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Original Research Article

Fear of needles does not influence pain tolerance and sympathetic responses among patients during a therapeutic needling

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ABSTRACT

Introduction: Dry needling is one of the therapies employed in pain medicine to reduce pain. However, no clear understanding exists as to whether there are differences in pain tolerance levels and sympathetic responses among individuals who have a fear of needles when compared to those who do not fear needling during dry needling treatment.

Aim: The main aim of this study was to investigate the differences in the pain pressure threshold and sympathetic changes among individuals who fear needling and those who do not fear needling during a sham dry needling procedure over a latent trigger point on the upper trapezius.

Material and methods: A cross sectional study was conducted in the Physiotherapy Outpatient Clinic at the University Teaching Hospital among 27 healthy subjects (12 subjects with needle phobia and 15 subjects with no fear of needles). Pain pressure threshold, blood pressure and heart rate were measured before and after the sham needling. The differences in the study variables between and within the groups were analyzed using a 2-way ANOVA.

Results: The results indicated no significant differences in pain pressure threshold ($P>.05$), blood pressure ($P>.05$) and heart rate ($P>.05$) between and within the two groups. However, the mean ($\pm$SD) value of pain pressure threshold showed an increased trend among those subjects with a fear of needles when compared to subjects who do not fear needling, -3.12 (± 1.20) and 2.97 (± 0.86), respectively.

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Conclusions: Individuals who exhibit a fear of needles showed no differences in pain tolerance and sympathetic changes when compared to those who do not fear needling during dry needling treatment.

1. Introduction

Musculoskeletal pain affects 85% of the general population,[34] and is a common complaint in primary care.[7] Myofascial trigger points (MTrPs) play a vital role in the pathophysiology of musculoskeletal pain.[31] MTrP is a hyperirritable spot and focal hyperalgesic contracture in skeletal muscles.[14] It was reported that MTrP could lead to a reduction in the pain pressure threshold of an individual.[23] Pain pressure threshold is the amount of pressure required to produce pain in a person.[38] Reduction in the pain pressure threshold causes the reduction of pain tolerance in a skeletal muscle with MTrP.[9]

Dry needling is one of the common invasive interventions used in treating MTrPs.[37] A systemic review has led to the conclusion that dry needling applied on MTrPs is an effective modality in reducing pain compared to no intervention at all.[37] Existing evidence showed that dry needling increased the pain pressure threshold of a muscle with MTrP.[16] An earlier study reported that dry needling reduced musculoskeletal pain significantly when compared with placebo needling (sham needling).[36] Thus, available evidence convincingly supports the thesis that dry needling reduces pain, increases pain pressure threshold and is superior to sham needling in pain reduction.[16,36,37] On the other hand, acupuncture, which also employs needles to treat patients, was also used to reduce pain.[17] Past studies on acupuncture indicated a significant reduction of pain after acupuncture therapy.[13] Thus, interventions such as dry needling and acupuncture which involve needles are commonly used therapeutically to reduce pain.[13,37] However, in clinical practice, when a clinician encounters patients scheduled for dry needling or acupuncture who exhibit a fear of needles, it is not clear how such fear might alter the pain threshold by either increasing or decreasing the pain tolerance of the individual. Therefore, this study aimed to investigate the difference in the pain pressure threshold between individuals who do not have a fear of needles and those who have needle phobia during a sham needling procedure performed over the latent trigger point of the upper trapezius.

According to the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV), approximately 10% of the world population were reported to have a fear of needles.[15,35] Past evidence showed that negative emotions such as fear, depression and anxiety could reduce the pain tolerance of an individual by increased pain perception toward noxious stimuli.[1,29] In addition, negative emotions resulted in an increased production of pain mediating substances such as bradykinin and substance P, which were reported to increase pain perception.[2] Therefore, this study hypothesized that those individuals who had a fear of needles presented with the reduced pain pressure threshold when compared to people without needle phobia during a sham needling procedure applied to the upper trapezius latent trigger point. To our knowledge, there were no reported studies that investigated the influence of needle phobia and its effects on the pain pressure threshold. It is our opinion that the understanding of how a fear of needles might influence the pain pressure threshold would be helpful to interpret the clinical outcomes after dry needling and acupuncture and also for the science of pain management.

A review performed by Sokolowski quoted that individuals with a fear of needles experienced an increased heart rate and blood pressure before needle puncture, followed by a sudden drop in both blood pressure and heart rate after needle puncture.[8,35] Preliminary evidence also proved that blood pressure and heart rate increased in response to sympathetic changes caused by fear.[3] Besides, Meagher et al. stated that fear influenced pain perception by reducing pain tolerance associated with autonomic arousal manifested through vasoconstriction and blood pressure.[21,27] Hence, this current study tested the second hypothesis that the vasovagal response during needling was higher among people who exhibited needle phobia when compared to individuals without any fear of needles. Thus in this study, the changes in blood pressure and heart rate were measured as variables of interest during a sham needling procedure.

2. Aim

The aims of this study were (1) to investigate the pain pressure threshold among subjects with a fear of needles; (2) to measure the sympathetic response (blood pressure and heart rate) among people with and without needle phobia; and (3) to compare the sympathetic response (blood pressure and heart rate) and pain pressure threshold between individuals with needle phobia and those without needle phobia before and after a sham needling procedure.

3. Materials and methods

3.1. *Subjects*

A total of 27 subjects (12 with a fear of needles and 15 without needle phobia) participated in this cross sectional experimental study. Pain pressure threshold, blood pressure and heart rate were measured before and immediately after the sham needling procedure. The subjects for this study were recruited from the Outpatient Physiotherapy Clinic at the University Teaching Hospital. The subjects who participated in this study were carers who accompanied the patients to the Physiotherapy Clinic. The inclusion criteria were as follows: (1) healthy subjects aged 20–40 years old, (2) without any musculoskeletal and systemic diseases, (3) not under any medications for hypertension, diabetes or any other diseases and metabolic syndrome disorders, and (4) presence of latent trigger point on the right upper trapezius muscle. The study methodology was

approved by the Research Ethical Committee of Universiti Kebangsaan Malaysia Medical Centre. All participants signed an informed consent form before their inclusion. At first, all subjects who participated in this study were interviewed for needle fear using Modified Traveler's Needle Fear (MTNP) questionnaire.[39] Based on the scores for the fear of needles, the participants were allocated to two groups: (1) individuals who have a fear of needles and (2) those without fear. MTNP questionnaire has a total score of 36. Participants who scored more than 18 were included in the needle phobia group, and those participants with a score of below 18 were assigned to the group without needle phobia.

3.2. *Procedure*

A qualified physiotherapist trained at trigger point therapy identified the latent trigger point on the upper trapezius. The therapists positioned the subjects in an upright sitting position on the chair with back support to palpate the upper trapezius muscle. The therapist stood behind the subjects and palpated the upper trapezius muscle for the presence of the trigger point. The identification of the upper trapezius latent MTrP was performed using the criteria proposed by Simon et al.[32] and Shah et al.[30] The criteria followed to identify the latent MTrP include (1) presence of a palpable taut band in the right upper trapezius muscle; (2) presence of a hyperirritable tender spot in the taut band; (3) local twitch response elicited by a snapping palpation of the taut band; and (4) presence of local tenderness in response to latent MTrP compression.[30,32] The identified MTrP on the right upper trapezius muscle was marked by the researcher.

Prior to the sham needling, pain pressure threshold, heart rate and blood pressure were measured among the subjects from both groups. Pain pressure threshold algometry (FPIX Algometer, Wagner's instruments, USA) was used to measure the pain pressure threshold of the latent trigger point of the right upper trapezius muscle for each subject. A systematic review[20] stated that pain pressure algometry was a common measurement tool to measure the pain pressure threshold of MTrP. Studies by Fischer revealed that pain pressure algometry has a high reliability in measuring pain pressure threshold.[10,11,12] During the procedure, the researcher placed the tip of an algometer probe made of rubber, 1 cm in diameter, over the marked latent MTrP at the right upper trapezius. The researcher applied gentle pressure over the trigger point and gradually increased the pressure to the point of the pain tolerance of the subject. Subjects were instructed to acknowledge the researcher by raising their left hand when pressure applied via the algometer changed into pain sensation. The transition point from pressure to pain was regarded as the pain pressure threshold which was recorded in units of kilograms. An average of three measures was taken as the final measure of pain pressure threshold.

Immediately after the pain pressure threshold measurement, blood pressure and heart rate were measured using an ambulatory blood pressure monitor (Automatic Blood Pressure Monitor BP760, Omron, USA). An ambulatory blood pressure monitor (ABPM) is a non-invasive tool used to measure blood pressure and heart rate.[6] The British Hypertension Society has published recommendations for the use and interpretation of ABPM in clinical practice for measuring blood pressure and heart rate of an individual.[24] During the blood pressure and heart rate measurement, the subjects remained in the same position as they had been in during the pain pressure threshold measurement. The cuff of the ABPM was wrapped around the right upper extremity 1 cm or 2 cm above the cubital fossa and the blood pressure and heart rate were measured once prior to the sham needling procedure. The blood pressure was recorded in units of millimeters of mercury (mm Hg) and the heart rate was recorded in beats per minute (bpm). The subjects remained seated with the cuff wrapped around their right upper extremities during the sham needling procedure in order to take the measurement immediately afterward. Sham needling was performed using the dry needling guide tube. Prior to the sham needling, the original dry needle (30 mm in size) used for dry needling was shown to all the subjects. All the subjects were informed that they would receive a dry needle puncture over the latent trigger point of the right upper trapezius. During the sham needling procedure the researcher stood behind the patients so that the subjects were not able to see either the needle or the guide tube. The sham needling was applied over the trigger point only with the guide tube without any needle. The guide tube was placed in contact with the skin of the subject and removed after 5 s as it is done during dry needling. In this study, the guide tube of the dry needle was used instead of a dry needle itself to give the subjects a sensation similar to that of dry needling and thus, the sham needling was performed. The guide tube was placed on the MTrP of the right upper trapezius to give the subjects an illusion that dry needling was performed on their right shoulder. The subjects were requested not to turn their heads during the sham needling for 60 s. After the sham needling, blood pressure and heart rate were measured immediately. Then, the researcher informed the subjects that the needle was removed from their muscle. The pain pressure threshold of the MTrP of the right upper trapezius was measured again after the sham needling procedure.

3.3. *Statistical analysis*

All the data were analyzed with the SPSS software (17.0 version). The data variables were checked for normality of distribution using the Shapiro–Wilk test. A descriptive analysis of the variables and subject characteristics was performed. A two-way ANOVA was used to analyze the differences in pain pressure threshold, blood pressure, heart rate between both groups and within the group with a fear of needles and the group without needle phobia. The level of significance was set at .05.

4. Results

4.1. *Demographic characteristics of the subjects*

A total of 27 subjects – 12 subjects in the needle phobia group aged 23±2 years (mean±SD), 15 subjects without needle phobia aged 23±4 years – participated in this study. The scores of the MTNP questionnaire among the subjects with a fear of needles and without a fear of needles are 23±3 and 8±6, respectively. Table 1 indicates the mean and standard deviation of pain pressure threshold, blood pressure and heart rate before and after sham needling between the two groups.

Table 1 – Pain pressure threshold, blood pressure and heart rate between groups with a fear of needles and without needle phobia before and after sham needling.

	Needle phobia group		Without needle phobia group	
	Before sham needling	After sham needling	Before sham needling	After sham needling
Pain pressure threshold, kg	2.87±1.14	3.14±1.20	2.76±0.84	2.97±0.86
Systolic blood pressure, mm Hg	105.67±14.00	107.00±11.00	113.94±15.00	115.56±13.00
Diastolic blood pressure, mm Hg	65.91±10.00	66.58±11.00	72.31±7.00	73.56±8.00
Heart rate, bpm	75±11	73±14	77±16	75±12

The values are expressed in mean±SD.

4.2. *Pain pressure threshold*

The ANOVA result shows that there is no significant difference in pain pressure threshold between the subjects within the groups after sham needling, $F_{1,25}=20.03$, $P=.600$, partial $\eta^2=0.01$. The test shows that pain pressure threshold among the subjects between the two groups does not differ after sham needling, $F_{1,25}=0.274$, $P=.717$, $\eta^2=0.01$ (Table 2). However, there is a trend toward an increase in pain pressure threshold among the subjects who have a fear of needles (3.14±1.20) when compared with the subjects without needle phobia after sham needling (2.97±0.86) (Table 1).

4.3. *Systolic blood pressure*

There is no significant difference in systolic blood pressure among the subjects within the groups after sham needling, $F_{1,25}=0.138$, $P=.716$, partial $\eta^2=0.005$. The result also shows that systolic blood pressure among the subjects between the two groups does not differ after sham needling $F_{1,25}=2.414$, $P=.133$, $\eta^2=0.080$ (Table 2). However, there is a trend toward an increase in systolic blood pressure among the subjects with a fear of needles (107.00±11.00) when compared with the subjects without needle phobia after sham needling (115.56±13.00) (Table 1).

4.4. *Diastolic blood pressure*

The ANOVA result shows that there is no significant difference in diastolic blood pressure among the subjects within the groups after sham needling, $F_{1,25}=0.056$, $P=.815$, partial $\eta^2=0.002$. The test result also shows that diastolic blood pressure among the subjects between the two groups does not differ after sham needling, $F_{1,25}=3.159$, $P=.088$, $\eta^2=0.012$ (Table 2). Although there is no statistical significance, there is a trend toward an increase in diastolic blood pressure among both subjects with a fear of needles (66.58±11.00) and subjects without needle phobia after sham needling (73.56±8.00) (Table 1).

4.5. *Heart rate*

The result shows that there is no significant difference in heart rate among the subjects within the groups after sham needling, $F_{1,25}=0.002$, $P=.966$, partial $\eta^2<0$. The test result also shows that heart rate among the subjects between the two groups does not differ after sham needling, $F_{1,25}=0.118$, $P=.734$, $\eta^2=0.005$ (Table 2). However, there is a trend toward a decrease in heart rate among the subjects with a fear of needles (73±14) when compared with the subjects without needle phobia after sham needling (75±12) (Table 1).

5. Discussion

5.1. *Pain pressure threshold*

This study investigated the differences in pain pressure threshold, blood pressure and heart rate among subjects with a fear of needles and without needle phobia during a sham needling procedure. The results showed no significant differences in pain pressure threshold between participants with and without needle phobia. However, the results of this study showed that the mean value of pain pressure threshold among individuals with a fear of needles was higher than in participants without needle phobia. The increased pain pressure threshold identified by increased mean values from pressure algometry among subjects with a fear of needles could be discussed further. Evidence from the past study explained a concept termed as "fear induced hypoalgesia" or "stress induced hypoalgesia."[4] That study suggested that fear might have a hypoalgesic effect.[4] Thus, it might be postulated that the subjects in this current study exhibited similar effects which accounted for an increased pain pressure threshold after sham needling. Besides, Rhudy et al. investigated the influence of fear on the pain perception of an individual and discovered that an individual experiencing fear has reduced pain perception.[28] Thus, it might be possible that the subjects with a fear of needles in the current study could have encountered a similar phenomenon which indicates that an individual experiencing fear will have a higher pain tolerance.

Unpleasant emotions such as fear, anxiety and depression were also reported to reduce pain pressure threshold in an individual.[1,29] Meagher et al. explained that an unpleasant emotion reduces the pain pressure threshold by amplifying the perceived intensity of the noxious stimulus.[21,29] In this study, the mean value of the total score obtained from the MTNP questionnaire among the subjects with a fear of needles was higher (23±4) when compared to the participants without needle phobia (8±2). The high total score of the MTNP questionnaire among participants with a fear of needles indicated high intensity of fear among these subjects. A past study on fear and pain modulation reported that the intensity of pain modulated the perception of pain.[21] High

Table 2 – Results of ANOVA for pain pressure threshold, blood pressure and heart rate between subjects with a fear of needles and without needle phobia before and after sham needling.

	Within group				Between groups			
	F	*df*	*P*	η^2	*F*	*df*	*P*	η^2
Pain pressure threshold, kg	20.03	1.25	.600	0.001	0.274	1.25	.717	0.010
Systolic blood pressure, mm Hg	0.138	1.25	.716	0.005	2.414	1.25	.133	0.088
Diastolic blood pressure, mm Hg	0.056	1.25	.815	0.002	3.159	1.25	.088	0.012
Heart rate, bpm	0.002	1.25	.966	0.000	0.118	1.25	.734	0.005

F – Fisher–Snedecor distribution, *df* – degrees of freedom, *P* – statistical probability, η^2 – partial eta-squared (effect size).

intensity of fear was reported to inhibit pain while moderate intensity of fear enhanced pain perception.[21,22] Thus, high pain pressure threshold values among the subjects with a fear of needles after sham needling could be explained by the fact that needle phobia might have inhibited the pain, thus resulting in higher pain tolerance as measured by pressure algometry. Ploghaus et al. investigated the influence of preliminary information given to the patients regarding the pain stimuli and studied the effects on pain perception.[26] The result of the Ploghaus et al. study suggested that the pain perceived by the participants was lower when the subjects received preliminary information regarding the pain stimuli compared to subjects who were randomly induced with pain. Thus in the current study, similar effects might have occurred among the subjects with a fear of needles, as information regarding a dry needling procedure might have changed the outcome of the pain pressure threshold of participants in the needle phobia group.

5.2. *Blood pressure and heart rate*

The results showed that there was no significant difference before and after sham needling in blood pressure and heart rate readings among subjects with a fear of needles. However the mean value of systolic pressure increased after sham needling among individuals with a fear of needles compared to those without needle phobia. Meanwhile the mean value of diastolic blood pressure showed no changes between the groups. Also, there was a decrement in the mean value of heart rate after sham needling among individuals with a fear of needles. The results of the current study could be explained utilizing past studies concerning fear and autonomic changes.[3,5] Meagher et al. suggested that fear induced reduction in pain pressure threshold was related to autonomic changes.[1,29] The autonomic changes associated with fear included vasoconstriction of blood vessels and alteration of blood pressure.[1,29] Few researchers have explained the relationship between fear and associated autonomic changes.[3,33] Sympathetic arousal was also closely related with the "flight or fight" theory proposed by Cannon.[4,5] Kreibig et al. quoted that the "flight or fight" reaction pattern of engagement was characterized by sympathetic activation, causing heart rate acceleration and blood pressure elevation.[3,18,19] An increased blood pressure and heart rate during fear was also explained by means of epinephrine sympathetic response.[33] The epinephrine sympathetic response caused a higher systolic blood flow and increased heart rate while it kept the diastolic blood flow relatively low.[33]

A review by Sokolowski et al. showed that participants with a fear of needles experienced vasovagal reflex which resulted in vasovagal bradycardia and vasodilatation.[35] Vasovagal reflex caused a decrease in heart rate and blood pressure among individuals under a fear of needles. [35] Another study reported a reduction of heart rate (bradycardia) leading to vasovagal syncope (faint) among people with needle phobia.[8] This might support and explain the findings of the current study as to why there was a decrement in the mean value of heart rate after sham needling among subjects with a fear of needles.

5.3. *Limitation*

This is a pilot study and therefore the small sample size was one of the main limitations. In this current study, the modified MTNP questionnaire used failed to identify and differentiate fear and anxiety among the subjects with needle phobia. Anxiety was reported to influence pain perception and pain modulation.[29] Therefore, the researchers were not able to rule out the presence of unidentified anxiety among the subjects during needling which might have influenced the outcome of the pain pressure threshold. Therefore, future studies should be conducted on a larger scale of sample size in order to obtain a clearer picture about the influence of needle phobia on pain pressure threshold. Besides, future studies might consider functional magnetic resonance imaging of the brain to explore the influence of the fear of needles on pain modulation during needling.

6. Conclusions

This preliminary study concludes that the fear of needles does not influence the pain pressure threshold, nor blood pressure and heart rates among those subjects with a fear of needles as evidenced during the sham needling procedure conducted over the latent trigger point on the upper trapezius. The findings of the current study might shed some light on the physiological effects of the fear of needles during dry needling treatment, which is one of the interventions currently used in musculoskeletal clinical practice.

Conflict of interest

None declared.

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REFERENCES

[1] al Absi M, Rokke PD. Can anxiety help us tolerate pain? *Pain*. 1991;46(1):43–51.
[2] Apkarian AV, Sosa Y, Sonty S, Levy RM, Harden RN, Parrish TB, et al. Chronic back pain is associated with decreased prefrontal and thalamic gray matter density. *J Neurosci*. 2004;24(46):10410–10415.
[3] Bosch JA, de Geus EJ, Kelder A, Veerman EC, Hoogstraten J, Amerongen AV. Differential effects of active versus passive coping on secretory immunity. *Psychophysiology*. 2001;38(5):836–846.
[4] Butler RK, Finn DP. Stress-induced analgesia. *Prog Neurobiol*. 2009;88(3):184–202. http://dx.doi.org/10.1016/j.pneurobio.2009.04.003.
[5] Cannon WB. *Bodily Changes in Pain, Hunger, Fear, and Rage*, 2nd ed. New York and London: D. Appleton & Co.; 1929.
[6] Chugh AR, Loughran JH, Slaughter MS. Circadian variations in blood pressure in health and disease: implications for patient management. *J Chronophysiol Ther*. 2011;1:17–31. http://dx.doi.org/10.2147/CPT.S15597.
[7] Elliott AM, Smith BH, Hannaford PC, Smith WC, Chambers WA. The course of chronic pain in the community: results of a 4-year follow-up study. *Pain*. 2002;99(1–2):299–307.
[8] Ellinwood EH, Hamilton JG. Case report of a needle phobia. *J Fam Pract*. 1991;32(4):420–422.
[9] Fernandez C, Alonso BC, Fernandez CJ. The immediate effect of ischemic compression technique and transverse friction massage on tenderness of active and latent myofascial trigger points: a pilot study. *J Bodywork Mov Ther*. 2006;10(1):3–9.
[10] Fischer AA. Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. *Pain*. 1987;30(1):115–126.
[11] Fischer AA. Documentation of myofascial trigger points. *Arch Phys Med Rehabil*. 1988;69(4):286–291.
[12] Fischer AA. New developments in diagnosis of myofascial pain and fibromyalgia. *Phys Med Rehabil Clin North Am*. 1997;8:1–21.
[13] Furlan AD, van Tulder M, Cherkin D, Tsukayama H, Lao L, Koes B, et al. Acupuncture and dry-needling for low back pain: an updated systematic review within the framework of the cochrane collaboration. *Spine*. 2005;30(8):944–963.
[14] Ge HY. Prevalence of myofascial trigger points in fibromyalgia: the overlap of two common problems. *Curr Pain Headache Rep*. 2010;14(5):339–345. http://dx.doi.org/10.1007/s11916-010-0127-5.
[15] Hamilton JG. Needle phobia: a neglected diagnosis. *J Fam Pract*. 1995;41(2):169–175.
[16] Hsieh YL, Kao MJ, Kuan TS, Chen SM, Chen JT, Hong CZ. Dry needling to a key myofascial trigger point may reduce the irritability of satellite MTrPs. *Am J Phys Med Rehabil*. 2007;86(5):397–403.
[17] Irnich D, Behrens N, Gleditsch JM, Stör W, Schreiber MA, Schöps P, et al. Immediate effects of dry needling and acupuncture at distant points in chronic neck pain: results of a randomized, double-blind, sham-controlled crossover trial. *Pain*. 2002;99(1–2):83–89.
[18] Kreibig SD, Wilhelm FH, Roth WT, Gross JJ. Cardiovascular, electrodermal, and respiratory response patterns to fear- and sadness-inducing films. *Psychophysiology*. 2007;44(5):787–806.
[19] Lovallo WR. *Stress and Health: Biological and Psychological Interactions*, 2nd ed. Thousand Oaks: Sage Publications; 2005.
[20] Lucas N, Macaskill P, Irwig L, Moran R, Bogduk N. Reliability of physical examination for diagnosis of myofascial trigger points: a systematic review of the literature. *Clin J Pain*. 2009;25(1):80–89. http://dx.doi.org/10.1097/AJP.0b013e31817e13b6.
[21] Meagher MW, Arnau RC, Rhudy JL. Pain and emotion: effects of affective picture modulation. *Psychosom Med*. 2001;63(1):79–90.
[22] Meagher MW, Ferguson AR, Crown ED, McLemore S, King TE, Sieve AN, et al. Shock-induced hyperalgesia: IV generality. *J Exp Psychol Anim Behav Process*. 2001;27(3):219–238.
[23] Niddam DM, Chan RC, Lee SH, Yeh TC, Hsieh JC. Central modulation of pain evoked from myofascial trigger point. *Clin J Pain*. 2007;23(5):440–448.
[24] O'Brien E, Coats A, Owens P, Petrie J, Padfield PL, Littler WA, et al. Use and interpretation of ambulatory blood pressure monitoring: recommendations of the British hypertension society. *Br Med J*. 2000;320(7242):1128–1134.
[26] Ploghaus A, Narain C, Beckmann CF, Clare S, Bantick S, Wise R, et al. Exacerbation of pain by anxiety is associated with activity in a hippocampal network. *J Neurosci*. 2001;21(24):9896–9903.
[27] Randich A, Maixner W. Interactions between cardiovascular and pain regulatory systems. *Neurosci Biobehav Rev*. 1984;8(3):343–367.
[28] Rhudy JL, Grimes JS, Meagher MW. Fear-induced hypoalgesia in humans: effects on low intensity thermal stimulation and finger temperature. *J Pain*. 2004;5(8):458–468.
[29] Rhudy JL, Meagher MW. Fear and anxiety: divergent effects on human pain thresholds. *Pain*. 2000;84(1):65–75.
[30] Shah JP, Danoff JV, Desai MJ, Parikh S, Nakamura LY, Phillips TM, et al. Biochemicals associated with pain and inflammation are elevated in sites near to and remote from active myofascial trigger points. *Arch Phys Med Rehabil*. 2008;89(1):16–23. http://dx.doi.org/10.1016/j.apmr.2007.10.018.
[31] Simons DG. Review of enigmatic MTrPs as a common cause of enigmatic musculoskeletal pain and dysfunction. *J Electromyogr Kinesiol*. 2004;14(1):95–107.
[32] Simons DG, Hong CZ, Simons LS. Endplate potentials are common to midfiber myofacial trigger points. *Am J Phys Med Rehabil*. 2002;81(3):212–222.
[33] Sinha R, Lovallo WR, Parsons OA. Cardiovascular differentiation of emotions. *Psychosom Med*. 1992;54(4):422–435.
[34] Skootsky SA, Jaeger B, Oye RK. Prevalence of myofascial pain in general internal medicine practice. *West J Med*. 1989;151(2):157–160.
[35] Sokolowski CJ, Giovannitti Jr. JA, Boynes SG. Needle phobia: etiology, adverse consequences, and patient management. *Dent Clin North Am*. 2010;54(4):731–744.
[36] Srbely JZ, Dickey JP, Lee D, Lowerison M. Dry needle stimulation of myofascial trigger points evokes segmental anti-nociceptive effects. *J Rehabil Med*. 2010;42(5):463–468.

[37] Tough EA, White AR, Cummings TM, Richards SH, Campbell JL. Acupuncture and dry needling in the management of myofascial trigger point pain: a systematic review and meta-analysis of randomised controlled trials. *Eur J Pain*. 2009;13(1):3–10.
[38] Vanderweeën L, Oostendorp RA, Vaes P, Duquet W. Pressure algometry in manual therapy. *Man Ther*. 1996;1(5):258–265.
[39] Wright S, Yelland M, Heathcote K, Ng SK, Wright G. Fear of needles – nature and prevalence in general practice. *Aust Fam Physician*. 2009;38(3):172–176.