TOLERANCE TIME OF EXPERIMENTAL THERMAL PAIN (COLD INDUCED) IN VOLUNTEERS

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ABSTRACT

Perception of thermal pain (cold induced) was studied in 106 volunteers from troops and civilians deployed in J & K. Thermal stimulus devised was "holding ice". Tolerance time of holding ice was taken to be a measure of thermal sensitivity. volunteers were classified based on their native areas, addiction habits and socio-economic status. out of 106 volunteers, 81 could & 25 could not hold ice over 10 min. Sixteen out of 40 from coastline States and 9 out of 66 from non-coast line States failed to hold ice over 10 min. In "below average" "average" and "high average" socio-economic groups, three out of 27, 19 out of 73 and 03 out of 6 failed to hold ice over 10 min respectively. Fifteen out of 64 from "addiction habit group" and 10 out of 42 from "no addiction habit group" failed to hold ice over 10 min. Statistically no classification used in the study revealed significant difference in "tolerance times" of volunteers except the one based on coastline and non-coastline States.

MJAFI 1998; 54 : 315-318

KEY WORDS: Pain; Nociception; Thermal sensations.

Introduction

Pain is a perception rather than a sensation [1]. Patients tolerance to pain and capacity to experience it without verbalisation are influenced by race, culture and religion [2]. It is a matter of training, habit and temperament that some remain stoic in face of pain while others react opposite. Some people think that bearing pain is beneficial. It is also common to attribute pain to psychological factors. Nurses tend to give more analgesics to women and less to children and adults [3]. Patients complaining excessively may end up getting more placebo than analgesics. Fear of addiction and respiratory depression often preclude proper pain treatment. With advances in medicine, complete alleviation of pain is possible. Infact concensus is evolving to see pain as basic human right issue [4]. Pain is perceived through many sensations and there are many factors involved in its expression. It is important to study a particular sensation producing pain under different factors affecting expression of pain. This study attempts to examine tolerance to cold induced thermal pain in relation to geographical distribution, economic affluence and addiction habits of cross section of our society.

Method

One hundred and six healthy adult male volunteers from troops and civilians deployed in J & K were tested. the stimulus chosen was holding ice in each hand. each volunteer was positioned in

standing posture, holding half kg, block of ice in each hand, fore-arms supinated with elbows flexed to 90 degree & kept on the sides of the body. Pronation of forearms was not allowed. the study was conducted from May 96 to August 96. Ambient temperature during the study ranged between 20 degree-30degree celsius. Volunteers were told that they are expected to hold the ice for 10 min but if they cannot, they can keep the ice block down. Tolerance time was recorded by a stop watch from the time one picks up the block to the time he puts it down. If one held the ice in one hand longer than the other, the reading of hand holding for shorter duration was taken into account. Particulars were recorded and based on native areas volunteers were classified as under

North Zone- J & K, Punjab, Haryana, Delhi, Himachal Pradesh.

South Zone-Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Pondicherry.

East Zone- West Bengal, Sikkim, Assam other Eastern states and Nepal.

West Zone-Rajasthan, Gujrat, Maharashtra, Goa.

Central Zone-Uttar Pradesh, Bihar, Orrisa, Madhya Pradesh.

Coastline States-Gujrat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Pondicherry, Orrisa and West Bengal.

Non-coastline States-All other states of India and Nepal.

Addiction habits were clasified under addiction habit score (AHS) as follows:-

(a) AHS-O-No addiction habit.

(b) AHS-I Habituated to any one of the following: (i) Alcohol, (ii) Smoke, (iii) Tobacco chewing, (iv) Any other.

(c) AHS-II -habituated to any two shown in para (b) above.

(d) AHS-III- Habituated to any three shown in para (b) above

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Socio-economic status (SES) was classified according to service/occupational seniority into three groups viz:-

(a) SES-I (Below average socio-economic status) - (i) Sepoy or skilled worker in civil employment during first five years of service, (ii) Unskilled worker.

(b) SES-II (Average socio-economic status) - (i) Sepoy or NCO or JCO after 5 years but before 20 years of service, (ii) Skilled worker in regular employment after five years.

(c) SES-III (High Average socio-economic status) - (i) Serving person with service of 20 years or more, (ii) Skilled worker after 20 years of regular employment or self employed professional for over 20 years.

Data obtained was tabulated & results analysed statistically using chi-square test.

Results

Mean age of the volunteers under study was 30 ± 6.9 years, mean weight was 63 ± 17.35 kg and mean height was 170 ± 4.81 cm. There were 81 volunteers with tolerance time over 10 min. Nine volunteers had tolerance time under 3 min. Thirteen volunteers had tolerance time under 5 min. Twenty volunteers had tolerance time under 7 min and a total of 25 volunteers had tolerance time under 10 min.

TABLE 1
Geographical distribution of "Tolerance time"

Geographical zone	No of volunteers	Tolerance time		
		> 10 min	< 10 min	< 10 min (%)
Coast line states	40	24	16	40
Non-coast line states	66	57	09	13.6
North	30	25	05	16.6
South	26	16	10	38.4
East*	07	06	01	14.2
West	11	07	04	36.3
Central	32	27	05	15.6

Chi square analysis for coastline and non-coastline states published value of X^2 for significance (p over .05) in DF 2 = 5.99, observed value $X^2 = 9.632$

For North South West and Central zones published value of X^2 for significance (p over .05) in DF 3 = 7.82 observed value $X^2 = 5.979$

*East zone data insufficient for chi square analysis (E under 2 hence excluded)

TABLE 2
Distribution : Tolerance times and addiction habit scores (AHS) in socio-economic status groups

No. of volunteers Tolerance time	Socio-economic status scale (SES)							
	SES-I		SES-II		SES-III		Total	
	27	73	06	106	Over 10min	Under 10min	Over 10min	Under 10min
No. of volunteers as per tolerance time	24	03	54	19	03	03	81	25
No. with AHS-O	13	00	19	10	00	00	32	10
No. with AHS-I	10	02	19	05	01	00	30	07
No. with AHS-II	01	01	15	04	02	03	18	08
No. with AHS-III	00	00	01	00	00	00	01	00
Total no. with addiction habits (AHS I+II+III)	11	03	35	09	03	03	49	15

Geographical distribution of volunteers as per their tolerance times is shown in Table 1. It shows that 40% volunteers from coastline States and only 13.6% volunteers from non-coastline States had tolerance time less than 10 min. Percentage of volunteers with tolerance times less than 10 min in North, South, East, West and Central Zones was 16.6%, 38.46%, 14.2%, 36.3% and 15.6% respectively.

As shown in Table 2 in socioeconomic status group-I (SES-I) there were 27 volunteers out of which 24 had tolerance time over 10 min. In these 24 there were 13 volunteers with no addiction habit (AHS-O), ten were in addiction habit score group-I (AHS-I), one was in AHS-II & none in AHS-III Table-3 also shows that a total of 42 (32+10) volunteers had no addiction habit (AHS-O).

Table 3 compares the effect of addiction habit and socioeconomic status on tolerance time of volunteers. It shows that 23.8% volunteers with no addiction habit (AHS-O) had tolerance time less than 10 min as against 20.6% volunteers in addiction habit groups (AHS-I+II+III). Percentage of volunteers in socioeconomic status groups I & II with tolerance time less than 10 min, was 11.1% and 26.0% respectively.

TABLE 3
Comparison : Effect of socio-economic status (SES-I & II only) and addiction habit on tolerance time

	Tolerance time		Total	% under 10 min score	*Chi square test x2 observed value
	Over 10 min	Under 10 min			
SES-I	24	03	27	11.1	2.554
SES-II	54	19	73	26.0	
AHS-O	32	10	42	23.8	0.131
AHS (I+II+III)	46	12	58	20.6	

*Published value of X^2 for significance (p over 0.05) in DF2 = 3.84

Discussion

The study was designed to examine perception of cold induced thermal sensation in relation to geographical distribution, socio-economic status & addiction habits. Stimulus chosen was tolerance to cold induced thermal sensation by holding 1/2 kg block of

Fig. 1 : Experimental pain

ice. This stimulus qualifies as a thermal contact stimulus for cold induced ischaemic pain. In an analysis of properties of experimental pain simulation methods by Gracely [13] such a stimulus qualifies under two heads viz "Thermal contact" and "Cold press" & thus having the advantage of being a natural, severe constant stimulus involving few afferents and fast in offset. A severe constant stimulus suits for assessment of intensity through time. A natural stimulus is more physiological. Fewer afferents involved means lesser mixing with other non-nociceptive (proprioceptive) sensations. Fast in offset means safer for the subject.

As regards geographical distribution volunteers were classified into East, West, North, South and Central zones, statistical analysis did not reveal any significant difference in perception of cold induced thermal sensation among volunteers classified in this manner. As there was no statistically significant difference observed in perception of cold induced thermal sensation among volunteers classified on the basis of socio-economic and addiction habit groups a scrutiny of classification of volunteers was undertaken, on such scrutiny it was found that if the volunteers were classified as coastal and non-coastal states the statistical analysis

revealed significant difference in perception of cold induced thermal sensation.

It is possible that the observed significant difference could be due to the fact that people from coastal States are from warmer climate and testing tolerance to cold induced thermal sensation to which they are less adept, puts them in disadvantageous position as far as their capacity to withstand cold is concerned. It can be argued that had they been tested for "Hot" sensation, they could have fared better. The point may be valid & an analogy can be drawn to the finding that persons from warmer southern USA are more prone to cold injuries than persons from the colder northern States of America [5].

People as widely different as Eskimos, Whites and Indians have same pain threshold [6]. Why different people react differently to pain is a matter of reaction threshold over perception threshold just described. Reaction threshold varies widely among different people [7]. Temperature at a given intensity is not perceived as pain until it has undergone processing in brain [8]. Thermal sensation is perceived like burning aching pain. It requires early participation of reticular activating system which excites entire brain and brings unpleasant emotional element to sensory input.

Soldiers and athletes are known to negate pain in face of acute injury [1]. In a study on experimental pain Woodrow and Colleagues (1972) observed that whites had greater tolerance to experimental pain than blacks [3]. Another explanation to all these differences in pain perception in different people is by influence of pain inhibiting system.

Nicotine is known to increase serum concentration of beta endorphin [9]. Endorphin, Enkephalin & Dynorphin stimulate specific receptors in substantia gelatinosa, periaqueductal area, periventricular area and brainstem to regulate pain reception and responsiveness to environmental stimuli [10]. Alcohol addiction can interfere with pain perception in more than one way. Firstly, behavioural reinforcement effect of alcohol caused by acetaldehyde accumulation can reinforce the type of behaviour one is expected to portray. Alcohol causes fragmented sleep [11]. It may cause change in arousal response to pain. Lastly neuropathy resulting from alcohol abuse may reduce perception threshold of pain.

Socio-economic status may affect reaction threshold of pain. Pain is examined in central nervous system at different levels of vigilance [12]. First level is midbrain reticular substance. Vigilance at this level produces abrupt awakening. It is adrenergic and is for

startle and flight reaction. This may be affected by alcohol and may not be affected by socio-economic status. Second level of vigilance is rhinencephalon and thalamic reticular formation. It is affective component, cholinergic and may be affected by alcohol as well as socio-economic background. Narcotic analgesics act here and this may also be affected by tobacco related endorphin release. Third level of vigilance is at frontal cortex. It brings about temporospatial analysis and evaluation in regard to environment, can again be affected by alcohol and socio-economic background.

In our study volunteers though having addiction habits, do not probably qualify as true addicts. This may be the reason of no significant difference in their "Tolerance Times", compared to those with no addiction habit. Socio-economic status wise also probably the volunteers are not so far apart so as to produce significant difference in "Tolerance Times". The only positive finding of this study is the significant difference in "Tolerance Times" of coastal and noncoastal candidates. This finding compares well with the observation cited in "DGAFMS memorandum 92" that the troops from southern India States may be more prone to frostbite in comparison with troops from northern states [5]. Other causes of difference in "Tolerance Times" of coastline and non-coastline States and whether this difference pertains to cold induced thermal sensation only, would require further investigation.

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