A STUDY ON PAIN PERCEPTION INDUCED BY COLD PRESSOR TEST AMONG DIFFERENT ABO BLOOD GROUPS

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ABSTRACT

BACKGROUND

Different blood groups may have their own characteristics personality traits. For instance, people with blood group A tend to be more ambitious, restless and are referred to as type A personality. The ABO blood types are also found to be associated with multiple medical conditions, such as cardiovascular diseases, type 2 diabetes, and various cancers. Significant association of ABO groups with the prevalence of preeclampsia has also been reported. We wanted to examine if ABO blood group has any influence on pain perception in healthy volunteers induced by cold pressor test.

METHODS

The study procedure included a blood group test of the 80 students who were then subjected to undergo cold pressor test. The blood group test was done by using anti-sera A, B and D (Tulip Diagnostics Pvt Ltd). A cold pressor test was done by immersing the dominant hand up to the wrist in chilled water (4^0 C $\pm$ 1^0 C). Statistical Analysis was done by using independent t-test and one-way ANOVA, and all the values were expressed as mean ($\pm$SD) and p less than 0.05 was taken as significant.

RESULTS

The average pain threshold of males was 25.49 $\pm$ 7.62 seconds as compared to 17.58 $\pm$ 5.02 seconds of females which was statistically significant. The mean pain tolerance for male and female students were 28.69 $\pm$ 9.07 seconds and 18.08 $\pm$ 7.09 seconds respectively which was significant. Students having blood group B have highest pain threshold (22.85 $\pm$ 7.03 seconds), followed by blood group O (22.48 $\pm$ 7.64 seconds), blood group A (17.90 $\pm$ 7.53 seconds) and blood group AB have the least pain threshold (16.60 $\pm$ 1.67 seconds). Students with blood group B (26.96 $\pm$ 7.64) have the maximum pain tolerance while the students with blood group A (20.33 $\pm$ 11.43) have the least pain tolerance in response to CPT.

CONCLUSIONS

Students with blood group B are found to have highest pain threshold and pain tolerance while blood group AB showed least pain threshold and blood group A showed least pain tolerance.

KEY WORDS

Blood Group, Pain Threshold, Pain Tolerance, Cold Pressor Test

BACKGROUND

Acute pain is defined as an 'unpleasant, complex, dynamic psychophysiological response to tissue damage, disease or inflammation',[1-3] and often lasts for a short period.[1,4] Its biological function is to minimise behaviours that may lead to reduced tissue healing.[1,5]

The ABO blood groups are polymorphic, inherited, antigenic carbohydrate present on the surface of erythrocytes and other tissues.[6]

This system is important especially at the time of blood transfusion because they can produce severe reaction as

these antigens are the most immunogenic of all blood group antigens.[7,8] On the bases of antigen present on the surface of erythrocyte, it can be grouped into four types: A, B, AB and O. The ABO blood antigens are encoded by genetic locus located on chromosome 9 at 9q34.1–q34.2. It has three allelic forms: A, B, and O. The A allele encodes a glycosyltransferase-A which places a N- acetyl galactosamine to a H-antigen and forms A antigen while the B allele encodes a glycosyltransferase- B which transfers D-galactose to an H-antigen and produces B antigen. The O allele encodes an enzyme with no known function and therefore the H antigen remains unchanged and no antigens are produced.[7,8] The presence or absence of antigen A or/and antigen B in red blood cells will decide the blood type an individual will have. If antigen A or antigen B is present in the red blood cells, the person presents with blood type A and B respectively, whereas if both antigen A and antigen B are present or absent in the red blood cells, then the individual will have blood type AB and O respectively. ABO blood types are unequally distributed at both local and global scale.[9]

Agarwal et al[10] have done a study of ABO blood types and Rh (D) on 10,000 healthy blood donors donating in blood

banks situated in five different geographical regions (North, South, East and Center) of India. Their study showed that O was the most common blood group (37.12%) in the country closely followed by B at 32.26%, followed by A at 22.88% while AB was the least prevalent group at 7.74%. Their study also revealed that 94.61% of the donor population was Rh positive and the rest were Rh negative.

Previous study among the north Indian blood donor population has shown that the common blood groups in order of frequency were B, O, A, and AB.[11] Study conducted among the Medical students in Assam showed that blood group A was the most common followed by B, O and AB with 97.62% students having Rh positive.[12] Singh et al[13] carried out a study on the distribution of ABO and Rh (D) blood groups among Mao Naga tribe of Mao, Manipur, India. Out of the 775 people (359 males and 431 females), 354 individuals (46.2%) were found to possess blood group O and shows the highest allele frequency of 0.60 followed by 185 individuals possessing blood group 'A' (23.9%) with a corresponding allele frequency value of 0.22 and 139 individuals with blood group 'B' (17.9%) with a corresponding value of 0.18 while the remaining 93 individuals were found to be possessing blood group AB.

The ABO blood types are associated with various medical conditions, such as cardiovascular diseases, type 2 diabetes, and various cancers.[6,8,14] Earlier study has reported a significant association of ABO groups with the prevalence of preeclampsia, where AB group was found to be associated with an increased risk of 2.1-folds.[15] Preliminary studies suggested an association of ABO system with malignancies. A positive correlation has been shown between blood group A with chronic hepatitis‑B infection and pancreatic cancer;[16] and blood group B with ovarian cancer.[17]

Two studies have investigated the association between blood type and experimental-induced pain. The first study was done among the medical students and reported no significant difference between blood types and experimental-induced pain in healthy volunteers. [18] The second study was done among the healthy volunteers and found that the blood group B have the lowest mechanical pain sensitivity while blood group AB have the highest.[19] Therefore, the aim of this study was to examine if ABO blood type has any influence on pain perception in healthy volunteers induced by cold pressor test.

METHODS

This cross-sectional study was conducted among the 1st year undergraduate students of Jawaharlal Nehru Institute of Medical Sciences, Imphal. This study included 35 female and 45 male students aged 18-22 years. They were given detailed oral explanations regarding the nature, purpose and requirements of the study. The students were also given ample time to consider participation and written consent was taken from the participants after clearance from the Ethical Committee of the Institute.

All the student volunteers reported to the Autonomic Laboratory between 12 noon -1 pm in batches. Body mass index (BMI) was assessed using a standardised weighing machine and height scale according to the following formula: BMI= mass in kilogram/ (Height in meters).[2] The female students with regular menstrual cycle (28 ± 4 days) were called on the 5th to 7th day of the menstrual cycle. The exclusion criteria were gynaecological diseases, endocrine disorders and hormonal therapy. Both male and female students with history

of alcohol intake, drug abuse, acute and chronic pain as well as dermatoses at the site of pain stimulation were excluded. Three students were found to be Rh negative and so were excluded from the study.

A cold pressor test was used as a stimulus source. The dominant hand was immersed up to the wrist in chilled water (4^0 C $\pm 1^0$ C). The water bucket (2.8 L) was shaken manually by the experimenter every 30 second from warming up around the skin. The temperature in the bucket was measured by thermometer (INCO immersion thermometer) and was made sure not to exceed 6 ^{0}C. The participants were instructed to hold their hands as long as they could bear the pain and to inform when pain is first felt. Pain threshold was determined as the duration of time between the subject's first reported pain and exposure to the painful stimulus. Pain tolerance was determined as the duration of the time until the student withdrew his/her hand from the cold water as the pain was too intensive.

Three clean glass slides were taken on which a drop of known anti-sera (anti-A, anti-B and anti-D; Tulip diagnostics Pvt Ltd) were put. A drop of blood sample was added to each one of it. Using the edge of separate slides the blood was properly mixed with the anti-sera. The slides were kept undisturbed for 1-2 minutes at about 37 degrees. The presence of agglutination confirmed under microscope indicated the presence of that respective blood group and the Rh factor.

Statistical Analysis

Descriptive Statistics was applied using Statistical Package for the Social Sciences (SPSS) version 22. Statistical Analysis was done using independent t-test for comparison of pain threshold and pain tolerance in male and female students and one-way ANOVA for comparison of pain threshold and pain tolerance among the different blood groups respectively. All the values were expressed as mean (±SD) and p less than 0.05 was taken as significant.

RESULTS

Table 1 shows the distribution of sex in each blood group. Out of 80 students, 21 students have blood group A in which 13 were males and 8 students were females. Similarly, 27 students (14 males, 13 females) have blood group B, 27 students (16 males, 11 females) have blood O and 5 students (1 male, 3 females) have blood group AB.

Table 2 shows the average age, weight and body mass index (BMI) of the students in each blood group.

Table 3 shows the average value of pain threshold and pain tolerance in male and female students. The average pain threshold of males was 25.49±7.62 seconds as compared to 17.58 ± 5.02 seconds of females which was statistically significant. The mean pain tolerance for male and female students were 28.69±9.07 seconds and 18.08±7.09 seconds respectively which was significant.

Blood Group	Male (n)	Female (n)	Total (n)
A+	13 (28.9 %)	8 (22.9 %)	21 (26.3 %)
B+	14 (31.0 %)	13 (37.1 %)	27 (33.8 %)
O+	16 (35.6 %)	11 (31.4 %)	27 (33.8 %)
AB+	02 (4.4 %)	03 (8.6 %)	05 (6.3 %)
Total	45 (100 %)	35 (100 %)	80 (100 %)
Table 1. Distribution of Male and Female Students in Each Group			
n=number			

Parameter	A+ (n=21) (Mean ± SD)	B+ (n=27) (Mean ± SD)	O+ (n=27) (Mean ± SD)	AB+ (n=5) (Mean ± SD)
Age (Year)	20.57 ± 1.16	20.19 ± 1.21	20.07 ± 1.17	20.00 ± 0.71
Weight (Kg)	50.76 ± 6.69	50.81 ± 5.26	50.48 ± 5.99	49.00 ± 6.24
BMI (Kg/m²)	20.53 ± 1.87	20.56 ± 2.19	20.13 ± 1.86	19.04 ± 1.96

Table 2. Age, Weight and Body Mass Index (BMI) Among Different Blood Groups

	Female (n=35) (Mean ± SD)	Male (n=45) (Mean ± SD)	t-value	p-Value
Pain threshold (seconds)	17.58±5.02	25.49±7.62	-5.508	0.000*
Pain tolerance (seconds)	18.08±7.09	28.69±9.07	-5.866	0.000*

Table 3. Pain Threshold & Pain Tolerance Among Male and Female Students

*< 0.05; significance among the sex

	Blood Group				F-value	p-Value
	A+	B+	O+	AB+		
Pain threshold (seconds)	17.90 ± 7.53	22.85 ± 7.03	22.48 ± 7.64	16.60 ± 1.67	2.89	0.041*
Pain tolerance (seconds)	20.33 ± 11.43	26.96 ± 7.64	20.44 ± 7.84	22.20 ± 13.62	2.92	0.390

Table 4. Pain Threshold & Pain Tolerance Among Different Blood Groups

*< 0.05; Significance among the different blood group

Table 4 shows the average pain threshold and pain tolerance among the different blood groups. Students having blood group B have highest pain threshold (22.85 ± 7.03 seconds), followed by blood group O (22.48 ± 7.64 seconds), blood group A (17.90 ± 7.53 seconds) and blood group AB have the least pain threshold (16.60 ± 1.67 seconds). Students with blood group B (26.96 ± 7.64) have the maximum pain tolerance while the students with blood group A (20.33 ± 11.43) have the least pain tolerance in response to CPT.

DISCUSSION

This study was conducted among 80 1st year medical students in the age group of 18-22 years. The average BMI of the students ranges from 18 to 21 Kg/m². Maximum number of the students were found to have blood group B and blood group O (33.8 % each), followed by blood group A (26.3 %). Least number of students have blood group AB (6.3 %). Similar findings were also reported by Agarwal et al[10] India which showed that O was the most common blood group in with AB as the least prevalent group among 10,000 healthy blood donors of North, south, east and central India. Previous study conducted among 775 Mao Naga tribe of Mao, Manipur, North-East India found that the most common blood group was O followed by A, B and AB.[13] Another study done among Assamese medical students also showed that blood group A was the most common among the study group, followed by B, O and AB.[12]

Our study found that blood group O and B are the commonest and AB, the least common among the students. Globally, distribution of blood group is unequal among different population.[9] Moreover, our study was conducted among a specific group of subjects namely 1st year medical students. These factors perhaps might have influenced the observed rate of prevalence of different blood groups in our study.

Our study showed that both the average pain threshold and average pain tolerance were higher in males when compared to females which were statistically significant too. Similar to our findings, a study by Dixon et al[20] among patient groups and healthy controls showed higher pain sensitivity in females than in males. Another study also reported that women were significantly more sensitive to cold pain, to heat

pain, and to ischemic pain than men.[21] Their result also indicated that women are more sensitive to a variety of noxious stimuli than men and menstrual cycle phase does not appear to moderate those differences in healthy men and women. However, in a study done by Larson et al [22] no sex differences in pain sensitivity during CPT was observed.

The specific underlying mechanisms of sex differences in pain are yet to be established. An interaction of biological, psychological and socio- cultural factors may be responsible for the disparity in pain perception among males and females. The influence of sex hormones are believed to be a significant source of pain-related variability observed among males and females.[23] Effects of estradiol and progesterone on pain sensitivity are relative complex, both being pro-nociceptive and anti-nociceptive while testosterone appears to be more anti-nociceptive and protective in nature supported by the evidence of association between decreased androgen concentration and chronic pain.[23,24] It has been shown in a study that women with high estradiol exhibits decreased pain sensitivity and increased endogenous opioid neurotransmission while the low estradiol is associated with decreased endogenous opioid neurotransmission.

In our study, blood group B showed higher pain threshold or lower pain sensitivity and pain tolerance among the different blood groups while blood group AB have the least pain threshold and blood group A have the least pain tolerance. Similar findings have been reported by Simoni et al.[19] It was concluded from their study that blood group B showed lowest pain sensitivity with blood group AB displaying a tendency towards increased general pain sensitivity. However, a study by Shankar et al[18] observed a tendency of blood group B exhibiting a non-significant lowest pain threshold and pain tolerance. In another study done by Lausten et al[25] in patients who had undergone reconstructive knee surgery, there was no significant difference between post-operative pain measured by the amount of post-operative analgesics consumed and blood types A, B and O.

Study conducted by Maram at el[26] found that there is a significant reduction in fibromyalgia symptoms including pain scores (VAS score) with low "fermentable oligo-, di- or mono-saccharides and polyols (FODMAP) diet. Previous study in rats also suggested that High fatty diets, rather than obesity per se, increased pain behaviors.[27] All the above findings are suggestive of an association between diet types and pain perception among the different blood groups though further research is required. Another possible theory is the involvement of enzyme Glycosyltransferases in synthesis of ABO blood group which may contribute to different nociceptive patterns as the glycosyltransferases are involved in nerve myelination.[28]

CONCLUSIONS

There is an association of pain sensitivity and blood group, with individuals having blood group B having highest pain threshold and pain tolerance, while individuals having blood group AB showing least pain threshold and individuals with blood group A showing least pain tolerance.

Limitations

Our study was conducted among a limited group of 1st year medical students. Unequal distribution of blood groups at local

and global level and also the inability to enrol equal number of subjects having different blood groups in the present study also might have influenced the results of the study inviting the need of further research.

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