

Short Communication

Comparative Study of Neutrophil Activities in Adults and Full-Term Neonates in Relation to the Method of Delivery

(neutrophil activity markers / neonate / adult / comparative study)

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Abstract. The aim of this study was to compare the markers of neutrophil activity in healthy adults with those in healthy neonates in relation to the method of delivery. The following parameters were studied: absolute neutrophil count, neutrophil adherence to nylon fiber, NBT reduction, and neutrophil phagocytosis of latex particles. The study has shown that the method of delivery significantly affects the markers of neutrophil activity measured in umbilical cord blood. The levels of these markers were higher in neonates born by elective cesarean section than in adults, neonates born vaginally or those born by emergency cesarean section. This comparative study of defensive functions of neutrophils from adults and neonates indicates that the conflicting results of other studies may be caused not only by differences in investigative methodology but also by the fact that the eligibility criteria used in these studies did not include the method of delivery, which can affect the markers of neutrophil activity via triggering a stress response.

The susceptibility of the fetus and the neonate to infection is still an important problem of modern neonatology. For many years, attempts have been made to determine the causes of fulminant infections and frequent postinfectious complications in neonates. At present, the insufficiency of the neonatal immune system is thought to be the main cause of these events.

The ability of the neonate to promptly respond to infective microorganisms is primarily dependent on the efficacy of phagocytes, the oldest, in terms of phylogenesis, constituents of the immune system, among which neutrophils play a key role. Some studies of the neonatal immune system have shown differences in biologic function between neonatal and adult neutrophils.

However, the results of these studies are often called into question (Wilson, 1990; Speer and Johnston, 1992; Johnston, 1996). Some authors suggest that labor-related stress and the method of delivery may modify the components of immune response in neonates (Frazier et al., 1982; Gasparoni et al., 1990; Usmani et al., 1993).

The aim of this study was to evaluate the number, function and metabolism of umbilical cord blood neutrophils from healthy, full-term, eutrophic neonates in relation to the method of delivery and to compare these parameters with those of neutrophils from healthy adults.

Material and Methods

Sixty-nine full-term neonates born at the Department of Obstetrics and Gynecology, Medical University of Silesia, Katowice, were included in the study. The fetal age assessed by the method of Naegely ranged from 37 to 42 weeks and it differed from that assessed by the method of Dubowitz by not more than 2 weeks. The body weight of the neonates corresponded to their fetal age (mean 3430 ± 397g). The Apgar scores at 1 and 3 min ranged from 7 to 10.

The neonates were divided into 3 groups. Group A included 25 neonates delivered by elective cesarean section because of small pelvis abnormalities, abnormal fetal positions, or a history of cesarean section. Group B included 40 neonates delivered vaginally. Group C included 4 neonates delivered by emergency cesarean section during labor because of prolonged labor or abnormal cardiotocographic recordings indicating a life-threatening fetal condition.

The following neonates were excluded from the study: neonates born by mothers who contracted infections in the last trimester and by those with diabetes mellitus, gestosis or hypertension; neonates with congenital defects and those born by mothers receiving corticosteroids during pregnancy. The neonates included in the study showed no clinical symptoms of infection.

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Abbreviations: NBT test – nitroblue-tetrazolium test.

The control group included 20 healthy adults (8 women and 12 men) aged 20–50 years (mean 39 years) that showed no infection and were given no medications over a period of 3 months before the study.

Neonatal neutrophils were obtained from blood that was collected from the umbilical vein immediately after the umbilical cord was cut. Adult neutrophils were obtained from blood that was collected from the cubital vein during fasting between 8.00 and 10.00 a.m.

To assess neutrophil function, the following parameters were measured:

1. The absolute number of neutrophils was determined by means of the Technicon hematological automatic device Hemalog-D.
2. Neutrophil adherence to nylon fiber according to the method of McGregor (McGregor et al., 1978). The method has been described in detail elsewhere (Hrycek, 1993).
3. Nitroblue-tetrazolium (NBT) reduction by neutrophils quantified by means of a modification of the spontaneous and stimulated NBT reduction test described by Park (Park et al., 1968). The method was determined as presented previously (Hrycek, 1995).
4. Neutrophil phagocytic activity towards latex particles (Walters et al., 1971). The method was also presented previously (Hrycek, 1993).

Statistical analysis

The results are expressed as the arithmetic means (\bar{X}) \pm standard deviation (SD). The significance of differences between groups was analyzed by Student's t-test. When the variances were unequal, the C Cochran-Cox test was used.

Results

The results of the study expressed as the $\bar{X} \pm$ SD and their statistical analysis are presented in Table 1.

The absolute neutrophil count in umbilical cord blood was significantly higher in all neonatal groups (A–C) compared with the adult group. The highest values were found in neonates delivered vaginally and those delivered by emergency cesarean section.

Neutrophil adherence to nylon fiber also showed significant changes, depending on the method of delivery. It decreased significantly in neonates delivered either vaginally or by emergency cesarean section, while in adults and neonates delivered by elective cesarean section it reached similar levels.

The degree of NBT reduction was significantly higher in all neonatal groups compared with adults. The highest degree of NBT reduction was found in neonates delivered by emergency cesarean section.

Latex-stimulated NBT reduction in neonates did not differ significantly from that in adults and it was affected by the method of delivery.

Neutrophil phagocytic activity was significantly higher in neonates delivered by elective cesarean section compared with adults, whereas it decreased significantly in neonates delivered either vaginally or by emergency cesarean section.

Discussion

Neutrophils constitute the first line of defense that is encountered by microorganisms trying to infect the host. The basic functions of neutrophils, such as adherence, chemotaxis, phagocytosis, and degradation, have been extensively studied. The results of these studies are often controversial, probably because of methodological differences and diversification of the groups studied.

The host defense depends among other things on the number of neutrophils. When the absolute neutrophil count decreases below the normal value, the defensive potential of the host is reduced, even when neutrophils display normal chemotaxis, phagocytosis and intracellular degradation of antigen.

Table 1. Comparative analysis of the number and the functional and metabolic properties of adult and neonatal neutrophils in relation to the method of delivery

Parameter	Number of neutrophils in 1 l of blood		Percentage of adhering neutrophils (%)		Percentage of neutrophils phagocytosing latex particles (%)		Spontaneous NBT reduction by neutrophils (%)		Latex-stimulated NBT reduction by neutrophils (%)	
	$\bar{X} \pm$ SD	P	$\bar{X} \pm$ SD	P	$\bar{X} \pm$ SD	P	$\bar{X} \pm$ SD	P	$\bar{X} \pm$ SD	P
Newborns delivered by elective cesarean section Group A N = 25	$4.6 \times 10^9 \pm 1.9$	A v. D < 0.05	96.5 ± 2.59	A v. D n.s.	74.6 ± 8.9	A v. D < 0.05	20.8 ± 13.4	A v. D < 0.05	42.9 ± 7.4	A v. D n.s.
Newborns delivered vaginally Group B N = 40	$7.8 \times 10^9 \pm 1.8$	B v. D < 0.001	91.3 ± 4.5	B v. D < 0.001	62.1 ± 14.1	B v. D < 0.001	17.1 ± 13.7	B v. D n.s.	40.1 ± 9.9	B v. D n.s.
Newborns delivered by emergency cesarean section Group C N = 4	$8.1 \times 10^9 \pm 1.6$	C v. D < 0.05	90.9 ± 5.1	C v. D < 0.05	61.0 ± 11.9	C v. D < 0.05	17.9 ± 12.8	C v. D n.s.	40.8 ± 10.3	C v. D n.s.
Adults Group D N = 20	$3.2 \times 10^9 \pm 0.6$	–	97.1 ± 3.5	–	69.1 ± 8.3	–	14.0 ± 4.2	–	42.5 ± 8.3	–

N – the group size

n.s. – non-significant

v. – versus