23.3
Blood pressure instability	7	23.3
None	16	53.3
Total	30	100.0

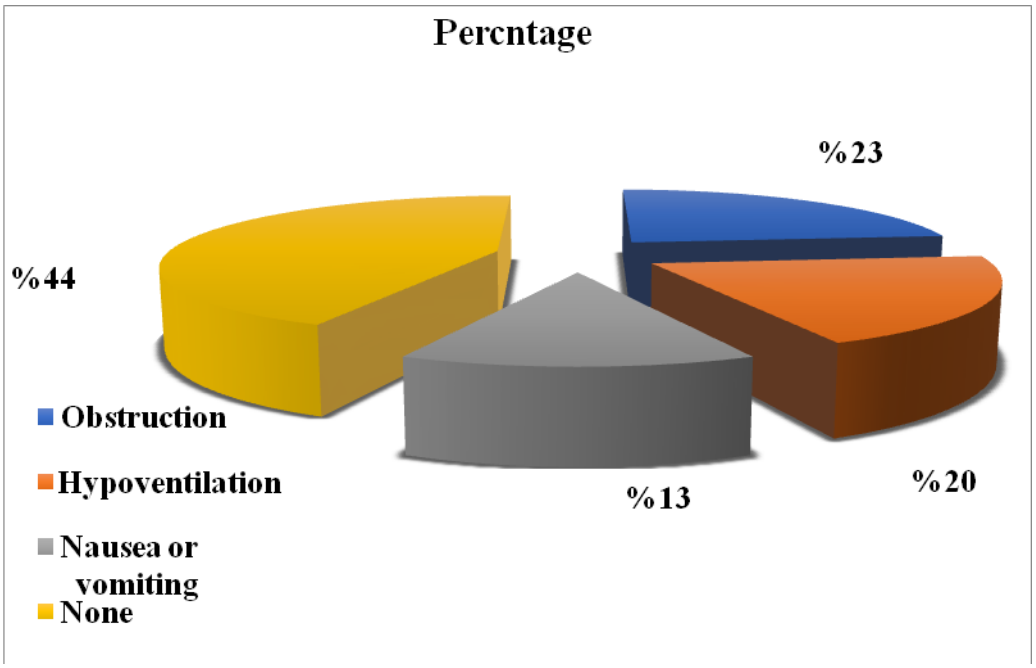

Figure 14: Shows the distribution of patients according to the occurrence of any respiratory complications.

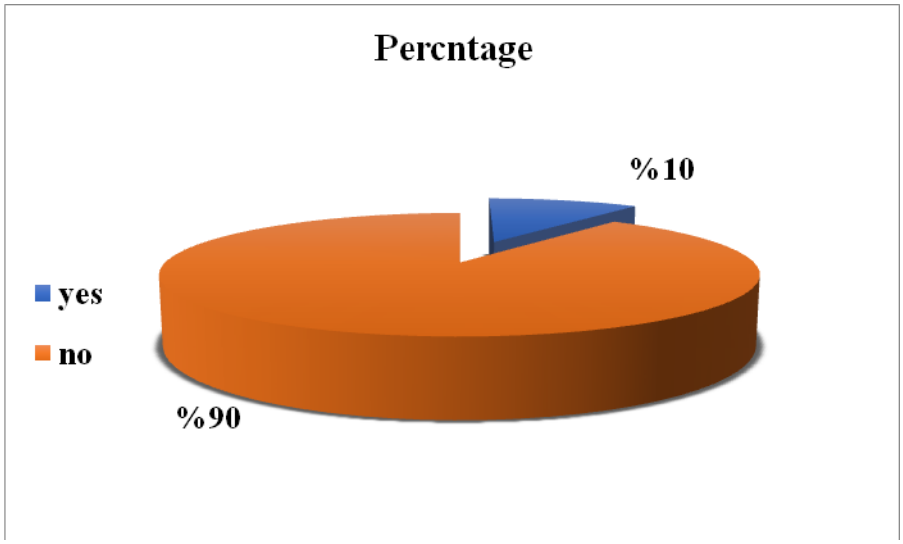

Figure 15: Shows the distribution of patients according to the occurrence of any neurological complications.

Table 7: Distribution of patients according to the occurrence of any musculoskeletal complications.

Were there any musculoskeletal complications	Frequency	Percentage
yes	7	23.3
no	23	76.7

Total	**30**	**100.0**

Table 8: Shows the distribution of patients according to whether any medical intervention was needed for those complications.

Was any medical intervention required for these complications	Frequency	Percentage
yes	**10**	**33.3**
no	**20**	**66.7**
Total	**30**	**100.0**

Regarding complications: table 6 shows that 53.3% of patients didn't experience any cardiac complication during or post anaesthesia, while 23.3% had bradycardia and the same percentage had blood pressure instability.

Airway obstruction was occurred in 23% of patients, and 20% of patients experienced hypoventilation as seen in figure14.

No neurological complications in 90% of patients, nor musculoskeletal complications in 76% of patients as that seen in figure15 & table 7 respectively.

Table 8 shows that 33.3% of patients require medical intervention to treat complications those occur during or post anaesthesia.

Discussion:

In this research we try to give valuable information regarding anesthesia-related complications in patients with Down syndrome in an under-resourced context, in Libyan hospitals. It highlights the unique risk profile regarding anesthesia-related complications that characterize DS patients that exists in consideration of their anatomical and physiological features and under the backdrop of systemic healthcare limitations.

The similarly high rate of congenital heart defects (CHD) in the population of interest (70%) supports global estimates that indicate that 40–60% of infants with DS have CHD (National Down Syndrome Society, n.d.). This comorbidity will play an important role in the anesthetic management, and supports further preoperative cardiovascular evaluation. Fortunately, 90% of patients in this study had an echocardiogram, representing awareness from participants about this serious risk factor.

On the other hand, other preoperative evaluations were clearly underutilized. Only 6.7% of patients had undergone any type of respiratory assessment, and only 3.3% had been evaluated with sleep studies, despite the established prevalence of obstructive sleep apnea (OSA) in patients with Down syndrome

(Aboud et al., 2023). It is alarming that 16.7% of the study population were diagnosed with OSA, which is known to compound the already complicated potential respiratory complications encountered during the perioperative period. Intraoperatively, awareness was reported in 66.7% of cases. This represents a remarkably high rate in this patient population, which may indicate another concern with respect to monitoring an adequate anesthetic depth. This may simply reflect inadequate equipment or training in anesthesia, as only 3.3% of patients were even monitored for end-tidal CO_2, which is used to assess ventilatory status and adequacy of anesthetic depth. This reinforces the need for improved intraoperative monitoring specific to the Down syndrome patient population.

In 43.3% of patients, intubation was difficult, which is consistent with the known anatomical issues with DS (i.e. macroglossia, subglottic stenosis) (Tsao et al., 2025). These results further demonstrate the need for airway management training and specific airway management protocol for anesthesiologists working in resource-limited settings. The anesthetic agents used (predominately sevoflurane and propofol) were appropriate for this population given their good histories in pediatrics and with patients with DS. Nonetheless, the relatively high use of muscle relaxants (56.7%) and opioids (43.3%) during induction are of concern in patients with hypotonia (10%) and those who are susceptible to respiratory depression.

Post-operative complications were also significant. Respiratory problems occurred in 36.7% of patients, which required intervention in 23.3% of patients while recovering. Cardiovascular instability was observed in 46.6% of subjects and included bradycardia and blood pressure irregularities. These results reaffirm the need for post-operative monitoring and create a foundation for developing autism-specific post-operative regimens. The absence of behavioral changes in 86.7% of subjects is promising, nonetheless, an investigation into the neurocognitive impact of anesthesia in this 13.3% is warranted.

In summary, this study shows clear gaps in perioperative care for DS patients in Libya, including inadequate preoperative assessments, limitted intraoperative monitoring, and insufficent postoperative care. Overall, these findings support a call for localized anesthesia guidelines and training programs tailored to address the needs of DS patients in resource limited contexts.

Conclusion and recommendations:

There is a considerable absence of Libyan medical literature related to anesthesia complications in patients with Down syndrome, which is an important knowledge deficit in understanding how best to care for this particular population. Although there may be general recommendations present in the international literature, when taking into account the unique context of the Libyan healthcare system, which includes resource limitations, the characteristics of the Libyan population, and difficulties within the Libyan healthcare system, there is clearly a need to conduct research in the Libyan

context which will improve perioperative outcomes for patients with Down syndrome in Libya. Research addressing this knowledge gap needs to take place in Libya, particularly as the prevalence of Down syndrome is relatively high in Libya and previous literature documents extensive preoperative and postoperative risks associated with perioperative risks for patients with down syndrome.

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