EAS Journal of Anaesthesiology and Critical Care
Abbreviated Key Title: EAS J Anesthesiol Crit Care
ISSN: 2663-094X (Print) & ISSN: 2663-676X (Online)
Published By East African Scholars Publisher, Kenya
Volume-1 | Issue- 6| Nov-Dec-2019 |

OPEN ACCESS

Research Article

Can Preoperative Enhanced Temporal Summation Predict Postoperative Pain After Hernia Repair?

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Abstract: ***Aim:*** The aim of the study is to evaluate the effect of mechanical temporal summation on prediction of postoperative pain in open inguinal hernia repair patients. ***Methods:*** Twenty five male subjects undergoing open hernia repair were included in this prospective study. Vonfrey filament (#6.45) 180G was used to elicit mechanical temporal summation on volar aspect of the dominant forearm of all the patients preoperatively. First and last stimuli pain rating was assessed using 101 point numerical pain scale. mTs was presumed to be present if the value of the last stimuli is higher than the first (mTs $\Delta>0$). VAS for anxiety is used to assess the level of anxiety. Postoperatively, vas scores for pain and analgesic consumption were recorded. ***Results:*** Out of 25 patients, 20% showed mTs more than '0' ($\Delta>0$). Their pain scores both at rest and sitting and analgesic consumption are greater than the mTs ($\Delta=0$) no change patients which is statistically significant. ***Conclusion:*** Assessment of preoperative mechanical temporal summation is significantly correlated with the level of VAS scores both at rest and sitting. Analgesic consumption also considerably increased. Thus vonfrey filament is a simple, bedside tool for predicting postoperative pain and analgesic consumption.

Keywords: hernia repair, temporal summation, VAS, I vonfrey filament.

INTRODUCTION

Inguinal hernia is one of the commonly performed surgical procedures worldwide. The annual incidence of inguinal hernia in India is 19, 57, 850 and it is increasing continuously (Primatesta, P., & Goldacre, M. J. 1996). Pain after inguinal hernia repair is significantly high at its initial 24 hours period. 0-54% of this acute post-operative pain develops into chronic pain (Beldi, G. *et al.*, 2008). Chronic pain leads to increased direct medical cost by additional resources utilization and increased indirect costs through job absenteeism and loss of productivity.

Pain is a mutifactorial component which consists of physiological, emotional and behavioral factors and it is also influenced by genetic factors. Individual variability in any of these factors can lead to different pain perceptions as well as variable responses to pain management therapies. Hence identification of patients at risk of severe post-operative pain will allow more individualized and effective pain management. This approach will also prevent unnecessary treatment of low risk patients and thus reduce the risk of potential adverse effects of postoperative analgesic medications.

Diversity in pain perception is also evident in experimental pain assessment via Quantitative Sensory Testing (QST) which utilises static (pain threshold, suprathreshold) and dynamic (Temporal summation) pshychophysical measures. QST can be done using mechanical (pressure, punctate, vibratory, and light, touch) thermal (cold pain, warm and heat pain) or electrical stimuli.

Temporal summation is defined as the "increases in pain rating after repetitive stimulus at constant stimulus intensity". It is considered to be the correlate of wind up of second or third order neurons

Quick Response Code

Journal homepage:
http://www.easpublisher.com/easjacc/

Article History
Received: 23.11.2019
Accepted: 06.12.2019
Published: 23.12.2019

DOI: 10.36349/easjacc.2019.v01i06.004

reflecting central sensitization (Granot, M. 2009). Enhanced TS has been suggested as a possible factor involving changes at central level which may later lead to chronic pain. This prompted us to conduct a prospective study on the effect of mechanical temporal summation on prediction of acute postoperative pain after inguinal hernia repair.

MATERIALS AND METHODS

Twenty five patients of ASA I and II grade of age 18-60 years, posted for inguinal hernia repair under spinal anesthesia were selected for this prospective study. After obtaining hospital ethics committee approval, patients with BMI < 30 kg/m^2 and unilateral hernia were included. Bilateral hernia, complicated hernia, BMI > 30 Kg /m^2, coagulation abnormalities, history of chronic pain and any previous surgery were excluded.

On the day of pre anesthetic checkup, all patients were informed in detail about the 11 point VAS Visual analog scale (0 represent no pain; 10 represent worst imaginable pain); 11 point VAS –A (0 represent no anxiety; 10 represent highest anxiety); 101 point numerical pain scale (NPS) (0 represent no pain; 100 represent worst imaginable pain) and evaluation of mechanical temporal summation. Written informed consent was obtained.

Patients were premedicated with T.Alprazolam 0.25 mg and T.Ranitidine 150 mg orally previous night and on the morning of surgery.

On the day of surgery, in the holding area of operation theatre, mechanical temporal summation was evaluated with Vonfrey filaments (#6.45) 180 G on the volar aspect of the dominant forearm as previously described. Patients were asked to rate of the level of pinprick intensity using 101 point numerical pain scale from a single stimulus pin prick. Subsequently 10 repetitive stimuli at an interval of 1 sec were applied within 1 cm in diameter using the same filament. Subjects were asked to rate the intensity of the last stimulus. The magnitude of mTs was calculated as the difference between the last and first pain scores. mTs was presumed to be present, if the value of the last stimuli is higher than the first ($\Delta>0$). Patient with mTs ($\Delta>0$) belonged to Group – I; whereas patients with mTs ($\Delta=0$) belonged to Group II.

On arrival in operation theater, an intravenous line was secured and standard monitors were connected. Under standard aseptic protocol, spinal anaesthesia with 3ml of 0.5% bupivacaine was given at L_{3-4} space in lateral position. At the end of surgery, under sterile aseptic precautions ultrasound guided transversus abdominis plane block was given with 20 ml of 0.25% bupivacaine on corresponding side using (6-14 mHz) high frequency linear probe of sonosite II. Vital parameters were monitored continuously.

Post operatively, the pain scores were assessed at rest and (sitting) position using VAS at 6, 12, 24 and 48 hours. The anaesthetist performing mTS and anaesthetist involved in data collection were blinded.

The time taken for the first request of analgesia, total analgesic requirements upto 48 hours was recorded. Inj.Tramadol 1.5 mg /kg was given intra muscularly when VAS at rest was >4 or on patient demand. It was not repeated in less than 6 hours. If VAS was still more than 4, Injection diclofenac 50mg was given intravenously.

Statistical analysis was performed using IBM statistical package for the social sciences (SPSS).

RESULTS

Twenty five male patients were enrolled in this prospective study. Demographic parameters were comparable among all the patient as shown in Table – I. Out of 25 patients, 5 patients had mTs ($\Delta>0$) and then belonged to Group I. Remaining 20 patients had no change in mTs ($\Delta=0$) and they belonged to Group II. Duration of analgesia was longer in group II than group I (399.4 ±27.7 Vs 363 ± 14.5) which was statistically significant (<0.01).

Table 1. Demographic characteristics of patients

S.No	Variable	Group I	Group II	'p' value
1.	Age (year)	42 ± 10.4	39.3 ± 11.9	0.63 (NS)
2.	Height (cm)	160.2 ± 3.7	162.9 ± 4.1	0.20 (NS)
3.	Weight (kg)	71.0 ± 5.7	71.4 ± 8.6	0.92 (NS)
4.	BMI kg/m^2	27.69 ± 2.0	26.8 ± 2.69	0.54 (NS)

Values are expression mean ± SD (NS – Not Significant)

Group I patients had greater VAS scores both at rest and sitting upto 48 hours than group II patients which was statistically significant as shown in Table 2 & 3 and Fig. 1&2. Number of doses of Inj. Tramadol was greater in group I compared to group II which was statistically significant (<0.006).

Table 2. VAS at Rest

VAS (Hr.)	Group I mTs (Δ>0)	Group II mTs (Δ=0)	'p' value
6	3.8 ± 0.44	3.05 ± 0.22	<0.001 (S)
12	4.2 ± 0.44	3.7 ± 0.47	<0.04 (S)
24	4.6 ± 0.54	4.1 ± 0.44	<0.043 (S)
48	5	4.05 ± 0.39	<0.001 (S)

Values are expressed as mean ± SD. 'S' significant.

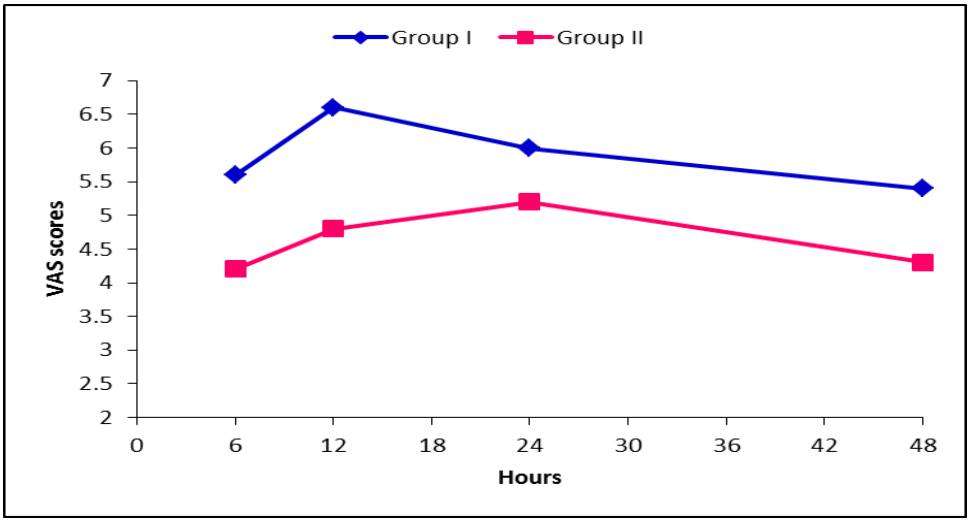

Fig.1. VAS at Rest

Table 3. Vas at sitting

VAS (Hr.)	Group I	Group II	'p' value
6	5.6 ± 0.54	4.2 ± 0.52	<0.001 (S)
12	6.6 ± 0.54	4.8 ± 0.69	<0.001 (S)
24	6 ± 1.2	5.2 ± 0.44	<0.031 (S)
48	5.4 ± 0.54	4.3 ± 0.73	<0.005 (S)

Values are expressed as mean ± SD. 'S' significant.

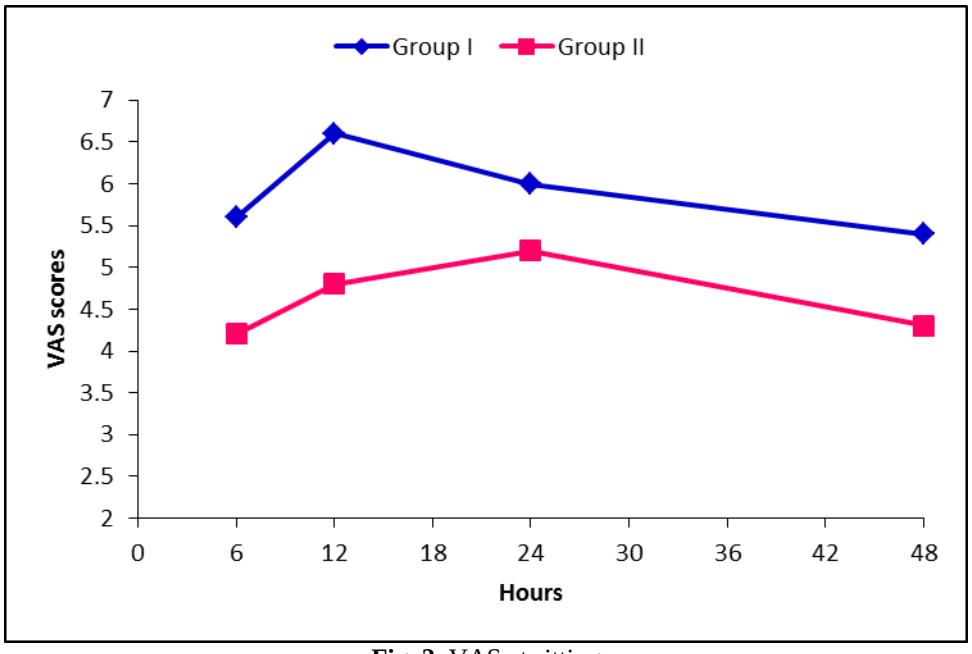

Fig. 2. VAS at sitting

DISCUSSION

The study demonstrated that the preoperative temporal summation assessment may predict the level of post-operative pain and analgesic consumption.

QST is a psychophysical test that investigates the functional state of somato sensory system by means of mechanical, thermal or electrical stimuli (Rolke, R. *et al.*, 2006). It enables the determination of nociceptive properties and non-nociceptive sub modalities of different groups of afferent nerve fibers and central pathways (Baron, R. *et al.*, 2012).

In 1835 Weber established a 2 point discrimination as a standard method to spatially differentiate 2 tactile stimuli from one another. In 1896 Vonfrey determine the tactile sensation of humans using horse or boar hairs of different stiffness and strength (von Frey, M. 1923). Now sets of filaments, made of nylon hair of all the same length but various diameter (#1.65 to 6.65) to provide range of force from (0.008 gm to 300gm) as available. Vonfrey monofilament is an inexpensive, easy to use, portable, diagnostic and research tool for pain experimental studies on animals and human. Calibrated monofilaments generate a reproducible buckling stress. The buckling force is inversely proportional to the length of the column and proportional to the cube of diameter. So that increasing the diameter of filament by a small amount, increase the buckling force considerably. Elicitation of repeated punctuate stimuli at one site as used in present study, may induce summation and sensitization in peripheral and central mechanism as noted by others, which should predict the post-operative pain.

Weissman Fogel *et al.*, (2009) found that enhanced temporal summation (TS) to both mechanical and heat stimuli are associated with greater provoked post-operative pain (POP) after thoracotomy. He used wide range of psychophysical tests like TS to heat and mechanical repetitive stimuli, pain threshold and suprathreshold pain estimation. He also found correlation between pain catastrophizing and POP at rest but no correlation was found between anxiety level and POP scores. In our study, mTS ($\Delta>0$) patients have high VAS scores both at rest and sitting. And the level of anxiety doesn't correlate with mTS ($\Delta>0$) patients. He also emphasized the role of central sensitization as a possible component determining pain after surgery which later determines the incidence of chronic pain.

Li, S. *et al.*, (2013) had found that the evoked mTs has clinical potential for identifying women at high risk of persistent post – caesarean section pain lasting at least 8 weeks. He also suggested the targeted analgesic care to high risk women.

Granot, M. *et al.*, (2003) assess heat pain threshold and magnitude estimation of pain scores for noxious stimuli on the day prior to caesarean section. He also stated that enhanced APOP is predicted by suprathreshold stimuli but not by pain threshold. Pain threshold represents the transition point between non painful and painful sensation, whereas suprathreshold painful stimuli closely mimics the clinical pain experience being at a level between threshold and tolerance.

Hsu, Y. *et al.*, (2005) reported the lower pressure tolerance, but not pain threshold is associated with pain intensity and morphine consumption in abdominal hysterectomy patients. This is in accordance with our study, that mTS ($\Delta>0$) patients have high requirements of analgesics compare to mTS ($\Delta=0$) patients.

In contrast, Aasvang, E. K. *et al.*, (2011) reported no significant correlation between electrical pain detection threshold and electrical pain tolerance to postoperative pain after groin herniotomy. He himself stated that using pain medication or methodological bias in eliciting electrical detection threshold might have obscured the data.

But Weissman fogel *et al.*, (2009) stated the advantage of dynamic psychophysical methods over static tests in identifying central augmentation of nocicetive input.

Pan, P. H. *et al.*, (2006) reported multifactorial preoperative predictors for pain intensity and analgesic requirements and he created cluster of predictors including pain threshold, pain intensity, unpleasantness, anxiety and pain expectation and scores of previous pain. He found that the thermal pain threshold in the lower back near the dermatome of surgical wound is the most important predictive factor for evoked pain and analgesic requirements. This is in accordance with Ortner, C. M. *et al.*, (2013) who found a correlation between mTS, preoperative scar hyperalgesia and postoperative pain scores at mobilization.

However Brandsborg, B. *et al.*, (2011) didn't find an association between wind up like pain, preoperative hyperalgesia or postoperative pain. This may be due to difference in method of eliciting mTs. We measured mTs as difference between last and first pain scores following pain stimulation. But Brandsborg measured final pain score only which doesn't allow for varying individual basal pain sensitivities to be accounted for. Limitation of our study is small sample size. A variety of QST to predict post-operative pain have been evaluated we selected mTs, as it is simple, rapid, and can be assessed bedside using Vonfrey filaments. Future studies should be done to identify whether this screening tool is helpful for other procedure also.

In conclusion, 20% of patient have enhanced mTs ($\Delta>0$) and have associated with increased postoperative pain and analgesic consumption.

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