Correlation of ABO and Rh blood groups with transfusion administration and fever onset after hip surgery in children

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Radivoj Brdar*/**, Ivana Petronic**/°, Dejan Nikolic°, Zoran Golubovic*/**, Bojan Bukva*, Vladimir Radlovic*, Dusan Abramovic*, Sinisa Ducic*/**, Hristina Colovic°°

**Pediatric Surgery Department, University Children's Hospital, Belgrade, Serbia*
***Faculty of Medicine, University of Belgrade, Belgrade, Serbia*
°Physical Medicine and Rehabilitation Department, University Children's Hospital, Belgrade, Serbia
°°Clinic for Physical Medicine and Rehabilitation, Clinical Centre of Nis, Nis, Serbia

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OBJECTIVE: *Aim of our study was to evaluate distribution of ABO and Rh blood type groups in children after hip surgery regarding transfusion administration and fever presence.*
METHODS: *Four types of ABO blood groups (A; B; AB; O) and 2 types of Rh blood groups (Rh+; Rh-) were evaluated in group with administered transfusion (tr+) and without given transfusion (tr-); and in group with fever (fev+) and without fever (fev-), in 146 children after hip surgery. Tr+ and fev+ groups were divided into 3 groups (0-24h; 25-48h; 49-72h): for tr+ group (Group 1, Group 2, Group 3), and for fev+ group (Group A, Group B, Group C).*
RESULTS: *AB blood group significantly decreased in Group 1 (χ^2= 6.44; p<0.05) and A blood group in Group 3 in tr+ group (χ^2= 7.68; p<0.01). O blood group significantly increased in Group 3 in tr+ group (χ^2= 9.96; p<0.01). AB blood group significantly decreased in Groups B (χ^2= 12.2; p<0.01) and C (χ^2= 4.2; p<0.05) in fev+ versus fev- group. B blood group significantly increased in Group C (χ^2= 34.4; p<0.01) in fev+group.*
CONCLUSION: *Administration of transfusion and fever onset in pediatric patients undergoing surgical correction of the hip is not influenced by the ABO and Rh blood groups system* in *humans. There is correlation between distribution of ABO blood groups with the time of transfusion administration and fever onset in children after hip surgery.*

KEY WORDS: Blood groups, Children, Fever, Surgery, Transfusion.

Introduction

Previously it was noticed that distribution of ABO blood groups differ between different populations [1,2]. Even though it is shown that certain blood groups are more prevalent and others not in healthy individuals of different populations, it is shown as well that such distinctions are present in different pathological conditions [3-6]. In the study of Matalliotakis et al, it is found that women with endometriosis have higher incidence of A blood group [3], while in the study of de Giorgi et al, authors point out to correlation between O Rh-negative blood group and possibility of melanoma [4]. For the exocrine pancreas malignancy it is stressed out that there is correlation with certain types of blood groups (lower frequency of O blood group) [5]. Discussions regarding possible association of some vascular disorders and non-O blood group were previously reported [6]. It was stressed out that individuals with O blood group have approximately 25% lower plasma levels of von Willebrands factor (VWF) [7]. The justification for possible correlation between O blood group and plasma levels of VWF is because of the fact that it is found that there are not significant differences among different blood groups regarding VWF plasma levels in neonates and infants [7]. It was noticed in several studies as well that certain ABO

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Correspondence to: Dejan Nikolic, MD, PhD, Physical Medicine and Rehabilitation Department, University Children's Hospital, Nikole Stefanovica 3, 11000 Belgrade, Serbia (E-mail: denikol27@yahoo.com)

blood groups closely correlate with increased sensitivity to different pathogens resulting in infection and increased body temperature (fever) [8-10]. In the favor of such observation it was pointed out that severity of infection can be linked to ABO phenotype directly [11].
Given the facts above, we hypothesized that increased bleeding and fever in children after hip surgery could be associated with different distribution of ABO and Rh blood groups. Therefore, the aim of our study was to evaluate distribution of ABO and Rh blood type groups in children after hip surgery regarding the transfusion administration and fever presence.

Material and Methods

In our study we included 146 children after hip surgery. We have evaluated 4 types of ABO blood groups (A; B; AB; O) and 2 types of Rh blood groups (Rh+; Rh-). Two main parameters were observed: transfusion administration and febrile status. Group with administered transfusion (tr+) and group without given transfusion (tr) as well as group with fever (fev+) and group without fever (fev-) were separately assessed. Regarding the time of transfusion, patients were grouped into 3 groups: Group 1 included those that were given transfusion within first 24 hours post surgery, Group 2 between 25 and 48 hours post surgery and Group 3 between 49 to 72 hours post surgery. Regarding the time of fever onset, patients were grouped into 3 groups: Group A included those that were developed fever within first 24 hours post surgery, Group B between 25 and 48 hours post surgery and Group C between 49 to 72 hours post surgery. Prior inclusion in the study, parents or legal guardians were informed about the procedures and consent was obtained. Transfusion administration was given according to recommendations for hemoglobin levels (hemoglobin threshold at 7g/dl) [12]. Analyses of ABO and Rh blood groups were done with the assistance of the Saint Sava Institute for blood transfusion from Belgrade in Serbia.
All patients were evaluated for the presence of inflammation before surgery in order to exclude possible febrile status as the result of infection preoperativelly. Blood samples were drown at the admission and further inflammatory parameters were analyzed: sedimentation rate (mm/hour), C reactive protein (CRP) (mg/L) and white blood cells (WBC) (x1000/mm^3) count. Patients with confirmed presence of inflammation were excluded from evaluation. Values exceeding 20 mm/hours for sedimentation rate (elevated sedimentation rate (ESR)), 20 mg/L for CRP and 15x1000/mm^3 for WBC were considered elevated for observed parameter [13]. According to the recommendations, the children with rectal fever≥38 ^{o}C were considered to be febrile [14].
We have evaluated children age over 18 months of life since it is shown that normal adult I antigen status that could be associated with plasma levels of VWF is reached in this period of life [7].
Evaluated parameters were presented as whole numbers and percents. Chi squared test (χ^2) was used to evaluated presence of significance between proportions of observed elevated groups of participants separatelly for ABO and for Rh blood groups. Statistical significance was set on $p<0.05$.

Results

In Table I we present distribution of ABO blood groups in evaluated group of patients due to the transfusion administration. The most frequent blood type in both groups (those that were given transfusion and those without transfusion) was A blood type. Regarding the subjects with given transfusion, A blood group was most frequent in those within first 24 hours, while less fre-

TABLE I - *Distribution of ABO blood groups in children after hip surgery regarding transfusion administration.*

Distribution of ABO blood groups		**Blood groups**			
		A N(%)	**B** N(%)	**AB** N(%)	**0** N(%)
Group with transfusion (tr+) (time from operation)	Group 1 (0-24h) N=42	24 (57.1)	5 (11.9)	1 (2.4)	12 (28.6)
	Group 2 (25-48h) N=25	10 (40.0)	2 (8.0)	3 (12.0)	10 (40.0)
	Group 3 (49-72h) N=23	7 (30.4)	2 (8.7)	3 (13.1)	11 (47.8)
	Total N=90	41 (45.6)	9 (10.0)	7 (7.8)	33 (36.6)
Group without transfusion (tr-)	N=56	28 (50.0)	5 (8.9)	6 (10.7)	17 (30.4)

TABLE II - *Distribution of Rh blood groups in children after hip surgery regarding transfusion administration*

Distribution of Rh blood groups		Rh + N (%)	Rh – N (%)
Group with transfusion (tr+) (time from operation)	Group 1 (0-24h) N=42	36 (85.7)	6 (14.3)
	Group 2 (25-48h) N=25	22 (88.0)	3 (12.0)
	Group 3 (49-72h) N=23	19 (82.6)	4 (17.4)
	Total N=90	77 (85.6)	13 (14.4)
Group without transfusion (tr-)	N=56	46 (82.1)	10 (17.9)

TABLE III - *Differences in prevalence of ABO and Rh blood groups among different groups of patients regarding transfusion administration*

Blood groups (χ^2)	tr-/tr+$_{Total}$	tr-/tr+$_{Group\ 1}$	tr-/tr+$_{Group\ 2}$	tr-/tr+$_{Group\ 3}$
A	0.39	1.01	2.00	7.68**
B	0.14	1.01	0.10	0.00
AB	0.79	6.44*	0.16	0.54
O	1.26	0.11	3.03	9.96**
Rh+	0.15	0.16	0.42	0.00
Rh-	0.68	0.72	1.94	0.01

*p<0.05; **p<0.01

quent was AB. In the period between 25 and 48 hours post surgery A and O blood groups showed equal distribution, while B blood group had lowest distribution. For the period between 49 to 72 hours postoperatively the most frequent blood group was O, while B blood group remained with lowest frequency.

In Table II. we present distribution of Rh blood groups in evaluated operated children due to the transfusion administration. For all evaluated groups, Rh+ blood group had highest frequency, with the highest values in the group of operated children that were given transfusion between 25 and 48 hours postoperatively (88.0%).

In Table III. we present differences in prevalence of ABO and Rh blood groups among evaluated groups of patients. Significantly decreased frequency of AB blood group (χ^2= 6.44; p<0.05) was found in patients that were given transfusion within first 24 hours and for those with A blood group (χ^2= 7.68; p<0.01) that were administered transfusion between 49 to 72 hours post surgery, compared to operated patients without transfusion. Significantly increased frequency of O blood group (χ^2=9.96; p<0.01) was found in those patients that were given transfusion between 49 to 72 hours post surgery compared to surgically treated subjects without given transfusion.

In Table IV. distribution of ABO blood groups in evaluated operated children regarding the febrile status was analyzed. The most frequent blood type in both groups (those that got fever and those febrile state) was A blood group. Regarding the subjects with fever, A blood group was most frequent in those within first 24 hours post surgery, while less frequent was B blood group. In the period between 25 and 48 hours post surgery A blood group remained to be most frequent, while we had no patients with AB blood group. For the period between 49 to 72 hours postoperatively the most frequent blood group was A, while AB blood group was with lowest frequency.

In Table V we present distribution of Rh blood groups in evaluated operated children regarding the presence of febrile state. For all evaluated groups, Rh+ blood group had highest frequency, with the highest values in the group of operated children that got fever (febrile condition) between 0 and 24 hours postoperatively (89.8%).

In Table VI we present differences in prevalence of ABO

TABLE IV - *Distribution of ABO blood groups in children after hip surgery regarding febrile status*

Distribution of ABO blood groups		Blood groups A N (%)	B N (%)	AB N (%)	0 N (%)
Group with fever (fev+) (time from operation)	Group A (0-24h) N=59	31 (52.5)	3 (5.1)	5 (8.5)	20 (33.9)
	Group B (25-48h) N=18	9 (50.0)	2 (11.1)	0 (0.0)	7 (38.9)
	Group C (49-72h) N=20	8 (40.0)	5 (25.0)	1 (5.0)	6 (30.0)
	Total N=97	48 (49.5)	10 (10.3)	6 (6.2)	33 (34.0)
Group without fever (fev-)	N=49	22 (44.9)	4 (8.2)	6 (12.2)	17 (34.7)

TABLE V - *Distribution of Rh blood groups in children after hip surgery regarding febrile status*

Distribution of Rh blood groups		Rh + N (%)	Rh – N (%)
Group with fever (fev+) (time from operation)	Group A (0-24h) N=59	53 (89.8)	6 (10.2)
	Group B (25-48h) N=18	14 (77.8)	4 (22.2)
	Group C (49-72h) N=20	16 (80.0)	4 (20.0)
	Total N=97	83 (85.6)	14 (14.4)
Group without fever (fev-)	N=49	40 (81.6)	9 (18.4)

TABLE VI - *Differences in 16 blood groups among different groups of patients regarding fever*

Blood groups (χ^2)	fev-/fev+$_{Total}$	fev-/fev+$_{GroupA}$	fev-/fev+$_{GroupB}$	fev-/fev+$_{GroupC}$
A	0.5	1.3	0.6	0.5
B	0.5	1.2	1.0	34.4**
AB	3.0	1.1	12.2**	4.2*
0	0.0	0.0	0.5	0.6
Rh+	0.2	0.8	0.2	0.0
Rh-	0.9	3.7	0.8	0.1

*p<0.05; **p<0.01

and Rh blood groups among different groups of patients regarding presence of fever. Significantly decreased frequency of AB blood group was found in patients that had onset of fever between 25 and 48 hours post surgery (χ^2=12.2; p<0.01) and 49 to 72 hours post surgery (χ^2=4.2; p<0.05), compared to operated patients without fever. Significantly increased frequency of B blood group (χ^2=34.4; p<0.01) was found in patients that had fever onset between 49 to 72 hours post surgery compared to surgically treated subjects without fever.

Discussion

Our results point out that administration of transfusion in pediatric patients undergoing surgical correction of the hip is not influenced by the ABO and Rh blood groups system in humans. However it is seen that as the period for the inclusion of transfusion is longer from the operation there is decrease in frequency of A blood group with significant decline in the period between 49 to 72 hours post surgery, and increase in frequency of AB and O blood groups in operated subjects with significant increase of O blood group in the period between 49 to 72 hours post surgery. These results could point out to the possible correlation of certain ABO blood groups regarding the period of transfusion administration after surgery in these patients. Possible bleeding as traumatic response to the stressogenic factor (surgery) could be one of the potential answers for increased frequency of O blood group in patients that were given transfusion after 49 to 72 hours post surgery. Increased possibility of bleeding in patients with O blood group was previously reported by several authors [15-17], stating that patients with this blood group could be at higher risk due to the lower amount of von Willebrand factor compared with patients with other blood groups. In the study of Mahapatra and Mishra [18] it is noticed that AB blood group is associated with prolonged bleeding time, while we found that this blood group is significantly less frequent in the period of 24 h after surgery for the group that was given transfusion. It can be seen from our results that frequency of AB blood group is significantly rising in later period post surgery of the hip in children for the group with administered transfusion, pointing out increased possibility of bleeding. Also, previous studies indicated as well association between peptic ulcers that might be associated with bleeding and could be present after exposure to stressogenic factors and O blood group [19]. Given the facts above, it can be seen that for those pediatric patients, after hip surgery, with given transfusion, there is correlation between distribution of ABO blood groups and the time of transfusion administration. As for the above mentioned analyses, it is seen from the results of our study that there is not significant difference in the frequency of ABO blood groups and Rh blood groups between patients that were not febrile and the group with fever. However, for the group of patients that had fever postoperatively, it is noticed that there is steady decline in frequency of A blood group as the time from the operation to the fever onset is longer. Opposite is shown for the B blood group, with significant increase of one for the patients that manifested as febrile between 49 to 72 hours post surgery versus those without fever. Significant decline in frequency of AB blood group was observed in patients that had fever after 25 hours post surgery. It can be seen, that for those children after hip surgery with acquired fever, there is correlation between distribution ABO blood groups and the time of fever onset. The results of our study are in correlation with other findings, pointing out that different blood groups are more sensitive versus other to the possibility of acquiring infection that could be manifested as a fever [9,10,20]. Such observations can be explained by the fact that there might be correlation between host genetics and environmental factors (i.e. infectious agents) in the genesis of diseases.

Given the facts above, it can be concluded that there is correlation between distribution of ABO blood groups

with the time of transfusion administration and fever onset in children after hip surgery

Riassunto

SCOPO DELLO STUDIO: Valutare la distribuzione dei gruppi sanguigni AB0 e Rh nei bambini sottoposti a chirurgia ortopedica dell'anca in relazione alla necessità di somministrare trasfusioni ematiche e la comparsa di febbre.
METODO DI STUDIO: 146 bambini sottoposti a chirurgia dell'anca sono stati suddivisi in quattro gruppi secondo l'appartenenza ai gruppi A, B, AB e 0, ed in due gruppi secondo l'appartenenza al tipo Rh+ ed Rh-, distinguendo quelli che ricevettero trasfusioni di sangue (tr+) da quelli che non furono trasfusi (tr-), controllando quanti svilupparono reazione febbrile (fev+) da quelli senza reazione febbrile (fev-).
I gruppi tr+ e fev+ furono suddivisi in tre gruppi distinti cronologicamente (0-24h; 25-48h; 49-72h): tre gruppi per i tr+ (Gruppo 1,Gruppo 2,Gruppo 3), e per I gruppi fev+ (Gruppo A, Gruppo B, Gruppo C).
RISULTATI: il gruppo sanguigno AB era significativamente meno rappresentato nel Gruppo 1 (χ^2=6.44; p<0.05) come pure il gruppo sanguigno A nel Gruppo 3 tra i gruppi tr+ (χ^2=7.68; p<0.01). Il gruppo sanguigno 0 si è dimostrato significativamente più rappresentato nel Gruppo 3 tra i gruppi t+ (χ^2=9.96; p<0.01). Il gruppo sanguigno AB è risultato significativamente meno rappresentato nel Gruppo B (χ^2=12.2; p<0.01) e nel Gruppo C (χ^2=4.2; p<0.05) nel gruppo fev+ rispetto al gruppo fev-. Il gruppo sanguigno B è risultato significativamente più rappresentato nel Gruppo C (χ^2=34.4; p<0.01) nel gruppo fev+.
CONCLUSIONE: La somministrazione di emotrasfusioni e l'insorgenza di febbre nei pazienti in età pediatrica sottoposti a chirurgia ortopedica per correzione dell'anca non dimostra influenza nei gruppi sanguigni AB0 ed Rh nella razza umana. Esiste una correlazione tra la distribuzione dei gruppi sanguigni AB0 e la cronologia della somministrazione delle emotrasfusioni e della insorgenza di febbre nei bambini sottoposti a chirurgia dell'anca.

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