Noise and the Anaesthetic Team

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SUMMARY

It is known that excess noise in the workplace can interfere with communication, and when sustained or extreme, can be associated with hearing loss. The environment in which the anaesthetic team work requires concentration and effective communication to ensure the safety of the patient. This study investigated the possibility of the interference of noise within the anaesthetic environment and the risk for noise induced hearing loss with noise levels reaching up to117dB. The results of the study suggest that the noise levels within the anaesthetic environment can cause interference with communication and care should be taken in some areas to reduce the risk of noise induced hearing loss.

INTRODUCTION

The effects of noise in the operating theatre and associated work areas in which anaesthetics are provided have always been an area of concern for the anaesthetist during the induction and emergence of anaesthesia for several reasons. Hearing is said to be the last sense to be suppressed on induction and the first to return on emergence during anaesthesia. Additionally the importance of communication between the anaesthetist and the anaesthetic technician during the anaesthetic intervention cannot be overstated. Impaired communication can lead to a breakdown in teamwork with the potential for patient safety being compromised during an anaesthetic. Increased concentration required when listening to equipment activation indicated by noise, tones or alarms can lead to an increase in fatigue. Excess noise can also cause noise induced hearing loss.

METHODS

Palmerston North Public Hospital Department of Anaesthesia provides anaesthesia for ten surgical specialities within the main operating theatre and anaesthesia in four remote areas within the hospital. From January 2008 until June 2008 data was collected from these areas to assess the noise levels to which the anaesthetic team were exposed.

Noise levels were monitored using either a Quest Electronics Model M28 Noise Logging Dosimeter for the noise dose monitoring of the Anaesthetist and in the areas in which the anaesthesia was administered. A Tecpel 331 Sound level Meter was used for the more specific data following initial data analysis. The sound level meters were calibrated prior to, and at the completion of each recording. All testing was carried out utilising the guidelines of AS/NZS 1269:1 1998 (Occupational noise management Part 1 Measurement and assessment of noise immission to optimise the best possible locations and technique for the recordings).

Anaesthetists were given the Quest Electronics Model M28 Noise Logging Dosimeter to wear during the recordings throughout the list with the microphone being placed on their uniform in close proximity to their ear. During the same time a second Quest Electronics Model M28 Noise Logging Dosimeter was placed on the anaesthetic machine prior to the commencement of the list to record the noise levels within the area in which the anaesthetics occurred. These recordings were conducted and recorded using the dB(A) parameters.

Once all the dosimetery was completed a rapid scan analysis of the data was conducted to determine areas of interest that would require more specific data on the noise levels. A Tecpel 331 Sound Level Meter was used for this testing with the dB(A) weighting parameters being used. During the specific testing an event log recorded the particular activities to isolate the noise levels.

RESULTS

Initial noise levels were recorded during 15 episodes in which there was anaesthetist involvement during the period between Jan 2008 and Jul 2008. In total 37 noise level readings were recorded on graphs for the L_{Aeq} with an additional 25 noise levels being recorded as spot checks for the noise level only.

The noise levels within theatres prior to any case or occupancy were measured with the air-conditioning in operation and the noise levels ranged between 46-54 dB(A)

Sound levels within the unoccupied theatres with air conditioning in operation

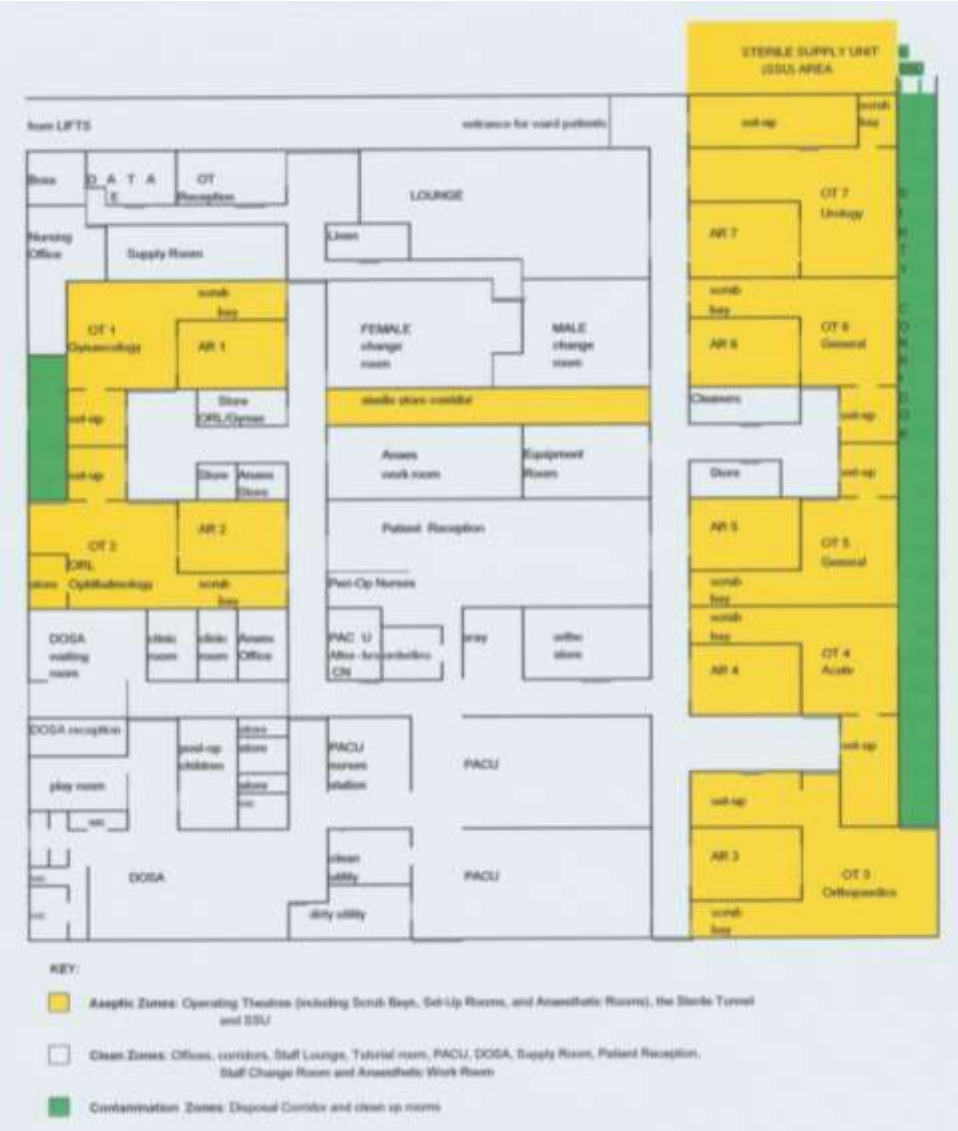
Theatre 1	46 dB(A)
Theatre 2	54 dB(A)
Theatre 3	46 dB(A)
Theatre 4	50 dB(A)
Theatre 5	54 dB(A)
Theatre 6	47 dB(A)
Theatre 7	48 dB(A)

Noise levels peaked during the routine checking of the anaesthetic machine, the surgical preparation for the procedure which often coincided with the induction of the anaesthetic. As expected noise levels increased with the use of the orthopaedic drills and saws, MRI scanning, Urology laser and lithotripsy. Minor fluctuations occurred throughout the procedure due to the anaesthetic monitor and ventilator, the dental drill, surgical diathermy and suction.

Noise readings from anaesthetic locations within Palmerston North Hospital

	ANAESTHETIST		ANAESTHETIC MACHINE	
AREA	Leq (Average)	Lmax	Leq (Average)	Lmax
Acutes OT4	75 dB(A) 4hrs	106 dB(A)	66 dB(A) 4hrs 40min	102 dB(A)
Dental OT5	73 dB(A) 3hrs 20min	105 dB(A)	70 dB(A) 4hrs	108 dB(A)
ENT OT2	69 dB(A) 4hrs 20min	105 dB(A)	68 dB(A) 5hrs	104 dB(A)
Eyes OT2	75 dB(A) 4hrs 20min	108 dB(A)	66 dB(A) 5hrs	105 dB(A)
General OT5	74 dB(A) 5hrs	107 dB(A)	69 dB(A) 5hrs 30min	110 dB(A)
LSCS OT1	75 dB(A) 5hrs	114 dB(A)	63 dB(A) 5hrs 20min	95 dB(A)
O & G OT1	72 dB(A) 2hrs 10min	105 dB(A)	73 dB(A) 2hrs 30min	108 dB(A)
OrthopaedicOT3	73 dB(A) 4hrs 30min	106 dB(A)	68 dB(A) 5hrs 30min	108 dB(A)
Urology OT7	68 dB(A) 5hrs 25min	105 dB(A)	69 dB(A) 5hrs 25min	108 dB(A)
Lithotripsy	76 dB(A) 4hrs 10min	111 dB(A)	79 dB(A) 4hrs 30min	117 dB(A)
ERCP	79 dB(A) 2hrs	113 dB(A)	65 dB(A) 2hrs	92 dB(A)
Dental Unit	78 dB(A) 3hrs 30min	106 dB(A)	74 dB(A) 4hrs 10min	108 dB(A)
MRI Scanner	85 dB(A) 3hrs 30min	100 dB(A)		
PACU	70 dB(A) 5hrs 20min	108 dB(A)		
Control	85 dB(A) 2hrs 25min	110 dB(A)	81 dB(A) 2hrs 25min	112 dB(A)

Map of Palmerston North Public Hospital's Operating Theatres



Source Palmerston North Public Hospital

Upon the completion of the initial sound level recordings, an assessment of the results identified areas in which a more detailed noise assessment was required to be undertaken. These areas included the following

Induction of anaesthetic. General conversation noise 70dB(A), moving of certain equipment (bowl stands with empty metal bowels 74dB(A)), Scrub bay running water 67dB(A) , intercom 75dB(A), set up of equipment 93dB(A) along with accidental dropping of metal trays onto metal setup trolleys (not recorded during testing)

Conclusion of anaesthetic-General conversation noise 73dB(A) Removing equipment 81dB(A)

Machine check-disconnection of the pipeline gasses 100-105dB(A)

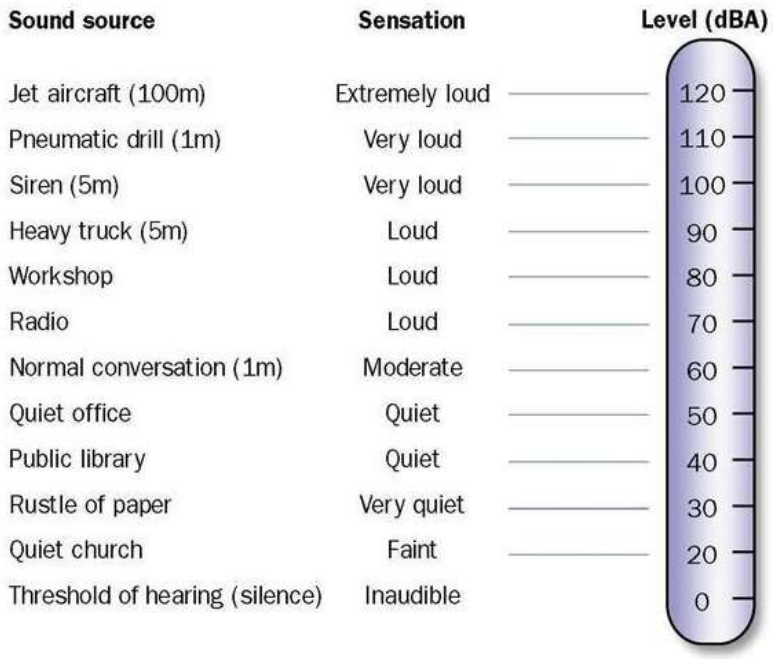
Lithotripsy-ESWL shock waves 102dB(A)

MRI-no access to the scanning room with the monitor due to the magnetic field however the initial testing with the microphone through a wall duct indicated an Lmax of 100dB(A)

Orthopaedic Knee joint replacement-Drilling and sawing of the bone for the prosthesis 85-92 dB(A)

Urology-laser operation of the lithocast laser continuous background fan noise 65-70dB with operation of laser 75-80 dB(A)

A comparison of similar noise levels



Source Hamilton City council

DISCUSSION

Although we hear it or say it on a regular basis “Can you keep the noise down please” little can be found about the noise within the anaesthetic environment.

A search of Medline using the keywords-noise, anaesthetics and operating theatre produced limited results.

Jones (1986) conducted studies using the auditory-evoked potential as a method of determining the depth of anaesthesia. This study reported that the sense of hearing is the last sense to be lost during the induction of anaesthesia and the first sense to return when the patient awakens. This would indicate the need for minimal noise during these times allowing a calm, relaxing experience for the patient.

It is noted by Kam(1994) that noise levels vary throughout the day with the noisiest times on the wards being late afternoon and early evening and that it is in fact the staff who are the major source for the noise during these periods. During anaesthetic procedures it was noted

that staff were noisiest during the setup and conclusion of the procedure and it was during these times that they were frequently required to be reminded to keep the noise levels down.

The current standard AS/NZS 2107 2000 (Acoustics – Recommended design sound levels and reverberation times for building interiors) recommends design criteria for conditions affecting the acoustic environment within occupied spaces and is not intended for use in evaluating occupancy noise. The recommended design sound level, L_{Aeq}, dB for theatres unoccupied states:

"40dB(A) as satisfactory and the maximum at 45dB(A)"

Therefore the unoccupied theatre should be less than 45dB(A) prior to any occupancy to reduce any ambient noise interfering with the working area. Once the theatre is in operation, with air conditioning and monitoring, the background noise levels increase. The noise levels within the operating theatres ranged between 46 and 54dB(A), it is expected that without the air-conditioning that the noise levels within the empty theatre will be below the maximum 45dB(A) that is recommended.

Health and Safety in Employment Regulations 1995: Regulation 11 set out the parameters of the noise levels at work and states that no employee is exposed to noise above the following levels:

A noise exposure level, L_{Aeq} 8hr of 85 dB or equivalent

And a peak noise level, L_{Peak}, of 140 dB unweighted

Although this regulation states a noise exposure level of, L_{Aeq} 8hr of 85 dB(A) it also applies to equivalent noise levels of higher dB but with less time exposure.

Equivalent noise level/exposure time

85dB(A)	8hrs
88dB(A)	4hrs
91dB(A)	2hrs
94dB(A)	1hr
97dB(A)	30min
100dB(A)	15min
103dB(A)	8min
106dB(A)	4min
109dB(A)	2min
112dB(A)	1min
115dB(A)	30sec

Accordingly, an exposure of 85dB for 8 hours is equivalent to an exposure of 106dB for 4 minutes.

It is unlikely that these levels will be exceeded in the operating room environment. In early studies for orthopaedic equipment, such as Holt (2003), the noise levels were high and of short duration. With the advances in technology since these studies the air powered equipment is now being replaced by battery powered equipment and there is little data about the noise from them but one presumes it should be. The changes have occurred due to the ease of operation of the equipment with the air hose no longer being in the field of operation

and infection control issues due to the equipment air flow over the surgical site rather than any issues with noise. Air powered surgical equipment is still in use and the noise levels from the disconnection from the driving gas have been reported at 105 dB (Nott(2003)) which is equivalent to the disconnection of the medical gases from the anaesthetic machine

The noise levels collected during the survey were within the Health and Safety Regulations in Employment 1995 guidelines for noise levels in the workplace. The Lmax levels, ranging between 92-114 dB, were detected during the anaesthetic session. The general background noise was the loudest during the setup phase of the procedure which coincided with the induction of the anaesthetic with levels reaching 93dB(A). The noise levels reduced once the surgical team settled into the procedure with the anaesthetic monitor and ventilator along with the surgical diathermy and suction causing the Leq to range between 63-79 dB. This required extra concentrate from the staff throughout the case to enable effective and safe communication. Fredrick (2005) noted as civilization has progressed the noise in our environment has also increased. The pathologic process, while not fully understood, is believed to involve outer hair cell damage. First as it progressively involves the outer cells of the cochlea and later the inner hair cells, finally the cochlea neurons may atrophy.

The Urology laser produced noise levels between 65-80 dB(A) which, although it does not exceed the levels for noise exposure, it is in operation for long periods and has the possibility to cause problems with communication and concentration with staff members. Staff members at Palmerston North Public Hospital reported the feeling of "tired ears" after the introduction of the laser which was investigated but the full report was unavailable (Health and Safety Unit PNPH)

Orthopaedic theatres are known for their noise levels during joint replacements (Nott (2003)), and the risk of noise induced hearing loss to the orthopaedic staff (Willett (1991)). Noise levels recorded during the knee replacement during the periods of drilling and sawing produced noise levels between 85-92 dB(A). This would cause some concern to the anaesthetic team but their exposure time tends to be of short duration (30sec to 120sec) and limited amount of repetitions per case.

The Machine check conducted prior to the start of the anaesthetic session produced an Lmax of 105 dB upon the disconnection of the medical gases from the pendant. Although the noise levels are of short duration and about 6 times per machine check, this combined with other noise exposure for the day, could lead to the cumulative noise exposure time being reached within the shift.

Conversations within the theatre occurred throughout all phases of the procedure. The levels during induction and emergence of the anaesthetic were at levels that could hinder communication with the anaesthetic staff as this is an area requiring effective communication with quiet, calm communication to reduce the stress levels throughout the procedures. As the patients hearing is the last sense to be suppressed one should also consider the appropriateness of the conversation during this time and also whether the conversation is across the room to another staff member.

Music that is played within the theatre environment varies in volume and can be distractive however it may be beneficial in patients that find music calming and has a relaxing effect but the music volume should be reduced once the patient is asleep to a level suitable for the staff working during the procedure.

Although areas such as the lithotripsy and MRI had high readings when the respective technology was in operation, these areas have already been identified as high risk and hearing protection is currently placed on patients throughout the procedure. It is available to the anaesthetic staff and the MRI and Lithotripsy staff ensures that staff entering these areas use the hearing protection. The use of hearing protection can of course, in itself, cause communication difficulties. There were also limitations with monitoring the noise levels within the MRI scanner due to the magnetic effects on the sound level monitor by the strong magnetic field produced by the MRI.

CONCLUSION

The noise levels were within the guidelines of the Health and Safety in Employment Act 1992 and Health and Safety in Employment Regulations 1995 (Regulation 11) however hearing protection should be considered for the disconnection of pipelines during the machine check and other identified areas that may be of concern. Consideration into the suitability of noise reducing headphones for the use with constant background noises to reduce that noise and improve vigilance without hindering conversation and intermittent noise of importance. Currently the MRI and Lithotripsy provide hearing protection for patients and staff working in the scanner and the treatment room, this would reduce the risk of hearing damage due to cumulative noise exposure. The appropriateness and noise of conversation during certain periods of the anaesthetics should be kept to a minimum to reduce the possibilities of difficulties with communication.

REFERENCES

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