Original Article

Noise Levels During Laparoscopic Procedures In Operation Theatres: An Observational Study In A Tertiary Care Hospital In Southern India

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Abstract

Introduction: Noise pollution in operating theatres has deleterious effects on patient outcomes and staff performance. At the same time, the use of noisy technological equipment in operation theatres has increased in recent years. In light of this trend, it can be assumed that noise pollution in operating theatres remains challenging for patients and providers.

Objective: To measures noise levels during laparoscopic procedures in operation theatres of a tertiary care hospital in Southern India and compare them with the recommended standards.

Methods: In this cross-sectional observational study, the noise level in the operating theatre of a tertiary care hospital in Southern India during laparoscopic procedures was evaluated using a Decibel Meter from January 2022 and June 2022. Statistical analysis was done using descriptive statistics and one-way ANOVA.

Results: Noise levels between 73.68 dB(A) and 49.30 dB(A) during laparoscopic procedures exceeds national and international recommended standards. The highest noise level is observed in the extubation phase of laparoscopic surgery, followed by the surgery and induction phases.

Conclusion: Prolonged exposure to high levels of noise during laparoscopic procedures in operating theatres is a hazard to surgeons, anesthetists, personnel, and patients. Government, healthcare professionals, and other agencies should discuss guidelines for improving measures to reduce noise in operation theatres.

Keywords: Laparoscopic surgery, Noise pollution, Operating rooms, Southern India

INTRODUCTION

The deleterious effects of noise levels on individual health and work performance have evoked considerable attention in recent years. Noise pollution is defined as undesired or unwanted sound in the external environment. It is an irregular or arbitrary combination of sounds.[1] Noise is often measured on the dB(A) scale, a frequency-weighted tool that separates frequencies below 1 kHz.[2] Prolonged exposure to loud noise in everyday life may be a biological stressor with far-reaching physiological and psychological consequences. The adverse effects of noise pollution on humans include hearing loss, poor communication, emotional issues, and physical and psychological repercussions.[3] Likewise, excessive noise might negatively impact individual work efficiency. It can also cause an increase in intestinal activity, blood pressure, heartbeat, oxygen consumption, respiratory rate, and impaired sleep and behavior.[4]

Hospitals are one of the settings where high noise levels can significantly affect public health.[5,6] The patients and healthcare staff alike are subjected to a barrage of sounds. Notably, operation theatres are particularly susceptible to noise pollution.[7] Literature reveals a mean noise level in operating theatres of about 65–60 dB(A); however, some studies indicate noise levels above 100 dB(A).[8] Previous studies have shown that surgical instruments may expose patients and providers to high noise levels of 131 dB(A).[9-11] Moreover, noise exposure might elevate blood-based cortisol levels in operating surgeons, result in permanent hearing loss, or trigger cardiovascular disorders.[12-14] Besides, noise indirectly affects patients' health by reducing the quality of the surgeons' work.[15,16] In particular, research shows that intraoperative noise, among other factors, hinders the concentration of the operating team, eventually leading to postoperative difficulties (e.g., infections).[17-20]

Therefore, it is crucial to measure the noise levels in operating theatres and compare them to accepted standards to reduce noise pollution. Noise, however, may have varying effects on certain surgical phases. For instance, the operative phase of surgery is the most difficult for surgeons and produces the most cognitive workload.[21] Thus, evaluating the noise levels during different phases of surgery can provide a comprehensive understanding of the noise generated at each step. Further, to the best of the authors' knowledge, no studies have been done in India on noise levels in the operating rooms of hospitals, particularly during various laparoscopic procedures, a widely performed surgical technique. Therefore, this study aimed to measure the noise levels in the operating theatres during laparoscopic procedures in a tertiary care hospital in Southern India. Furthermore, obtained results were compared with recommended noise level standards.

MATERIALS AND METHODS

Study design, period, location, and approval

This cross-sectional observational study was conducted between January 2022 and June 2022 in a tertiary care hospital in Bangalore, South India. Noise levels of three laparoscopic procedures such as intraperitoneal onlay mesh (IPOM), laparoscopic cholecystectomy (LAP Chol.), and transabdominal preperitoneal (TAPP), were monitored. No identifiable patient/provider information parameters were used in data analysis. The study did not require approval from the Institutional Ethics Committee. Informed consent was waived due to the adopted research method.

Procedure

The noise level in the operating theatre of the hospital was monitored using the 'Mengshen Decibel Meter, Digital Sound Level Meter Handheld Audio Noise Meter Tester' with certain specifications on frequency range (31.5 Hz-8Hz), microphone (½ inch electric condenser microphone), sound range (40Db(A)-130 Db(A)), display (LCD 4 digits, measuring range 30-130 dB(A); +/- 1.5 dB Accuracy with 0.1 dB Resolution), calibration (electrical calibration with the internal oscillator) and ASIN: B01CZFCRA8.

For evaluation and measurement, the project executor calibrated the device every time before starting to measure. This was followed by placing the device at the top of the 'anesthesia machine', which was set at 2 feet from the patient's head and 3 feet from the floor. Data about the noise level measurement were gathered from the laparoscopic operation theatres when the surgical procedure was being performed, during three periods of 5 minutes (5 minutes at the start of the surgery, 5 minutes in the middle of the surgery, and 5 minutes at the end of the surgery). The middle of the surgery is the period just after the completion of the Induction Phase. The noise level was registered in dB(A) every second, and other details of such noise (conversations and music) were not noted. Noise recordings were made in one operation theatre at a time.

Statistical analysis

After transferring data to MS excel, data were analyzed using descriptive statistical tests using mean ± standard deviation in SPSS software version 22.0. A comparison of noise levels during the three surgical procedures and phases of surgery was performed using one-way ANOVA.

RESULTS

A total of 50 laparoscopic surgeries were observed, including three phases: induction, surgery, and extubation. Data were derived from 33 LAP Chol., 6 IPOM, and 11 TAPP surgery observations. The demographics of the data are shown in Table 1.

Table 1: Demographic characteristics

Surgery	Number of Observations (N = 50)	Frequency (%)
LAP Chol.	33	66
IPOM	6	12
TAPP	11	22

Table 2: One-way ANOVA results of maximum noise levels in the induction phase during laparoscopic procedures

Surgery	N	Mean	SD	F	p-value
LAP Chol.	33	70.06	2.345	.594	.556
IPOM	6	69.37	1.642		
TAPP	11	70.56	2.243		

Table 2 indicates the one-way ANOVA results of maximum noise-level measurements in the induction phase by type of laparoscopic surgery such as LAP Chol., IPOM, and TAPP. The difference in maximum noise levels in the induction phase by laparoscopic procedures was not significant ($F = .594$, $p = .556$).

Table 3: One-way ANOVA results of maximum noise levels in the surgery phase during laparoscopic procedures

Surgery	N	Mean	SD	F	p-value
LAP Chol.	33	71.99	1.948	.259	.773
IPOM	6	71.60	1.840		
TAPP	11	72.18	1.645		

Table 3 indicates the one-way ANOVA results of maximum noise-level measurements in the surgery phase by type of laparoscopic surgery such as LAP Chol., IPOM, and TAPP. The difference in maximum noise levels in the surgery phase by laparoscopic procedures was not significant ($F = .259$, $p = .773$).

Table 4: One-way ANOVA results of maximum noise levels in the extubation phase during laparoscopic procedures

Surgery	N	Mean	SD	F	p-value
LAP Chol.	33	73.68	1.450	4.77	.13
IPOM	6	71.68	2.234		
TAPP	11	72.95	1.487		

Table 4 indicates the one-way ANOVA results of maximum noise-level measurements in the extubation phase by type of laparoscopic surgery such as LAP Chol., IPOM, and TAPP. The difference in maximum noise levels in the extubation phase by laparoscopic procedures was significant (F = 4.77, p = .13).

Table 5: One-way ANOVA results of minimum noise levels in the induction phase during laparoscopic procedures

Surgery	N	Mean	SD	F	p-value
LAP Chol.	33	49.56	1.765	.197	.822
IPOM	6	49.75	2.158		
TAPP	11	50.04	1.658		

Table 5 indicates the one-way ANOVA results of minimum noise-level measurements in the induction phase by type of laparoscopic surgery such as LAP Chol., IPOM, and TAPP. The difference in minimum noise levels in the induction phase by laparoscopic procedures was not significant (F = .197, p = .822).

Table 6: One-way ANOVA results of minimum noise levels in the surgery phase during laparoscopic procedures

Surgery	N	Mean	SD	F	p-value
LAP Chol.	33	49.30	1.531	.383	.684
IPOM	6	49.83	1.632		
TAPP	11	49.86	1.399		

Table 6 indicates the one-way ANOVA results of minimum noise-level measurements in the surgery phase by type of laparoscopic surgery such as LAP Chol., IPOM, and TAPP. The difference in maximum noise levels in the surgery phase by laparoscopic procedures was not significant (F = .383, p = .684).

Table 7: One-way ANOVA results of minimum noise levels in the extubation phase during laparoscopic procedures

Surgery	N	Mean	SD	F	p-value
LAP Chol.	33	51.13	2.413	.541	.586
IPOM	6	52.10	2.784		
TAPP	11	51.58	2.051		

Table 7 indicates the one-way ANOVA results of minimum noise-level measurements in the extubation phase by type of laparoscopic surgery such as LAP Chol., IPOM, and TAPP. The difference in maximum noise levels in the extubation phase by laparoscopic procedures was not significant (F = .541, p = .586).

Table 8: One-way ANOVA results of maximum noise levels during different phases of laparoscopic surgery

Surgery	N	Mean	SD	F	p-value
Induction	50	70.09	2.238	34.10	.000
Surgery	50	71.99	1.845		
Extubation	50	73.28	1.666		

Table 8 indicates the one-way ANOVA results of maximum noise-level measurements by phase of laparoscopic surgery, such as induction, surgery, and extubation. Maximum noise levels between phases of laparoscopic surgery in the operation theatres surgery were found to be significantly different (F = 34.10, p = .000).

Table 9: One-way ANOVA results of minimum noise levels during different phases of laparoscopic surgery

Surgery	N	Mean	SD	F	p-value

Induction	50	49.69	1.764	15.12	.000
Surgery	50	49.49	1.507		
Extubation	50	51.35	2.359		

Table 9 indicates the one-way ANOVA results of minimum noise-level measurements by phase of laparoscopic surgery, such as induction, surgery, and extubation. Minimum noise levels between phases of laparoscopic surgery in the operation theatres surgery were found to be significantly different ($F = 15.12$, $p = .000$).

DISCUSSION

Long-term noise exposure in operating theatres has negative physical and psychological ramifications. The results showed a noise level between 73.68 dB(A) and 49.30 dB(A) during the three surgical procedures, which is considerably greater than the allowable levels recommended by the World Health Organization (WHO) and International Noise Council. The International Noise Council[22] and WHO[23] have suggested that noise levels in hospital surroundings should be 35-40 dB(A) during the day and 30-40 dB(A) in the evening. Working in extreme conditions while exposed to noise levels exceeding those standardized parameters established by laws or agencies such as the WHO can delay patients' recovery and impair healthcare professionals' performance.[24-26]

A study by Giv et al.[27] revealed that orthopedic procedures cause the most noise pollution, whereas laparoscopic and cardiac surgery procedures cause the least. However, the present study results add to this existing literature and indicate that even noise levels in operating theatres during laparoscopic procedures exceed the recommended maximum noise levels in operation theatres. Corroborating these findings, Tsiou et al.[16] reported a noise pollution level index in laparoscopy surgery (internal injuries) of 61 dB(A).

Noise levels were unstable in three phases of laparoscopy surgery, with the main surgery and closing extubation phases noisier than the initial induction phase. Maximum noise level is found to be higher in the last phase of surgery extubation, followed by the surgery phase and initial induction phase. Findings reveal a significant difference in maximum noise levels across the types of laparoscopic surgeries during the extubation phase of the laparoscopic procedure. Relatedly, results indicate a significant difference in the minimum and maximum noise levels during these three phases of laparoscopy surgery. These findings are consistent with earlier studies that found increased noise levels during surgical procedures or exceptionally high noise pollution in the last phase of surgery.[16,17,28] Additionally, the main effect of noise on staff was found to be impaired concentration and communication. Previous research evaluating the effect of noise in operation theatres reported that communication was the factor most adversely affected.[15] Because miscommunication is one of the most commonly identified causes of adverse events and medical errors, noise pollution in operation theatres has to be addressed with prime importance.[7]

The strength of the study includes a comparison of noise levels during different laparoscopic surgeries at different phases with recommended noise levels by different organizations. However, it could not include that other tasks and off-task distractions that could influence noise. Also, the study did not measure the concentration/distraction of the surgical team or the surgical performance during laparoscopic surgeries. The measurements included in the present study were limited to laparoscopic procedures conducted in a tertiary care hospital in India. Further research is required to evaluate noise levels in operation theatres across various surgeries in other hospitals.

Thus, the findings suggest that daily exposure to noise by the laparoscopic surgical team should be kept as low as possible. This could be achieved by providing noise barriers, boosting the absorption of ceilings and walls, implementing practical standards, or reducing the time professionals are exposed to. Thus, a multidisciplinary approach may be required to eliminate unwanted noise in operating rooms. Future research can focus on locations where equipment was installed, time of measurement, measurement height from ground level, and measurement period to improve hospital noise assessment.

CONCLUSION

In conclusion, this study offers comprehensive knowledge of noise levels in a tertiary care hospital in South India, albeit from an operating theatre perspective. The study highlights that noise levels in operating theatres deserve special attention from planners and policy-makers since noise can impair the performance of medical professionals and aggravate the health issues of both patients and providers. Future research can explore the physical and psychological consequences of noise levels during laparoscopic surgeries from the perspectives of patients and operating room staff.

DECLARATION

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Conflict of Interest: Nil

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