

Noise Exposure During Minimally Invasive Benign Prostatic Hyperplasia Laser Surgery Procedures

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Abstract

Objective: To monitor the occupational noise exposure during minimally invasive benign prostatic hyperplasia (BPH) laser surgery procedures in the operating room.

Methods: A wireless noise level meter was used to monitor the noise exposure to the surgeon and patients during different BPH laser surgery procedures. The sound level were recorded during 180-W Photoselective vaporization of the prostate surgery (Realton Co., Beijing,China), 100-W Holmium laser enucleation of the prostate(HoLEP, VersaPulse Power-Suite, Lumenis Ltd),90-W HoLEP (Dahua Laser Co., Jiangsu, China) and 60-W HoLEP (VersaPulse Power-Suite, Lumenis Ltd). Maximum peak level and time-average decibel level were measured. State Anxiety Inventory (S-AI) scores of 37 surgeons from 5 hospitals after an 8-h working day for different laser surgery were recorded.

Results: The mean background sound levels in the operation room prior to laser surgery was 48dB within a range of 40~54 dB. A maximum sound level of 91 dB was recorded at level of surgeon' head during the working of 100-W HoLEP machine, while the mean decibel level was 85dB. Use of the 90-W HoLEP machines achieved the lowest mean decibel level (66 dB) recording both at level of surgeon's and patient's head. The sounds during 180-W PVP ranged from 60~77 dB at level of surgeon's head and 60~75dB at patients's head. The State Anxiety score was significantly higher in the 100-W HoLEP group compared with other groups ($P<0.05$).

Conclusions: Our data showed the noise exposure during minimally invasive benign prostatic hyperplasia procedures. A modified cooling system in 90-W HoLEP machine could effectively reduce the noised emitted by the laser generator. Surgeons may experience uncomfortable and anxiety after an 8h working day for HoLEP. Music and noised-induced headphones may help to reduce negative emotion.

Introductions:

Benign prostate hyperplasia (BPH) is the main etiology of lower urinary tract symptoms in elderly men ^[1]. Transurethral resection of the prostate (TURP) has been the "Gold Standard" treatment of BPH for many decades. As technology has evolved in the past few years, the rate of alternative minimal invasive surgical therapies (MISTs) including GreeLight photoselective vaporization of the prostate (PVP) and holmium laser enucleation of the prostate (HoLEP) have increased ^[2]. Several studies have determined comparable efficacy for MISTs and TURP ^[3, 4, 5].

On the other hand, occupational noise-induced hearing hazard in urologic procedure has aroused some attention. Long-term chronic noise exposure is considered associated with the risk of hearing impairment and loss of quality of life ^[6]. Due the necessity of cooling system in laser emitters, many surgeons may complain about the noise during the laser procedures. The aim of this study was to measure the nose exposure level to urologists and patients during BPH laser procedures.

Patients And Methods:

Two types of surgery procedures and four kinds of laser machine were monitored for noise exposure. In our center, 2 main minimally invasive surgical options exist for BPH in accordance with the clinical practice guidelines [7]. Large volume of prostate (glands over 80g) was triaged to HoLEP consistent with practice norms. The following laser device were included: 180-W Photoselective vaporization of the prostate surgery (Realton Co., Beijing,China), 100-W Holmium laser enucleation of the prostate(HoLEP, VersaPulse Power-Suite, Lumenis Ltd),90-W HoLEP (Dahua Laser Co., Jiangsu, China) and 60-W HoLEP (VersaPulse Power-Suite, Lumenis Ltd). A digital sound meter (Sauter Ltd., German) was positioned by the surgeon's ear (1.5m from the device) and at the patients' head (4m from the device) during each procedure for 2 minutes. Maximum peak level and time-average decibel level were measured. Also, the background noise level in the operation room prior the surgery was also recorded. All the surgery was performed in the same room. Meanwhile, 37 surgeons from 5 hospitals were enrolled in this study and asked to respond to the State-Trait Anxiety Inventory (S-AI) scores after an 8-hour working day for different laser surgery. All methods were carried out in accordance with relevant guidelines and regulations or the 'Declaration of Helsinki'.

Statistical Methods

Statistical analysis was performed using the Statistical Package for Social Sciences, version 22.0(IBM Corp., Armonk, NY). Continuous variables were described as means and standard deviation or as median value plus range. Continuous variables were analyzed using a one-way analysis of variance (ANOVA). All statistical tests were 2-sided, and the statistical significance was set at $P < 0.05$.

Results:

As showed in Table 1, the mean background sound level in the operation room prior to laser surgery was 48dB within a range of 40~54 dB. Sound level measurement during the procedure of 4 laser machines are also detailed. A maximum sound level of 91 dB was recorded at level of surgeon' head during the working of 100-W HoLEP machine, while the mean decibel level was 85dB. Use of the 90-W HoLEP machines achieved the lowest mean decibel level (66 dB) recording both at level of surgeon's and patient's head. The sounds during 180-W PVP ranged from 60~77 dB at level of surgeon's head and 60~75dB at patients's head. Use of the 60-W HoLEP was associated with the second highest decibel level recordings. There was almost no difference of sound level between the level of surgeon's and patient's head. The average working time in our institute of different devices was also showed in Table 1.

Table 1
Decibel Measurement during minimally invasive BPH procedures

Laser Machine	Surgeon's head (Mean dB, range)	Patient's head (Mean dB, range)	working time
Control	48 (40~54)	50(42~55)	
180-W PVP	67(60~77)	65(60~75)	10~30min
100-W HoLEP	85 (80~91)	83 (78~90)	15~85min
90-W HoLEP	66 (58~80)	66 (54~80)	15~85min
60-W HoLEP	71(62~83)	70(61~83)	20~100min

Post-surgery State-Trait Anxiety Inventory scores of 37 surgeons were presented in Table 2. The State Anxiety score was significantly higher in the 100-W HoLEP group compared with other groups ($P < 0.05$). The Trait Anxiety score showed no significant difference among surgeons after 4 laser procedures.

Table 2
Post-surgery State-Trait anxiety Score of Surgeons

	180-W PVP	100-W HoLEP	90-W HoLEP	60-W HoLEP	P value
State Anxiety Score	38.0±7.9	43.4±9.2	38.1±8.6	42.5±8.3	0.001
Trait Anxiety Score	41.2±10.4	41.5±12.4	40.5±11.8	40.3±10.8	0.441

Discussion:

Due to the accelerating growth of aging population, the high BPH/LUTS prevalence has been a significant financial and medical burden to patients and society. In the domain of BPH surgery, the rate of TURP has been decreasing with an increase in minimally invasive surgical therapies (MISTs). Photoselective vaporization of the prostate (PVP), as a major laser surgery, was considered a safe and effective outpatient procedure due to several advantages including reduction of bleeding^[8]. Compared with PVP, HoLEP showed effectiveness at improving urinary parameters and associated with minimal postoperative discomfort^[9].

On the other hand, the concern for the surgeons' occupational health is rising. Occupational noise exposure is one of the main hazards and described according to European regulations in 2003^[10]. In these regulations, the occupational noise exposure should not exceed 87 dB and hearing protection was recommended above 85 dB. According to the standard set by the "Law of the People's Republic of China on Prevention and Control Law of Occupational Diseases", 8h of exposure to 85~90 dB is considered as slight harm to health. Long-term occupational noise exposure is considered to increase rates of noise-induced hearing loss. In terms of urologic operation, the evaluation of noise exposure during lithotripsy

procedure has been studied ^[11]. A maximum sound level of 83 dB with an average of 77 dB was recorded during SWL ^[12]. It seemed that the risk of hearing loss caused by the devices with high decibel levels was low due to the relatively short duration. However, it was estimated that the risk of noise-induced hearing loss would increase to 35% for workers with a 40-year exposure to 85 dB per 8-hour working day ^[13]. It was believed that the occupational noise exposure is an underestimated problem during the urologic procedures.

The noise produced by the laser machine was mainly from the cooling system. In our study, the relative high decibel level was recorded in the 100-W and 60-W holmium laser machine and the lowest average decibel was recorded in the 90-W holmium laser machine which is from a different manufacturer. The reasons for this difference lie in the theory of the refrigerator. The function of the compressor is to compress low temperatures and high pressures gas into high temperatures and high pressure gas, so that the steam volume is reduced and pressure is elevated, which is sent to condenser then. It condenses into low temperatures and high pressure liquid and throttled to be low temperatures and pressures liquid. The liquid is sent to evaporation and evaporated to be high temperature and low pressure gas. The cooling cycle is then completed when the gas is sent to the entrance of compressor. In the 90-W machine, the cooling system is modified. The evaporator is placed in the water tank and the water temperature can be dropped. The water is pumped and sent to the laser generator to take away the heat from xenon lamp. The effect of refrigeration is achieved by the hot and cold water exchange in the water tank. When this cooling system is not working, the main noise comes from pump. Noise comes from compressor and cooling fan when the system is working. Due to the low speed of fan, the noise will be controlled under relatively low decibel level. In the 100-W and 60-W laser system, when the water from pump comes into the laser generator, the working fan cool down the water temperature. The speed of fan should produce high rotation to take away the great heat, making a lot of noises at the same time.

The data also presented that the anxiety scores of surgeons who work with the 100-W HoLEP machine were higher than surgeons working with other laser machine, presenting that working in a noisy environment for an 8h working day directly make surgeons uncomfortable. Several studies showed the efficacy of music and noise –cancelling headphones during surgery would reduce unwanted ambient sounds and lower the anxiety and pain scores (VAS) ^[11, 14]. Thus, we believe that surgeons may benefit from the music therapy and headphones during the procedure.

Conclusions:

Our data showed the noise exposure during minimally invasive BPH procedures. A modified cooling system in 90-W HoLEP machine could effectively reduce the noise emitted by the laser generator. Surgeons may experience uncomfortable and anxiety after an 8h working day for HoLEP. Music and noise-induced headphones may help to reduce negative emotion.

Declarations:

Ethics approval and consent to participate

Institutional Review Board approval of Renji Hospital affiliated to Shanghai JiaoTong University, Medical school was obtained for the retrospective study and patient written informed consent was obtained.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Xia shengqiang and Tong zhen two authors contributed equally to this work.

Sun jie collected the data for manuscript.

Shi an wrote part of manuscript text.

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