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ETIOLOGICAL RISK FACTORS FOR BRACHIAL PLEXUS PALSY

ETIOLOŠKI RIZIČNI ČIMBENICI ZA KLJENUT BRAHIJALNOG PLEKSUSA

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Original paper

Key words: brachial plexus palsy, newborn, delivery risk factors

SUMMARY. During a period of nine years, from 01. 01. 1996 to 31. 12. 2004, 45 544 live-born children were analyzed. The analysis is retrospective and is based on medical documentation of the Clinic for Gynecology and Obstetrics, Clinic for Neurology, and Clinic for Rehabilitation and Physiatrics of University Clinical Center Tuzla. The 86 newborns with brachial plexus palsy have been recorded, the prevalence is 1.86 per 1000 live-born children. Analyzing maternal and neonatal factors, and the delivery pattern itself, it has been found that the highest risk-factors for brachial plexus injury are birth weight over 4000 grams, precipitous second stage of labor (<15 minutes), and vacuum-extractor assisted delivery of newborns. Brachial plexus palsy was more frequent when the newborns' mothers were overweight, with a body mass index ≥ 29 kg/m². None of the parturient women, whose newborns were diagnosed with brachial plexus palsy, had a narrowed pelvis. Newborns, who were delivered vaginally, were not diagnosed to have a higher frequency of brachial plexus palsy compared to newborns who were delivered by Caesarean section, but newborns with vaginal breech delivery have had a higher incidence of brachial plexus palsy. Newborns, whose mothers were older than 35, had have brachial plexus palsy more frequently; statistically significant difference between primiparas and multiparas was not found. A total of 39 newborns (45.2%) were diagnosed to have a fracture of clavicle, which was the most frequently combined damage with brachial plexus injury. The 42 newborns (48.8%) had an Apgar score of ≤ 7 in the first minute after delivery, which indicates intraparturial distress of fetus and points to traumatic nature of these deliveries. Average birth weight of newborns with plexus brachialis damage was 3858 ± 8 grams, which, for an average gestation age of 38.8 ± 1.8 weeks of gestation, corresponds to eutrophic newborns. Both male and female newborns were diagnosed to have plexus brachialis equally and almost all deliveries (97.7%) started spontaneously. The majority of newborns were born early in the morning between 2–3 hours or afternoon between 14–15 hours.

Izvorni članak

Ključne riječi: kljenut brahijalnog pleksusa, novorođenče, rizični čimbenici

SAŽETAK. U devetgodišnjem vremenskom razdoblju od 01. 01. 1996. do 31. 12. 2004. godine analizirano je 45 564 živorođene novorođenčadi. Analiza je retrospektivna, bazirana na medicinskoj dokumentaciji Klinike za ginekologiju i akušerstvo, Klinike za neurologiju i Klinike za rehabilitaciju i fizijatriju Univerzitetsko-kliničkog centra Tuzla. Registrirano je 86 novorođenčadi s paralizom pleksusa brahijalisa, incidencija je 1,89 na 1000 živorođene novorođenčadi. Analizom maternalnih i neonatalnih faktora, te samog tijeka poroda utvrđeno je da su najveći rizični faktori za nastanak povrede pleksusa brahijalisa porodna težina novorođenčeta preko 4000 grama, skraćeno drugo porodno doba (<15 minuta) te rađanje novorođenčeta uz pomoć vakuuma ekstraktora. Povreda pleksusa brahijalisa češće nastaje kod novorođenčadi gojaznih majki, kod kojih je indeks tjelesne mase ≥ 29 kg/m². Ni jedna roditeljica nije imala suženu zdjelicu. Nije nađena veća učestalost povrede pleksusa brahijalisa novorođenčadi rođene vaginalno u odnosu na novorođenčad rođenu carskim rezom, a češće nastaje povreda pleksusa brahijalisa kod novorođenčadi rođene u stavu zatkom. U novorođenčadi majki starijih od 35 godina nađena je veća učestalost povreda brahijalnog pleksusa, a nije nađena statistički značajna razlika povreda pleksusa brahijalisa između prvototkinja i višerotkinja. Najčešća združena povreda s paralizom pleksusa brahijalisa je fraktura klavikule koja je dijagnosticirana u 39 novorođenčadi (45,2%). 42 novorođenčadi (48,8%) imalo je Apgar zbroj u 1. minuti ≤ 7 , što govori o intraparturijalnoj patnji ploda i ukazuje na traumatsku prirodu ovih poroda. Prosječna porodna težina novorođenčadi s povredom pleksusa brahijalisa je 3858 ± 8 grama, što za prosječnu gestacijsku dob od $38,8 \pm 1,8$ nedjelja gestacije odgovara eutrofičnoj novorođenčadi. Povreda pleksusa brahijalisa nastaje podjednako često kod muške i ženske novorođenčadi, a gotovo svi porodi (97,7%) su započeti spontano. Najviše novorođenčadi je rođeno noću između 2–3 sata i poslije podne između 14–15 sati.

Introduction

Brachial plexus injuries are very common in the structure of neonatal morbidity. The injured muscles are

inerved by nerves whose roots are at cervical and thoracic segments of spinal column.¹ One of the earliest studies in this sphere is one made by Fieux in 1897. He made dissection on dead newborns and he found that in

shoulder dystocia 5th and 6th cervical roots were stretched like violin strains, and the other cervical roots were unaffected (cit.²). The incidence of brachial plexus injuries vary from 1 to 5 on 1000 deliveries and depends on level of health care. In Sweden incidence of brachial plexus palsy as a birth injuries is 1,3 on 1000 deliveries,³ in England it is less than 1 on 1000 deliveries, and in developing countries it is 5 on 1000 deliveries.⁴ The risk factors for brachial plexus injuries during delivery may be divided in three categories: neonatal factors, maternal factors or some other characteristics of second stage of labor.⁵

The abnormal position of fetal arm (abduction and external rotation of shoulder when the arm remaining behind the head) causes the stretching roots of brachial plexus and thus leads to injure nerve roots.^{6,7} The other mechanisms of brachial plexus injuries are traction of head and neck of infants in vertex presentation of infants, extreme traction of shoulder and hyperextension of arms in breech presentation.^{8,9} Recognized obstetric risk factors for brachial plexus injury include shoulder dystocia, fetal macrosomia and maternal diabetes mellitus. Other risk factors for brachial plexus palsy include maternal obesity or excessive weight gain, midpelvic operative delivery, prolonged second stage of labor, and postdate gestation.¹⁰

Recent reports have shown that some cases of brachial plexus injury have an intrauterine origin. Several lines of evidence support the concept that not all of these nerve injuries are due to traction. Erb's and Klumpke's palsies may occur in the absence of recognized risk factors, in the absence of shoulder dystocia, in posterior arm of infant whose anterior shoulder was impacted behind pubic symphysis, and in vertex-presenting fetuses delivered by traumatic Caesarean section; there is no apparent relationship to the type or number of maneuvers used to disimpact the fetal shoulder, the association with other peripheral nerve injuries and the electromyographic evidence of muscular denervation during the immediate postpartum period.²

Material and methods

In retrospective study (datas from 01. 01. 1999. to 31. 12. 2004.) we analysed newborns with diagnosis of brachial plexus palsy.

We used data from protocols, histories of disease and newborns cards from Clinic for Gynecology and Obstetrics, and also datas from protocols of Clinic for Neurology and Clinic for Physical Medicine and Rehabilitation, University Clinical Center Tuzla, from 01. 01. 1996.–31. 12. 2004. There was a small group of newborns who had brachial plexus palsy diagnosed after leaving Clinic and they were also included in our investigated group.

The diagnosis of all brachial plexus palsy was made by neurological examination of newborn by pediatrician, by physiatrist or neurologist. The bone fractures of newborns were diagnosed by radiological exam.

The investigated group were of 86 newborns who had diagnosis of brachial plexus palsy as a delivery injury. We analysed maternal factors for brachial plexus palsy of newborns using their histories of disease. The control group was made of 39 primiparas and 47 multiparas, as well as in investigated group. All patients in the control group had vaginal delivery without brachial plexus palsy, they were chosen by method of randomisation, out of 1000 patients. Duration of labor was calculated from the moment of beginning of the regular contractions till the moment of delivery of newborn; the duration of the second stage of labor was calculated from the moment of total dilatation of the cervix till the moment of delivery of the newborn. Prolonged labor was considered to be a labor with duration of 18 hours and more in primiparas or 12 hours and more in multiparas.

Labor with normal duration was considered to be in primiparas with duration of 2 to 18 hours, and in multiparas 2 to 12 hours. Precipitous labor was the one which lasts less than 2 hours in primiparas and multiparas.

Incidence of brachial plexus palsy of newborns is a number of new cases of brachial plexus palsy on 1000 newborns during one year period. We used χ^2 test, Fischer exact test and Student t test.

Results

Epidemiological characteristics

From 01. 01. 1996. to 31. 12. 2004. there were 45 564 deliveries in the Clinic for Gynecology and Obstetrics in Tuzla. In that period is a permanent decreasing number of deliveries from 6946 in 1996 to 4144 in 2004. The number of brachial plexus palsy in newborns was 86. The incidence of brachial plexus palsy for a nine years period is 1.89 on 1000 newborns (*Table 1.*).

Maternal factors

Mother's age as a risk factor for brachial plexus palsy is shown on the *table 2.* None of 86 mothers from investigated group was younger than 18, 15 mothers (17,4%) were older than 35; 82.5% (71) of newborns with bra-

Table 1. The incidence of brachial plexus palsy among newborns in Tuzla
Tablica 1. Učestalost paralize pleksus brahijalisa u Tuzli

Year Godina	Newborns Novorođenčad	BPP	The incidence ‰ Pojavnost ‰
1996	6946	18	2,59
1997	5711	12	2,1
1998	5499	14	2,55
1999	5028	7	1,39
2000	4767	6	1,26
2001	4513	6	1,33
2002	4565	7	1,53
2003	4391	9	2,05
2004	4144	7	1,44
Total – Ukupno	45564	86	1,89

BPP – Brachial plexus palsy – Paraliza pleksus brahijalisa

Table 2. Maternal and neonatal characteristics
 Tablica 2. Maternalna i novorođenačka obilježja

Characteristic Obilježje	Study group Istraživana skupina (n=86)	Control group Kontrolna skupina (n=86)	P value P vrijednost
<i>Maternal</i>			
Maternal age (years)	26.6±6.4	24.7±5.7	<0.05
Dob (godine)			
Body mass index (kg/m ²)	30.8±4.5	28.0±3.3	<0.05
Parity			NS
primiparas	39 (45.3%)	39 (45.3%)	
multiparas	47 (54.7%)	47 (54.7%)	
<i>Neonatal</i>			
Male gender	47 (54.7%)	48 (55.8%)	NS
Female gender	39 (45.3%)	38 (44.2%)	NS
Gestational age at delivery (weeks)	38.8±1.8	38.7±1.8	
1-minute Apgar score	6.6±2.5	8.8±0.7	<0.01
5-minute Apgar score	7.9±1.5	9.0±0.3	<0.05
Birth weight (g)	3858.1±587.7	3427.8±335.7	NS

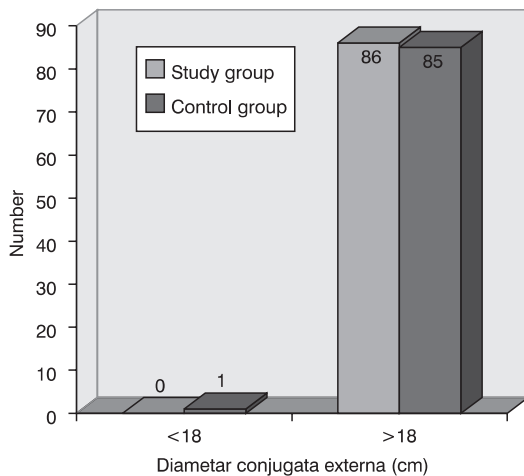


Figure 1. The conjugata externa – diameters
 Slika 1. Dijametri konjugate eksterne

chial plexus palsy were newborns whose mothers were from 18–35 years old. In the control group two patients (2.33%) were younger than 18, 77 (89.5%) were 18 to 35 years, and 7 mothers (8.17%) were older than 35 years. However the statistically significant difference is among mothers older than 35 years (p<0.05).

Out of total sum of mothers with brachial plexus palsy 58 (67.4%) had BMI ≥29 and 28 (32.6%) of mothers BMI <29 (Table 2). Out of total sum of mothers in control group (without injury) 52 mothers (60.5%) had BMI <29 and 34 (39.5%) ≥29 (p<0,01) (Table 2).

In investigated group there were 39 (45.3%) nulliparous and 47 (54.7%) multiparous women. We haven't found statistically significant difference between control and investigated group.

All mothers in investigated group had conjugata externa diameter >18 cm. In the control group one mother (1.2%) had diameter conjugata externa <18 cm (Figure 1).

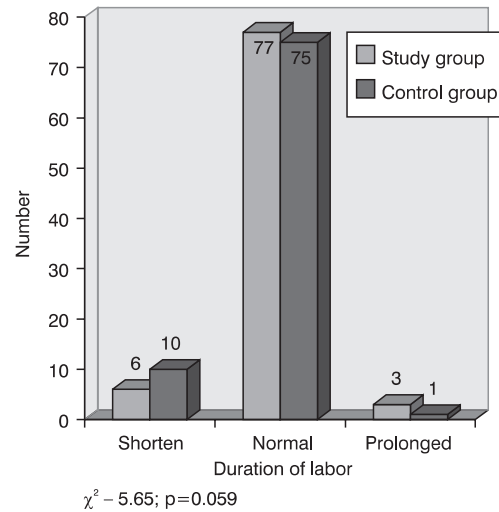


Figure 2. The impact of duration of labor on brachial plexus palsy of newborn

Slika 2. Trajanje poroda i paraliza pleksus brahijalisa

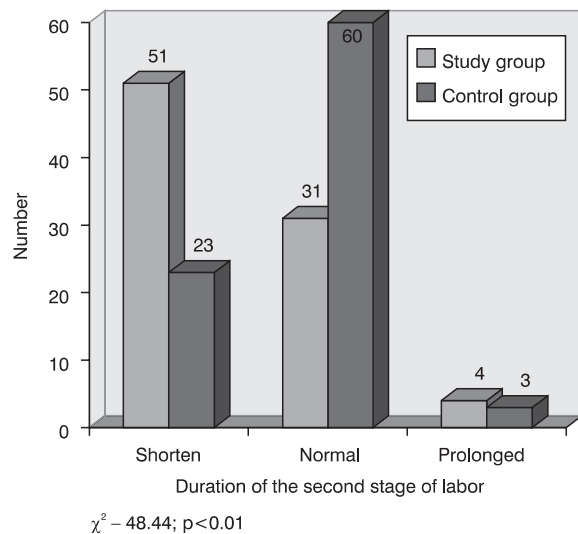


Figure 3. The impact of duration of the second stage of labor on brachial plexus palsy of newborns

Slika 3. Trajanje druge porodne dobi i paraliza pleksus brahijalisa

There is no significant difference between these two groups.

Delivery factors

The analysis of duration of labor has shown that 77 (89.5%) labors were of normal duration, 6 labors were precipitous, and 3 (3.5%) labors were prolonged. In the control group 75 (87.2%) deliveries were labors with normal duration, 10 labors (11.6%) were precipitous, and only 1 (1.2%) prolonged (Figure 2.). We haven't found statistically significant difference between investigated and control group (p=0.059).

Figure 3 presents the duration of second stage of labor among mothers in investigated and control group. In investigated group we have found 51 (59.3%) mothers

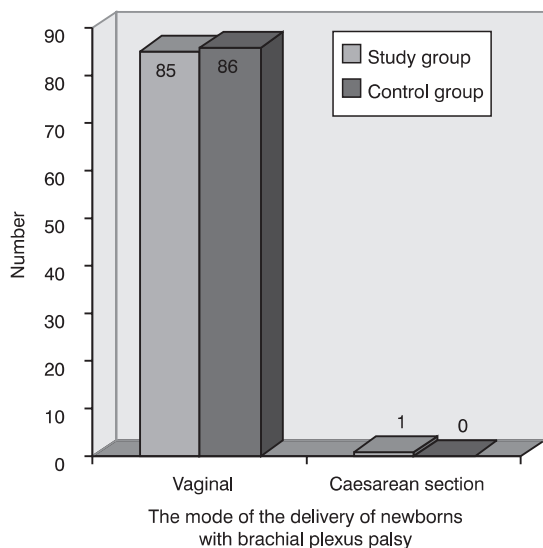


Figure 4. The mode of ending of the delivery
Slika 4. Način dovršenja poroda

with precipitous second stage of labor, 31 (36%) mothers with normal duration, and 4 of them (4.7%) with prolonged second stage of labor. In control group 60 (69.8%) mothers had normal duration of second stage of labor, 23 (26.7%) had precipitous and 3 (3.5%) had prolonged second stage of delivery. These differences are statistically significant ($p < 0.01$).

Out of 86 newborns with brachial plexus palsy, 85 (98.8%) were delivered vaginally and one (1.2%) was delivered by Caesarean section. In control group all newborns were delivered vaginally (Figure 4).

Out of total number of 86 cases the 12 deliveries were accomplished by an application of vacuum extractor. Out of seven labors with breech delivery, six of them (7%) were delivered by Bracht, and just one (1.2%) by Veit-Smellie maneuver. Episiotomy was made in 41 (47.7%) women. Forty five (52%) labors did not have any delivery intervention. In control group we had just one newborn (1.2%) that was delivered by vacuum extractor, 3 labors (3.5%) were delivered by Bracht method. Fifty labors (58.1%) had episiotomy, while 33 labors (38.4%) did not have any delivery interventions. However, we found statistically significant incidence of

Table 3. The impact of obstetric maneuvers on brachial plexus injuries
Tablica 3. Porodničarski manevri i paraliza pleksus brahijalisa

	Study group Istraživana skupina (n=86)		Control group Kontrolna skupina (n=86)	
	n	%	n	%
Vacuum extraction*	12	14,0	1	1,2
Bracht	6	7,0	3	3,5
Veit-Smellie	1	1,2	/	/
Episiotomy	41	47,7	50	58,1
Without maneuvers	45	52,0	33	38,4

$\chi^2 - 125.62; p < 0.01$

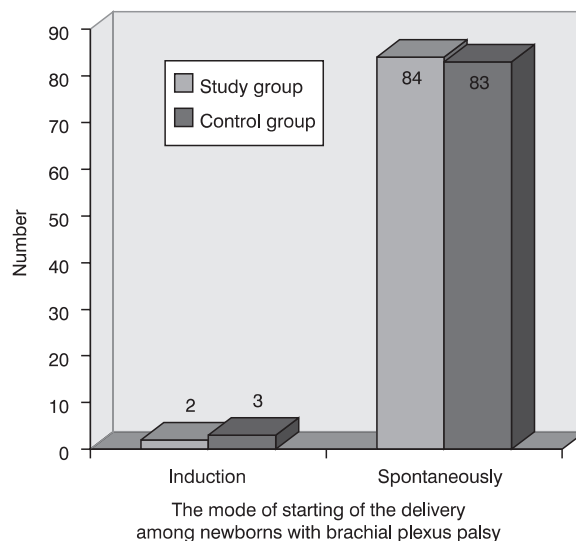


Figure 5. The mode of starting of the labour among newborns with brachial plexus palsy

Slika 5. Način početka poroda novorođenčadi s paralizom pleksus brahijalisa

brachial plexus injuries during surgically vaginal delivery (Table 3).

In investigated group 97.7% of labors started spontaneously and 2 of them (2.3%) were induced. In control group 83 (96.5%) of labors started spontaneously and 3.5% were induced (Figure 5).

Neonatal factors

In injured group were 47 (54.7%) male and 39 (45.3%) female newborns. In control group the 48 (55.8%) were male and 38 (44.2%) female newborns (Table 2). The difference is not statistically significant.

The birth weight of newborns with brachial plexus palsy varied from 2200–5550 grams, the mean value was 3858.1 ± 587.7 . In control group the birth weight was between 2500 to 4150 grams, the mean value was 3427.8 ± 335.7 . In study group 50 newborn (58.1%) have had birth weight less than 3999 grams, 27 (31.4%) birth weight 4000–4499 and 9 newborns (10.5%) have had birth weight more than 5000 grams. In control group 81 newborns (94.2%) have birth weight less than 3999 grams, 5 (3.8%) between 4000–4499 and there was none over 4499 grams (Table 2). The statistically significant higher frequency of injuries in children heavier than 4000 grams is established ($p < 0.01$).

In the study group 79 (91.9%) newborns were delivered in cephalic presentation. Seven (8.1%) were breech deliveries. In the control group 83 (96.3%) were delivered in cephalic position, and 3 (3.5%) were breech deliveries (Table 4). The difference is statistically significant ($p < 0.01$).

In the 1st minute after birth 42 (48.8%) newborns with brachial plexus palsy had Apgar score ≤ 7 , and 44 (51.2%) had Apgar score > 7 . In the control group 5 (5.8%) newborns had Apgar score ≤ 7 and 81 (94.2%) > 7 ($p < 0.01$)

Table 4. The impact of the pose of fetus on brachial plexus palsy
 Tablica 4. Utjecaj stava djeteta na paralizu pleksus brahijalisa

Position of infants Stav djeteta	Study group Istraživana skupina		Control group Kontrolna skupina		All	
	n	%	n	%	n	%
Head – Glava	79	91,9	83	96,5	162	94,2
Breech – Zadak	7	8,1	3	3,5	10	5,8
All – Svi	86	100,0	86	100,0	172	100,0

$\chi^2 - 5.53; p < 0.01$

Table 5. Accompanying injuries
 Tablica 5. Popratne povrede

Dignosis	Newborns with BPP	
	n	%
Clavicular fracture	39	45,2
Humerus fracture	1	1,2
Rib fracture	1	1,2
HIE	4	4,7
HIC	9	10,5
SAH	1	1,2
Brain oedema	1	1,2
No other injuries	30	34,8
All	86	100,0

BPP-brachial plexus palsy ; HIE – hypoxic-ischemic encephalopathy;
 HIC – intracranial hemorrhage; SAH – hemorrhage subarachnoid

Table 6. The time of the newborns birth
 Tablica 6. Vrijeme rođenja djeteta

The time Vrijeme	Study group Istraživana skupina		Control group Kontrolna skupina	
	n	%	n	%
00h–01h	5	5,7	4	4,6
02h–03h	17	19,8	11	12,9
04h–05h	8	9,2	4	4,6
06h–07h	7	8,0	4	4,6
08h–09h	7	8,0	9	10,6
10h–11h	3	3,4	8	9,2
12h–13h	4	4,6	3	3,4
14h–15h	12	14,0	13	15,3
16h–17h	7	8,1	7	8,1
18h–19h	7	8,1	6	6,7
20h–21h	3	3,4	8	9,2
22h–23h	6	6,7	9	10,6
Total – Ukupno	86	100,0	86	100,0

$\chi^2 - 5.28; p > 0.05$

(Table 2). In the 5th minute after birth 25 (29.1%) newborns had Apgar score ≤ 7 and 61 (70.9%) Apgar score > 7 . Apgar score in all newborns in the 5th minute in the control group was > 7 ($p < 0.05$) (Table 2).

Clavicular fracture was associated with brachial plexus palsy in 39 (45.2%) newborns, 9 (10.5%) had intracranial haemorrhage, 4 (4.7%) newborns had hypoxic-ischemic encephalopathy and 30 (34.8%) newborns were without injuries (Table 5).

In the investigated group there were 96.5% of term deliveries, one (1.2%) infant was delivered in 28th gestational week, 2 (2.3%) infants between 33–36 gestational weeks. There were no post-term deliveries. The mean gestational age of infants with brachial plexus palsy was 38 ± 1.8 gw. In the control group there were 82 (95.3%) term deliveries, 1 (1.2%) infant was delivered in 28th gestational week and 3 (3.5%) between 33–36 gestational weeks. There were no post term deliveries. The mean gestational age of deliveries in control group was 38.7 ± 1.79 (Table 2).

Out of all infants with brachial plexus injury 60 (69.8%) were delivered between 16–08 hours, 17 (19.8%) between 02–03 hours. In normal working time (between 08–16 hours) there were delivered 26 (30.2%) infants with brachial plexus palsy. In the control group there were 33 deliveries in normal working time (between 08 and 16 hours) and out of their number 13 (15.3%) were delivered between 14 and 15 hours and 53 (61.6%) between 16 and 08 hours (Table 6). The difference between investigated and control group is not statistically significant ($p > 0.05$).

Discussion

Brachial plexus injuries play an important role in numerous studies in various medical branches. This is an object of interest for neurologists, neurosurgeons, pediatricians and physiatrists. In the period from 01. 01. 1996. – 31. 12. 2004. 86 infants with brachial plexus palsy were registered in Clinic for Gynecology and Obstetrics in Tuzla. The mean incidence of brachial plexus palsy is 1.89 per 1000 deliveries. In Sweden the incidence of brachial plexus palsy as a birth injury is 1.3 per 1000 deliveries.³ In England this incidence is even lower and it is less than 1 per 1000 deliveries. In the developing countries this incidence is 5 per 1000 deliveries.

By analysing the total duration of labor we haven't found more precipitous or prolonged labors in investigated group infants with brachial plexus injuries. Results of this study show statistically significant difference in duration of second stage of labor in the study group. This can be confirmed by researches of other authors. There are also authors who haven't found significant difference in duration of second stage of labor between the investigated and control group. The most common mechanism of brachial plexus injury is unfinished rotation of shoulder,¹¹ but according to other authors prolonged second stage of labor causes brachial plexus injury as well.^{10,12}

Out of 86 newborns with brachial plexus palsy, 98.8% were delivered by vaginal delivery and one newborn by Caesarean section. In the control group all infants were delivered vaginally. There are authors, in different studies, who have found injuries of brachial plexus in infants delivered by Caesarean section, especially if they are heavier than 4500 g.¹³ Instrumental vaginal delivery is a great risk for intraparturial injuries, especially for brachial

plexus palsy. Injuries of brachial plexus are usually caused by stretching of cervical nerve roots during vacuum extraction or by direct compression of fetal neck during delivery by forceps.¹⁴ Almost all authors in their studies confirm that obstetrical manoeuvres increase risk for brachial plexus injuries with infants.^{5,12,14,15}

Swedish authors investigated the influence of induction of the labor on brachial plexus palsy of newborns during 7 years period (100 000 labors were studied). According to them, induction of labor is not the risk factor for brachial plexus palsy, that is similar to our results.¹⁶ Some other authors have found significantly higher incidence of brachial plexus palsy in induced labors in relation to spontaneous vaginal delivery.^{17,18}

In literature^{10,19} there is a higher number of labors with brachial palsy that belong to women older than 35 years. In our material the mothers of infants with brachial plexus palsy had the mean age 26.6±6.14 years, statistically significantly more than the mothers in control group who had 24.6±5.7 years. There is a statistically significant higher incidence of brachial plexus injuries of newborns whose mothers were more than 35 years old as well.

The mean BMI value of mothers of newborns with brachial plexus palsy was 30.8±4.5 and in the control group 28±3.3. The difference is statistically significant. According to some authors obesity is not risk factor for brachial plexus injuries during delivery,^{20,21} but according to other authors BMI is significantly higher in mothers of newborns with brachial plexus palsy.^{10,22}

Statistically significant difference between primiparas and multiparas has not been found, that is similar to other author's results.²³ However, the results of numerous researches are different. According to some researches primiparas have higher incidence of brachial plexus palsy,¹⁰ but this has not been found in this research.

All mother's in the study group of infants with brachial plexus injuries had pelvic diameter externa >18 cm. This phenomenon could be explained by the fact that all mothers with narrow pelvis or with doubt of disproportion were delivered by Caesarean section.²⁴ Sex ratio in injured group was 1,21:1 for male infants, which is not statistically significant difference in comparison to the control group where sex ratio was 1,26:1. These results are similar to results of other authors who haven't found significant difference regarding the gender distribution,⁵ but there are also a few authors who found that incidence of brachial plexus injuries is higher among female infants.²⁵

Birth weight in an injured group varied from 2200 to 5500 grams, the mean value was 3858.1±587.7 grams. Birth weight in the control group varied from 2500 to 4150, the mean value was 3427.8±335.7 grams. Out of 86 infants with brachial plexus palsy, 36 had birth weight higher than 4000 grams. The most of authors found that birth weight higher than 4000 grams is one of the most

important risk factors for brachial plexus injuries that is by our research confirmed.^{12,26} Analyzing the impact of fetal position on the injury of brachial plexus, this study confirmed statistically significant frequency of the mentioned injury with the breech delivery newborns, which agrees with the results of many authors. They agree that newborns who are breech delivered belong to the risk group and there is a high probability for injury of brachial plexus.⁸

In this study statistically significant lower Apgar score was found in infants with brachial plexus injuries, mean value in the 1st minute was 6.6±2.5 versus 8.7±0.6 in control group. Other authors have also found lower values of Apgar score in injured group of infants.^{2,21} Fracture of clavicle is the most frequent associated injury in brachial plexus palsy. A great number of studies confirm these results.^{23,27} One newborn had fracture of humerus. Out of 15 infants with brain injuries, 9 infants had intracranial bleeding, one subarachnoidal bleeding, and one had brain oedema. In injured group of infants an average gestational age was 38.8±1.8, and in uninjured group 38.7±1.79 weeks gestation. According to intrauterine growth standards all newborns in both groups were on-term newborns and statistically significant difference between these groups has not been found. These results are confirmed by other authors.^{20,21} A large number of infants (17–19.7%) with brachial plexus injuries were delivered between 2 and 3 hours a.m., but significant difference in relation to the control group is not found, probably because of small number of our sample. Some authors have found that lack of experience of medical staff,²⁸ as well as their small number, have significant influence on incidence of birth injuries. Some authors haven't found any correlation between level of obstetrical experience and incidence of brachial plexus injuries.²

Conclusion

The prevalence of brachial plexus palsy of the newborns delivered in Tuzla University Hospital is 1.86 per 1000 live-born children, the 86 cases among 45 544 live-born newborns were registered, in 82 of them (95.3%) during a stay in the hospital.

The highest risk factor for brachial plexus injury is the birth weight over 4000 grams, precipitous second stage of labor (<15 minutes) and vacuum extractor assisted delivery. Brachial plexus palsy was more frequent in newborns of obese mothers with body mass index ≥29, of older mothers (>35 years) and in newborns with breech presentation delivered vaginally. The 45.2% of newborns had a concomitant clavicle fracture.

The 42 newborns (48.8%) had an Apgar score in the first minute ≤7 which indicates the intrapartur distress of the fetus and points to traumatic nature of these deliveries.

The highest rate of brachial plexus injuries happened between 02–03 hours (19.8%) and 14–15 hours (14.0%)

at a time of lower obstetrician's vigilance and at the end of working time.

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