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The Influence of the Risk Factors on the Localisation and Degree of Severity in Perinatal Brachial Plexus Lesions

Wpływ czynników ryzyka na umiejscowienie i stopień ciężkości okołoporodowych uszkodzeń splotu ramiennego

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Abstract

Background. The frequency of the perinatal brachial plexus palsy varies from 0.35‰ to 5‰. Risk factors of the obstetrical brachial plexus lesions include: large birth weight, shoulder dystocia, prolonged II stage of labour, forceps delivery and vacuum extraction, breech presentation, diabetes mellitus and mother's obesity, delivery an infant with obstetrical brachial plexus palsy in antecendent delivery. The most often localisation of the brachial plexus palsy is the superior part (C5-C6) – Duchenne-Erb's palsy.
Objectives. Analysis of the influence of the risk factors on the localisation and degree of severity in perinatal brachial plexus lesions.
Material and Methods. Clinical material consisted of 83 children with obstetrical brachial plexus palsy treated surgically (54) and conservatively (29) at the Department of Trauma and Hand Surgery in the period 1994–2003. Control group consisted of 56 healthy born children. The following parameters were analysed statistically: duration of the II stage of delivery, birth weight, body length, head and chest circumference, Apgar scale at 1 min in the scheme: control group – C5-C6 injuries – C5-C6-C7 injuries – complete injuries and control group – rupture injuries – avulsion + mixed injuries.
Results. In own material the complete brachial injuries were predominant and made-up 49.4% of all cases. 65% of children with total brachial palsy were treated surgically. The other lesions were localised in: C5-C6 – 25.3%, C5-C6-C7 – 24.1%, C8-Th1 – 1.2%. The children with injuries of the superior part (C5-C6) have had a significantly lower birth weight, body length, head and chest circumference in comparison with complete palsy group (all parameters) and C5-C6-C7 palsy group (excluding chest circumference). The Duchenne-Erb's palsy (C5-C6) have had the greatest tendency to improvement due to conservative treatment. There were no statistically important differences in the analysed parameters between rupture injuries group and avulsion + mixed injuries group. Lesions with discontinuity of the neural elements of the brachial plexus were found in 38 cases (15 of them with shoulder dystocia). In this group the authors observed 29 cases with complete palsy, 3 cases with C5-C6 injuries and 5 cases with C5-C6-C7 lesions.
Conclusions. The foetus dimension is an essential factor influencing the localisation and degree of severity in perinatal brachial plexus palsy. The remaining risk factors do not determine ultimately the extension of the brachial plexus palsy (**Adv Clin Exp Med 2006, 15, 2, 303–308**).

Key words: obstetrical brachial plexus palsy, Duchenne-Erb's palsy, risk factors, surgical treatment.

Streszczenie

Wprowadzenie. Częstość okołoporodowych uszkodzeń splotu ramiennego wynosi 0,35–5‰. Czynniki ryzyka wystąpienia okołoporodowych uszkodzeń splotu ramiennego obejmują: dużą urodzeniową masę ciała, dystocję barkową, przedłużający się II okres porodu, poród z użyciem kleszczy lub próżniowy, poród pośladkowy, cukrzycę i otyłość matki, poród dziecka z okołoporodowym uszkodzeniem splotu ramiennego w wywiadzie. Najczęstszym umiejscowieniem uszkodzeń splotu ramiennego jest część górna (C5-C6) – porażenie Duchenne-Erba.
Cel pracy. Analiza wpływu czynników ryzyka na umiejscowienie i stopień ciężkości uszkodzenia w okołoporodowych uszkodzeniach splotu ramiennego.
Materiał i metody. Analizą objęto 83 dzieci z okołoporodowymi uszkodzeniami splotu ramiennego leczonymi operacyjnie (54) i zachowawczo (29) w Klinice Chirurgii Urazowej i Chirurgii Ręki w latach 1994–2003. Grupę kontrolną stanowiło 56 zdrowo urodzonych dzieci. Analizowano statystycznie następujące parametry: czas trwa-

nia II okresu porodu, urodzeniową masę ciała, długość ciała, obwód głowy i klatki piersiowej oraz punktację w skali Apgar w pierwszej minucie w układzie: grupa kontrolna – uszkodzenia C5-C6 – uszkodzenia C5-C6-C7 – uszkodzenia całkowite oraz grupa kontrolna – uszkodzenia o typie przerwania – uszkodzenia o typie wyrwania i uszkodzenia mieszane.

Wyniki. W materiale własnym dominowały całkowite uszkodzenia splotu ramiennego, które stanowiły 49,4% z ogólnej liczby przypadków. 65,0% dzieci z uszkodzeniami całkowitymi było leczonych operacyjnie. Pozostałe uszkodzenia występowały w: C5-C6 – 25,3%, C5-C6-C7 – 24,1%, C8-Th1 – 1,2%. Dzieci z uszkodzeniami części górnej (C5-C6) miały znacząco mniejszą urodzeniową masę ciała, długość ciała, obwód głowy i klatki piersiowej w porównaniu z grupą dzieci z uszkodzeniami całkowitymi (wszystkie parametry) oraz z uszkodzeniami C5-C6-C7 (z wyłączeniem obwodu klatki piersiowej). Uszkodzenia Duchenne-Erba (C5-C6) najbardziej były możliwe do naprawienia w wyniku leczenia zachowawczego. Nie stwierdzono istotnych statystycznie różnic analizowanych parametrów między grupą dzieci z uszkodzeniami o typie przerwania a grupą z uszkodzeniami o typie wyrwania i z uszkodzeniami mieszanymi. Uszkodzenia z przerwaniem ciągłości elementów nerwowych splotu ramiennego stwierdzono w 38 przypadkach (15 z nich z zaklinowaniem barku). W tej grupie obserwowano 29 przypadków z uszkodzeniami całkowitymi, 3 przypadki z uszkodzeniami C5-C6 oraz 5 przypadków z uszkodzeniami C5-C6-C7.

Wnioski. Wielkość płodu jest istotnym czynnikiem wpływającym na umiejcowienie i stopień ciężkości okołoporodowych uszkodzeń splotu ramiennego. Pozostałe czynniki ryzyka nie determinują w sposób ostateczny rozległości uszkodzenia splotu ramiennego (**Adv Clin Exp Med 2006, 15, 2, 303–308**).

Słowa kluczowe: Okołoporodowe uszkodzenia splotu ramiennego, porażenie Duchenne-Erba, czynniki ryzyka, leczenie chirurgiczne.

The frequency of the perinatal brachial plexus palsy varies from 0.,35‰ to 5‰ [1–5]. Risk factors of perinatal brachial plexus palsy include: large birth weight, shoulder dystocia, prolonged II stage of labour, forceps delivery and vacuum extraction, breech presentation, diabetes mellitus and mother' obesity, delivery of a child with perinatal brachial plexus palsy in history [3, 4, 6, 7]. The most common are injuries of the superior part of plexus (C5-C6) which constitute about 50% of the general number of injuries. The remaining 50% constitute injuries of the superior and medial trunk (C5-C6-C7) as well as total injuries (C5-Th1) [8]. Injuries of the lower part of plexus are extremally rare and their frequency is about 0.6 % [9].

Material and Methods

Clinical material consisted of 83 children (46 boys, 37 girls) with perinatal brachial plexus palsy (right-sided injuries – 48, left-sided injuries – 34, bilateral injuries – 1) treated (surgically – 54, conservatively – 29) in Department of Trauma and Hand Surgery in the period 1994–2003. The children were born by (primagravidas – 26, multiparas – 57) mothers between 20 and 41 years of age with unifoetal pregnancies, delivery through natural passages without cesarean sections. The deliveries were between the 37th and 42nd week (81 children) and in the 35th and 36th week (2 children). The most frequent was cephalic presentation (79 cases), much more seldom was non-complete breech presentation (foots – 2 cases, buttocks – 1 case) and complete breech presentation (1 case). Assistance was used in 22 cephalic deliveries including manual assistance (13), vacuum (7) and forceps (2). The remaining 57 head deliveries were without assistance. The deliveries in breech presentation (4) took place in accordance with the accepted in obstetrics rules. Shoulder dystocia was observed in 26 deliveries and manual assistance was used in 13 of them, 4 cases were delivered with vacuum and 9 cases were without assistance.

The control group consisted of 56 healthy children (30 boys, 26 girls) of acquaintances and workers of Silesian Piasts University of Medicine in Wrocław, born at term (the 37th–42nd week), from unifoetal pregnancies, spontaneous labour, by mothers between 21 and 40 years of age.

The following parameters were analysed: duration of the II stage of delivery, weight and length of the child, head and chest circumference, Apgar scale at 1 min in the scheme:

– control group – injuries C5-C6 – injuries C5-C6-C7 – total injuries,

– control group – rupture injuries – avulsion + mixed injuries.

The obtained data were analysed statistically with use of program ANOVA/MANOVA (STATISTICA 4.5). Statistical importance was accepted at $p \leq 0.05$.

Results

The localisation and character of perinatal brachial plexus palsy is presented in Table 1. Brachial plexus palsy with anatomical discontinuity was observed in 38 cases. They included: rupture of neural trunks, avulsion of spinal nerve roots and mixed injuries. Table 2 presents the localisation of those injuries. Evaluation of statistical importance

Table 1. Localisation and the character of the brachial plexus injuries

Tabela 1. Umiejscowienie i charakter okołoporodowych uszkodzeń splotu ramiennego

Localisation of injury (Umiejscowienie uszkodzenia)	Number of cases (Liczba przypadków)	Surgical treatment (Leczenie operacyjne)		Conservative treatment (Leczenie zachowawcze)
		rupture and avulsion (przerwanie i wyrwanie)	with continuity of the brachial plexus (zachowana ciągłość splotu)	
C5-C6	21	3	1	17
C5-C6-C7	20	5	7	8
C5-Th1	41	29	8	4
C8-Th1	1	1	–	–
Summary (Łącznie)	83	38	16	29

Table 2. Localisation of the injuries with discontinuity of the neural elements of the brachial plexus

Tabela 2. Umiejscowienie uszkodzeń z przerwaniem ciągłości anatomicznej elementów nerwowych splotu ramiennego

Severity of injury (Stopień ciężkości uszkodzenia)	Number of cases (Liczba przypadków)	Localisation (Umiejscowienie)			
		C5-C6	C5-C6-C7	C5-Th1	C8-Th1
Rupture (Przerwanie)	21	3	4	14	–
Avulsion (Wyrwanie)	5	–	–	5	–
Rupture and avulsion (Przerwanie i wyrwanie)	12	–	1	10	1
Summary (Łącznie)	38	3	5	29	1

of the studied parameters in the above-mentioned schemes are presented in Tables 3 and 4.

Discussion

Perinatal brachial plexus palsy affect mainly its superior part (C5-C6) and are called Duchenne-Erb's palsy [8]. That localisation is dominant in evaluation of all cases of perinatal brachial plexus palsy, of which about 80% show tendency to gradual, spontaneous recovery of function [10–13]. Those proportions change when cases qualified for surgical treatment are the object of the analysis. In the own material total injuries of brachial plexus dominated. They constitute 49.4% (41 from 83) from the general number of children and 65% (54 from 83) of them were treated surgically. The remaining injuries constituted respectively: C5-C6 – 25,3%, C5-C6-C7 – 24,1%, C8-Th1 – 1.2%. Clear and statistically essential differences in particular localisation groups were observed while analysing the parameters evaluating the child's size. The children with injuries of the superior part (C5-C6) have had lower birth weight, body length, head and chest circumference in comparison with the group with total injuries (all parameters) as well as injuries C5-C6-C7 (with exclusion of chest circumference) – Table 3. Superior injuries showed the greatest tendency to improvement in the course of conservative treatment – Table 1. However, differences in the foetus dimension between the group with total injuries and the group with injuries C5-C6-C7 were not observed. Different observations were made by Bager who analysing material including 52 children did not observe the influence of the birth weight on the level of injury [7]. Shoulder dystocia was observed in the analysed material in 32.9% cases, that is, in 26 deliveries. In their consequence in 15 children there was injury of brachial plexus with discontinuity of its structural elements (14 total injuries, 1 injury C5-C6-C7). Compression of brachial plexus by scar perineural tissues was observed in 3 children (3 injuries C5-C6-C7). In 8 cases the return of upper extremity function in the course of rehabilitation treatment was observed (6 injuries C5-C6, 2 injuries C5-C6-C7). In the own material differences of duration of the II stage of delivery were not observed in injuries of plexus with various degrees of severity and localisation – Table 3 and 4 and it is confirmed by observations of other

Table 3. The evaluation of the statistical importance of the analysed parameters in scheme: control group – C5-C6 injuries – C5-C6-C7 injuries – complete injuries

Tabela 3. Ocena istotności statystycznej badanych parametrów w układzie: grupa kontrolna – uszkodzenia C5-C6 – uszkodzenia C5-C6-C7 – uszkodzenia całkowite

Examined parameter (Badany wskaźnik)	Control group (Grupa kontrolna) n = 56 K	C5-C6 injuries (Uszkodzenia C5-C6) n = 21 A	C5-C6-C7 injuries (Uszkodzenia C5-C6-C7) n = 20 B	Total injuries (Uszkodzenia całkowite) n = 41 C	Statistical importance (Istotność statystyczna) p
Birth weight (Urodzeniowa masa ciała) g	3107 ± 399	4106 ± 565	4499 ± 793	4604 ± 562	K/A, B, C = 0.000000 A/B = 0.028138 A/C = 0.001398 B/C = ns.
Body length (Długość ciała) cm	52.1 ± 1.9	56.5 ± 4.8	59.6 ± 2.9	59.3 ± 3.3	K/A = 0.000887 K/B. C = 0.000000 A/B = 0.005522 A/C = 0.002774 B/C = ns.
Head circumference (Obwód głowy) cm	32.7 ± 1.6	34.5 ± 2.2	36.2 ± 2.4	35.9 ± 1.2	K/A = ns. K/B. C = 0.000000 A/B = 0.027924 A/C = 0.031068 B/C = ns.
Chest circumference (Obwód klatki piersiowej) cm	32.4 ± 1.5	35.1 ± 2.5	36.4 ± 2.6	37.2 ± 1.9	K/A = 0.019794 K/B. C = 0.000000 A/B = ns. A/C = 0.005193 B/C = ns.
Apgar scale at 1 min – points (Skala Apgar w 1 min – punkty)	9.4 ± 0.9	5.5 ± 3.4	5.4 ± 3.4	3.8 ± 2.5	K/A = 0.000001 K/B. C = 0.000000 A/B = ns. A/C = 0.029605 B/C = 0.022049
Duration of II stage of labour (Czas trwania II okresu porodu) min	24.1 ± 17.08	21.0 ± 8.2	24.0 ± 17.9	21.8 ± 1.9	ns.

authors [14]. The frequency of deliveries with use of vacuum (7) or forceps (2) in the evaluated material was 11.3%. In consequence of forceps deliveries total injury of plexus requiring neurolysis was observed in 1 child, and in the second child – injury of the superior part which retreated after conservative treatment. In the deliveries with use of vacuum, 4 total injuries of mixed type requiring reconstructive treatment, 2 injuries of the superior part treated conservatively and 1 injury C5-C6-C7 requiring neurolysis of brachial plexus were observed. Deliveries in breech presentation constituted 4.9% of the general number of labours complicated with perinatal brachial plexus palsy. The injuries were localised in the superior part of plexus in 2 children, in superior – medial part in remaining 2 children. Discontinuity of the superior trunk with secondary spontaneous reinnervation was observed in 1 child. Compression of plexus requiring neurolysis was observed in the remaining 2 cases and 1 child regained extremity function after rehabilitation. Many authors accented greater susceptibility of the superior part of plexus to injuries during breech delivery [15–17]. The avulsion injuries of spinal nerve roots which may appear as complication of deliveries in breech presentation were not observed in the own material [12, 18]. The parameters analyzed in Table 3 and 4 have been evaluated by the authors of the work in the following aspects: surgically treated injuries – injuries treated conservatively and injuries with discontinuity of brachial plexus (treated with reconstruction) – injuries without discontinuity of brachial plexus (treated with neurolysis) and constitute the subject of another report [19]. In the present work statistical analysis of those parameters was made in the scheme: rupture injuries – avulsion and mixed injuries. Statistically important differences in foetus dimension between the control group and two tested groups were obser-

Table 4. The evaluation of the statistical importance of the analysed parameters in scheme: control group – rupture injuries – avulsion + mixed injuries

Tabela 4. Ocena istotności statystycznej badanych wskaźników w układzie: grupa kontrolna – uszkodzenia o typie przerwania – uszkodzenia o typie wyrwania i uszkodzenia mieszane

Examined parameter (Badany wskaźnik)	Control group (Grupa kontrolna) n = 56 K	Injuries – rupture (Uszkodzenia – przerwanie) n = 21 P	Injuries – avulsion and mixed (Uszkodzenia – wyrwanie i mieszane) n = 17 AM	Statistical importance (Istotność statystyczna) p
Birth weight (Urodzeniowa masa ciała) g	3107 ± 399	4604 ± 603	4651 ± 506	K/R = 0.000000 K/AM = 0.000000 R/AM = ns.
Body length (Długość ciała) cm	52.1 ± 1.9	59.7 ± 2.7	60.1 ± 3.9	K/R = 0.000000 K/AM = 0.000000 R/AM = ns.
Head circumference (Obwód głowy) cm	32.7 ± 1.6	35.8 ± 1.1	36.1 ± 1.1	K/R = 0.000007 K/AM = 0.000006 R/AM = ns.
Chest circumference (Obwód klatki piersiowej) cm	32.4 ± 1.5	36.6 ± 1.7	37.8 ± 1.8	K/R = 0.000001 K/AM = 0.000000 R/AM = ns.
Apgar scale at 1 min – points (Skala Apgar w 1 min – punkty)	9.4 ± 0.9	4.3 ± 2.7	3.8 ± 3.4	K/R = 0.000000 K/AM = 0.000000 R/AM = ns.
Duration of the II stage of labour (Czas trwania II okresu porodu) min	24.1 ± 17.08	20.0 ± 11.1	24.3 ± 11.7	ns.

ved without noticing differences between them – Table 4. Injuries of continuity of brachial plexus included 38 cases. Usually they had the character of trunks rupture (21), mixed injuries were more seldom (12) as well as isolated spinal nerve roots avulsion (5). In those most serious injuries shoulder dystocia was observed in 15 cases, and in the remaining 23 cases deliveries were without that complication. In clinical manifestation the most common in that group were total injuries (29) and they effected the superior (3) and superior – medial (5) part of plexus much more seldom. Children with total injury of plexus obtained the lowest amount of points in Apgar scale. Those differences were statistically important both in relation to the control group as well as the children with injuries C5-C6 and C5-C6-C7. Perinatal brachial plexus palsy is a medical problem with complicated etiology difficult for univocal evaluation [20].

The authors conclude that the foetus dimension is an essential factor influencing the localisation and degree of severity in perinatal brachial plexus palsy. The remaining risk factors do not determine ultimately the extension of the brachial plexus palsy.

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