

Are Nucleated Red Blood Cells in Umbilical Blood Affected By General or Spinal Anesthesia?

UMBİLİKAL KANDA BULUNAN NUKLEUSLU ERİTROSİTLER GENEL VEYA SPİNAL ANESTEZİDEN ETKİLENİRLER Mİ?

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Abstract

Objective: Circulating red blood cells in term infants vary in size and shape and have a shorter survival than that of normal adult red blood cells. Erythropoietin in turn is regulated by the relative availability of oxygen in circulation. The aim of this study is to determine the relationship between nucleated red blood cell count and umbilical chord blood gases and the effects of general or spinal anesthesia on nucleated red blood cell count during the elective cesarean section.

Material and Methods: ASA I-II physical status, between aged 18-38 years old, eighty patients scheduled for elective cesarean section. Patients were randomly divided into two groups. Patients in group I (n= 40) received spinal anesthesia. Patients in group II (n= 40) received general anesthesia. After delivery of babies, Apgar scores at 1st and 5th minutes were assessed, umbilical chord artery and vein blood gases were analyzed and blood was supplied from the umbilical vein for nucleated red blood cell assessment in all groups.

Results: There were no significant differences in nucleated red blood cell rate, and number and Apgar scores between the groups.

Conclusion: Both spinal and general anesthesia did not have any effect on nucleated red blood cell counts.

Key Words: Erythrocytes, anesthesia, spinal, general anesthesia

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Özet

Amaç: Termdeki infantta dolaşımda bulunan eritrositin yetişkindekilere göre boyutu, şekli değişkendir ve daha kısa yaşam süresine sahiptir. Eritropoetin dönüşümü dolaşımda kısmen bulunan oksijen ile düzenlenir. Bu çalışmanın amacı elektif sezaryen geçiren hastalarda genel veya spinal anestezinin etkisinin nükleuslu eritrosit sayısı ile umbilikal kord kan gazlarına olan etkisinin ve ilişkisinin saptanmasıdır.

Gereç ve Yöntemler: ASA I-II, 18-38 yaş ortalaması, elektif sezaryen geçiren 80 hasta çalışmaya dahil edildi. Hastalar iki gruba ayrıldı. Grup I'deki (n= 40) hastalara spinal anestezi, Grup II'de (n= 40) genel anestezi uygulandı. Bebek çıkarıldıktan sonra 1 ve 5. dk Apgar skorları değerlendirildi. Tüm hastalarda umbilikal arter, ven kan gazları nükleuslu eritrosit için kan sayımı yapıldı.

Bulgular: Her iki grup arasında nükleuslu eritrosit yönünden belirgin bir fark yoktu.

Sonuç: Spinal ve genel anestezinin nükleuslu eritrosit sayısı üzerine bir etkisi yoktur.

Anahtar Kelimeler: Eritrosit, anestezi, spinal, genel anestezi

Nucleated red blood cells, (NRBC), represent the stages of a red blood cell before it matures. Cells of this stage are usually seen in newborn infants, and in patients with res

ponses to hemolytic crises, such as in megaloblastic anemia and iron deficiency anemia. The average size of the normoblast is 7-12 µm in diameter. The cytoplasm is pink. The nucleus is pyknotic (a homogeneous blue-black mass with no structure). Although NRBC are rarely found in the circulation of older children, they are commonly seen in the blood of newborns. They are primarily produced in the fetal bone marrow in response to erythropoietin and are stored in the marrow as precursors to reticulocytes and mature erythrocytes. Many acute

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and chronic stimuli cause increases in the number of circulating NRBC from either increased erythropoietic activity or a sudden release from the marrow storage pools.¹

Circulating red blood cells in term infants vary in size and shape and have a shorter survival than that of normal adult red blood cells.² The presence of immature forms reflects the relatively hypoxic nature of the fetal environment. NRBCs are immature erythrocytes; their number is elevated in the circulation of preterm fetuses, diminishing in number as the pregnancy progresses.³

Red blood cell production is driven by erythropoietin. Erythropoietin in turn is regulated by the relative availability of oxygen in circulation. Erythropoietin does not cross the placenta, but levels have been found to be elevated in umbilical blood in cases of fetal acidemia.⁴ The presence of increased numbers of NRBCs in the circulation of term infants has been associated with states of relative hypoxia, such as intrauterine growth retardation, maternal diabetes, and preeclampsia.^{5,6} NRBC have also been implicated as a possible marker of perinatal brain damage.⁷

In this study we sought to determine the relationship between NRBC and umbilical chord blood gases and the effects of general or spinal anesthesia on NRBC count during the elective cesarean section. We therefore hypothesized that way of anesthesia might affect the NRBC. Thus, NRBC count might show us the hypoxia if the new born is affected from anesthesia.

Material and Methods

After obtaining Faculty Ethics Committee approval and informed patient consent, we studied ASA I-II physical status, aged between 18-38 years old eighty patients scheduled for elective cesarean section. Patients were randomly divided into two groups. In the operating room spinal anesthesia was performed after insertion of iv cannula and infusion of crystalloid fluid. Monitoring included ECG, non-invasive arterial blood pressure and peripheral oxygen saturation.

Patients in group I (n= 40) received spinal anesthesia. With patient lying in the left lateral position, a 27 gauge Whitacre spinal needle via a 20 gauge introducer was inserted at L₃₋₄ interspace. After the free flow of cerebrospinal fluid was obtained with the correct placement of spinal needle; 1.5ml 0.5% hyperbaric bupivacaine was administered over 10 s without barbotage. Patients were turned supine with left uterine displacement using a wedge pillow under the right hip.

Patients in group II (n= 40) received general anesthesia. After preoxygenation, 5 mgkg⁻¹ thiopental and 100 mg succinylcholine was administered for intubation. Anesthesia was maintained with 1% sevoflurane in 50% N₂O-O₂ mixture and 0.1 mg fentanyl (after delivery of baby).

ECG, systolic blood pressure (SBP), diastolic blood pressure (DBP) were recorded with 5 minutes intervals intraoperatively and also time of uterine incision and time of delivery of the baby were recorded. After delivery of babies, Apgar scores at 1st and 5th minutes were assessed, umbilical chord artery and vein blood gases were analyzed and blood was collected from the umbilical vein for NRBC assessment in all groups.

NRBC count was determined automatically on a Coulter LH 750 hematology analyzer (Beckman Coulter, CA, USA). Blood gas analysis was measured with a Statprofile analyzer (Nova Biomedical, USA). NRBC count was expressed as an absolute number and as a percent.

Hypotension and bradycardia were defined as 25% decrease of baseline measurements. Patients were also assessed with respect to other complications such as nausea, vomiting, headache, respiratory depression and neurological sequel.

All values are expressed as means \pm SD. Statistical analysis were performed by using Independent sample t test, Mann Whitney U test, and chi-square test. $p < 0.05$ was considered as statistically significant.

Table 1. Maternal and fetal demographic properties and operation duration characteristics (*Mean ± SD*).

	Group I (n= 40)	Group II (n= 40)	P value
Age (year)	28.2 ± 4.4	29.2 ± 4.2	NS
Weight (kg)	71.2 ± 7	72.3 ± 6.6	NS
Duration of surgery (min)	50.5 ± 5.5	47.1 ± 6.5	P= 0.017
Gestation age (week)	38.4 ± 1.5	38 ± 1.5	NS
Weight of fetus (g)	3226.4 ± 250.6	3123 ± 486.4	NS
Skin to uterine incision (min)	3.4 ± 0.7	2.3 ± 0.4	P= 0.001
Uterine incision to delivery (min)	2.4 ± 1.2	1.7 ± 1.4	P= 0.001

NS: not significant

Results

There were no significant differences among the two study groups with respect to age, weight, gestation age and weight of the fetus (Table 1). Similarly, systolic blood pressure and heart rate values did not significantly differ between the groups. Duration of surgery was longer in spinal anesthesia group than that of general anesthesia group ($p < 0.05$). Skin to uterine incision and uterine incision to deliver times were statistically longer in group I ($p < 0.05$).

There were no differences in NRBC rate, and number and Apgar scores between the groups. (Table 2) Also there were no statistically significant differences in the umbilical blood gases analyzes between both groups (Table 3).

Hypotension was observed in only 17 patients in group I and 2 patients in group II. It was treated with 5 mg efedrine. No other side effects were observed in both groups.

Discussion

NRBC are often present in the circulations of normal term neonates even sometimes in high number. Elevated NRBC cell counts are associated with neonatal acidemia, hypoxia and intrauterine growth retardation as shown in previous studies. Also, lower Apgar scores are associated with elevated NRBC counts.⁸

In our literature review we could not find any study which searched the relationship between

Table 2. NRBC and Apgar scores (*Mean ± SD*).

	Group I (n= 40)	Group II (n= 40)	P value
NRBC (%)	1.8 ± 2.3	1.8 ± 2.3	NS, p= 0.77
NRBC (n)	1.2 ± 6.3	0.2 ± 0.3	NS, p= 0.65
1 st min Apgar	9.1 ± 1.1	9 ± 1.2	NS, p= 0.37
5 th min Apgar	9.9 ± 0.2	9.9 ± 0.8	NS, p= 0.11

NS: not significant

Table 3. Umbilical blood gases values (*Mean ± SD*).

	Group I (n= 40)	Group II (n= 40)	P value
pH (a)	7.37 ± 3.8	7.21 ± 1.7	NS
pH (v)	25.4 ± 3.3	24.2 ± 3.1	NS
pO ₂ (a)	29.1 ± 9.1	28.9 ± 9	NS
pO ₂ (v)	19 ± 96.2	18.6 ± 8.4	NS
pCO ₂ (a)	40.5 ± 5.4	40.1 ± 6.1	NS
pCO ₂ (v)	46.26 ± 4	44.9 ± 8.6	NS
HCO ₃ (a)	24.5 ± 3.7	25 ± 3.4	NS
HCO ₃ (v)	25.6 ± 3.9	25.5 ± 2.9	NS
O ₂ Sat (a)	57.6 ± 15.6	50.7 ± 17.2	NS
O ₂ Sat (v)	28.81 ± 4.1	23.5 ± 12.8	NS

NS: not significant

(a): umbilical arterial

(v): umbilical venous

NRBC count, umbilical chord blood gases and the affects of anesthesia on NRBC. So, this is the first

study which was aimed to search the effects of general or spinal anesthesia on NRBC count during the elective cesarean section.

It is known that NRBC count to be elevated in cases of both respiratory and metabolic acidemia.⁹ Respiratory acidemia is often thought to occur in response to an acute hypoxic event. As expected, uncompensated metabolic acidemia was associated with higher NRBC counts.⁸

The magnitude of the increase in NRBCs following acute asphyxia is a function of both the severity and duration of the asphyxia. Hanlon-Lundberg and Kirby⁹ evaluated the relation between the severity of asphyxia and increased NRBCs by comparing cord NRBCs with cord pH and Apgar scores. The NRBC counts increased with progressive increases in cord acidosis and with progressive decreases in the Apgar scores. However, not all infants with low Apgar scores had increased NRBCs; in some infants with very low Apgar scores, almost no NRBCs were detected, and other infants with normal Apgar scores had increased NRBCs. Similarly, some infants with a pH 7.00 had few NRBCs, while others had normal cord pH values but considerably increased NRBCs. Other investigators have also found increased NRBCs associated with a fall in cord pH.^{10,11}

According to our data we did not observe any statistical differences in the umbilical blood gases analyzes between spinal and general anesthesia groups. None of the cases had developed any acidemic event according to their umbilical blood gases analyzes.

Apgar scores were designated as a method of quickly evaluating the status of the neonate. Hypoxia may be associated with depressed Apgar scores as well as with stimulation of NRBC production,⁹ also we did not observe any low Apgar scores. Thilaganathan found significant differences in cord NRBCs of infants born by emergency cesarean section compared with infants

born by elective cesarean section. However, there was significant overlap between the groups: in some infants born by emergency cesarean section no NRBCs were detected, and some infants born by elective cesarean section had large numbers of NRBCs.¹⁰ We did not have any emergency cesarean sections. All the cesarean section cases were elective.

The surgery timing, severity, and duration of a possible intrauterine hypoxic insult that may contribute to elevated NRBC count at birth in human is not well known and established. In our study duration of surgery was longer in spinal anesthesia group. Skin to uterine incision and uterine incision to delivery is significantly longer in spinal anesthesia group. There were no significant differences among the two study groups with respect to % of NRBC, number of NRBC. Also, hypotension was observed in only 17 patients. Either spinal or general anesthesia did not effect NRBC count.

In conclusion, both spinal and general anesthesia did not have any affect on NRBC counts. But more studies with large number of cases have to be done in order to show the affects of anesthesia on NRBC count.

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