

# Our newborn cases with brachial plexus palsy and its prognosis relation with clavicle fracture: A single-center retrospective study

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## Abstract

**Aim:** The aim of the study was to present clinical and demographic characteristics of the newborns born in our hospital via normal vaginal delivery and diagnosed with obstetric brachial plexus palsy (OBPP).

**Material and Methods:** Our study was planned as a retrospective single-center study. In our study, newborns born with normal vaginal route were included in Malatya Training and Research Hospital between October 1, 2015 and March 15, 2018. In this period, a total of 5288 newborns were born and 68 of these cases had the pathology of OBPP.

**Results:** Of 68 patients with OBPP, 37 were girls, 31 were boys and mean birth weight was 3,888 gr. The right arm of 38 cases and the left arm of 31 cases were found to develop OBPP. According to the Narakas classification, 39 cases of them (57.3%) were stage I, 21 (30.8%) were stage II, 6 (8.8%) were stage III, and 2 of the cases (2.9%) were evaluated as stage IV.

**Discussion:** In our study, the mean frequency of OBPP was close to the world average. Even, it was lower comparing to some European countries. However, the frequency of clavicular fracture was higher comparing to the literature. This gave the impression that the clavicle fracture could be considered as a protecting factor for the development of OBPP.

**Conclusion:** Although OBPP is a common congenital complication in newborns, its frequency in Turkey is parallel to the world average. The main reasons for this OBPP outcome can be due to increasing the number of highly skilled obstetricians in this field and women are currently performing most of the deliveries in a hospital setting even they are not under follow-up. In addition, the protective effect of clavicle fracture on OBPP was also observed in our study.

**Keywords:** Obstetric Complication; Brachial Plexus Palsy; Clavicular Fracture; Newborn.

## INTRODUCTION

Obstetric brachial plexus palsy (OBPP) develops due to brachial plexus injury in newborns and children and it necessitates a long-lasting follow-up and rehabilitation during the whole lifespan. These injuries mostly happen due to damages to neck and shoulder during delivery (1).

It is especially more frequently seen in overweight newborns. Prolonged and difficult delivery, usage of assist devices (such as forceps, vacuum) during delivery, birth weight of more than 4,000 grams, shoulder presentation, maternal small-size structure of pelvic bone, breech presentation, maternal age of less than 20 or more than 35 years old, diabetic mother and delivery at home setting are some risk factors for these injuries (2,3).

In the USA, the frequency of OBPP was reported as 1.7 per 1000 live births in 1997 while it was 1.3 in 2003. This value was reported to be 3 per 1000 live births in Norway and 4.6 in Sweden (1,4,5). In our country, there has been no comprehensive study introducing the incidence of this pathology clearly. However, according to the estimation derived from the data of the other countries, it was assumed that newborns numbering from 2,000 to 6,000 per year develop this condition (6).

In this study, it was aimed to present clinical and demographic characteristics of the newborns via normal vaginal delivery and diagnosed with OBPP.

## MATERIAL and METHODS

This retrospective study included 68 newborns born via

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vaginal delivery and diagnosed with OBPP in the obstetric ward of Malatya Research and Training Hospital between October 1, 2015 and March 15, 2018. The total number of newborns born in our hospital was 12,504 during this period. Only 5,288 newborns were born with the normal spontaneous vaginal route in the hospital. Of 5,288 newborns, 68 newborns diagnosed with OBPP were included in the study. Of 12,504 newborns, 7,216 newborn cases were not evaluated due to lack of inclusion criteria. Age, gender, birth weight, involved side, concomitant complications, type of the involvement and maternal characteristics were recorded (Table 1, 2 and 3) (Figure 1). The study was approved by the Inonu University Ethics Committee.

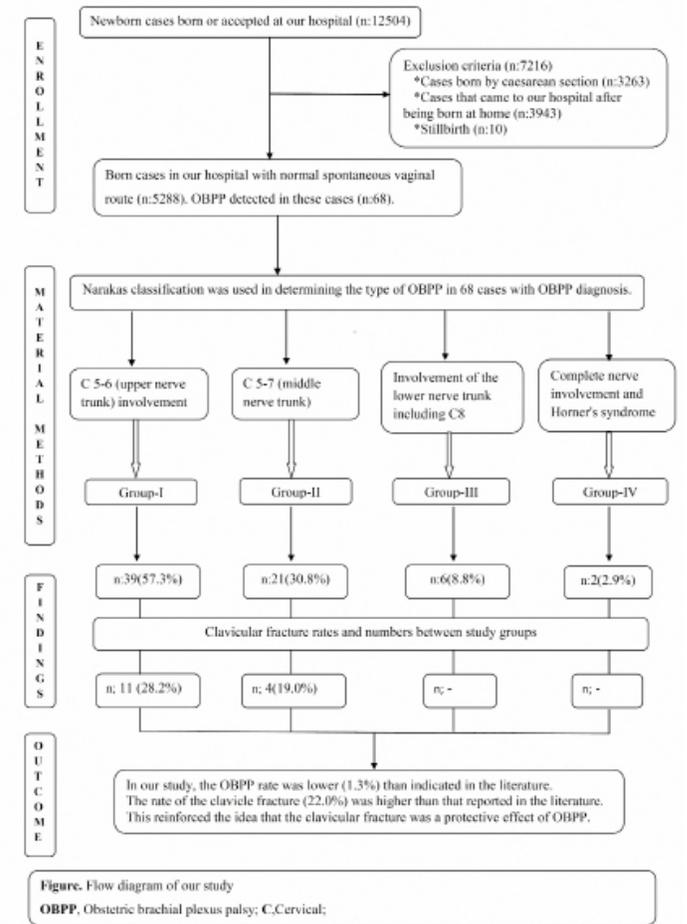
Gender (Female/Male)	37(54,4%)/31(45,6%)
Gestational Weight (gr) (med±min)	3888±52
Birth problems	10(14.6%)
Twin pregnancy	1(1.4%)
Breech presentation	2(2.8%)
Shoulder presentation	1(1.4%)
Forceps-vacuum use	6(8.8%)
Paralyzed side	
Right side	38(55.8%)
Left side	30(44.2%)
Both sides	
Cephalic hematoma	33(48.5%)
Torticollis	3(4.4%)
Horner syndrome	2(2.8%)
Clavicular fracture	15(22.0%)
Other orthopedic problems (humerus fracture, congenital hip protrusion, etc.)	-
Other neurological problems (facial paralysis, asymmetric crying face, etc.)	1(1.4%)

Maternal age (years) (med±min)	29±11
Additional diseases in mothers	4(5.9%)
Diabetes	3(4.4%)
Orthopedic problems	1(1.4%)
First pregnancy of the mother	31(46.2%)
Second pregnancy of mother	21(31.3%)
Mother with higher education	4(5.9%)
Number of regular follow-up mothers in pregnancy	11(16.4%)
Number of irregular follow-up mothers in pregnancy	57(85.0%)

**Table 3. Distribution of cases according to Narakas classification and relation with clavicle fracture**

OBPP types according to Narakas classification	Distribution of OBPP cases according to groups	Clavicle fracture cases
First-degree OBPP (Group-I)	39(57.3%)	11 (28.2%) <sup>a</sup>
Second-degree OBPP (Group-II)	21(30.8%)	4(19.0%) <sup>a</sup>
Third-degree OBPP (Group-III)	6(8.8%)	-
Fourth-degree OBPP (Group-IV)	2(2.9%)	-
p value		p <sup>a</sup> =0.009

**OBPP, Obstetric brachial plexus palsy;**



**Figure 1. Flow diagram of our study**

The cephalic hematoma was defined as hemorrhages which occupied more than half of the head bone in a case. Each OBPP case was drawn routinely in thorax graphics. The decision was made based on x-ray radiography for the clavicle fractures.

Maternal age, maternal chronic diseases (diabetes and orthopedic disorders), maternal parity, educational status, whether there was regular follow-up status of the pregnancy or not were recorded (Table 2). The Narakas Classification was used to determine the type of the OBPP (Table 3) (Figure). Accordingly, newborns with OBPP were classified into four groups (7).

First degree OBPP (Group I); Four patients were described to have this by Duchenne in 1872 and then after, described by Erb in 1974. The cases with totally paralyzed shoulder movements and elbow flexion due to the injury of C5-C6 nerve roots were classified in this group. Paresia and paralysis of deltoid and biceps muscles were also included in this group. The cases with the adducted arm, inverted shoulder, wrist in flexion and extended fingers were classified in this group (7).

Second degree OBPP (Group II); in this group, it is assumed that damage of C5, C6, and C7 nerve roots are involved. In addition to deltoid and biceps paresis and paralysis, triceps and wrist extensor muscles have paresis/paralysis but thenar/hypothenar muscles and long flexor muscles of the arm spared (7).

Third degree OBPP (Group-III); all nerve roots of brachial plexus (C5, C6, C7, C8, T1) are affected and third group is characterized by total paresis/paralysis of all arm muscles resulting with drop shoulder (7).

Fourth degree OBPP (Group-IV); sympathetic nerve injury and related ipsilateral Horner syndrome (miosis, ptosis and anhydrosis) and sometimes unilaterally raised diaphragm due to ipsilateral phrenic nerve injury can be observed. These cases are classified as group IV OBPP (7).

Fifth degree OBPP (Group-V); Proximal lesions of the upper extremity nerves. These lesions are proximal lesions of the nerves originating from the brachial plexus, such as the suprascapular nerve or the musculocutaneous nerve (3,7).

Deliveries in a home setting or via cesarian section or newborns transferred to neonatal ward/intensive care unit from out-of-hospital setting and newborns died at birth were excluded from the study.

#### Statistical analysis

The data were analyzed by using the SPSS (Versiyon 25, SPSS Inc. Chicago, Illionis) statistical package program. Distribution of the data was controlled via Shapiro-Wilk Normality test. Between groups, normally distributed variables were compared by using independent sample t test, and variables without normal distribution were compared by using the Mann-Whitney U test. The chi-square test was utilized to analyze rational data. A P value of <0.05 was accepted as statistically significant.

## RESULTS

The study was composed of 37 girls (54.4%) and 31 boys (45.5%). All subjects were born in our hospital via the normal vaginal route. Of them, 2 newborns (2.8%) had a breech presentation, one newborn has multiparity. In this multipart pregnancy, one of the siblings was diagnosed with OBPP. The delivery assist devices (forceps or vacuum) was used in 6 newborns (8.8%) and 4 of them experienced a clavicular fracture. Average birth weight was  $3,888 \pm 522$  grams and 37 newborns had birth weight over 4,000 grams. The heaviest newborn was 4,410 grams

in weight while the lowest birth weight was 3,366 grams (Table 1).

Of them, 38 newborns (55.8%) had OBPP on the right side while 30 newborns (44.2%) had on the left side. Three newborns (4.4%) had additional torticollis, 2 (2.8%) had additional Horner syndrome, 15 cases (22%) had an additional clavicular fracture and one case had additional left-side facial palsy. None of the cases had humerus fracture (Table 1,3).

Clavicle fracture was found in total 15 OBPP cases. The majority of these cases were low-grade OBPP cases. Clavicle fractures were found in 11 (28.2%) cases of Group I OBPP cases while 4 (19.0%) of clavicle fractures were found in Group II cases. There was statistically significant difference between these two groups in terms of clavicle fracture ( $p < 0.05$ ). In Group III and IV cases, no clavicle fracture was encountered. In our study, 33 (48.5%) cases had cephalic hematoma (Table 3) (Figure 1).

The total number of mothers was 67. A mother gave birth to a twin. Average maternal age was 29 years. The youngest age was 18 years while the oldest age was found to be 41 years. Diabetes and/or obesity were found in 4 mothers (5.8%). Only 11 mothers (16.1%) were under regular medical follow-up during all their pregnancies. However, all deliveries were carried out in a hospital setting. Of them, 31 cases (45.5%) were born as a child of first pregnancy, 21 (30.8%) were born as a child of a second pregnancy and 16 (23.4%) were born as a child of the third or then after pregnancy (Table 2).

According to Narakas classification, 39 newborns (57.4%) were classified to Group I, 21 newborns (30.9%) in Group II, 6 newborns (8.8%) in Group III and 2 newborns (2.9%) in Group IV. Since the newborns who had a risk to be in Group V couldn't be tracked after discharge to physical therapy unit, the number of newborns classified to Group V couldn't be determined (Table 3).

## DISCUSSION

It was assumed that OBPP develops due to excessive pulling force or intermingling of fetal shoulders in the birth canal during delivery of the fetal head. According to Narakas classification, OBPP reveals in four clinical settings. In the previous studies, it was reported that 2.4% of newborns with average birth weight Of 4,272 grams develops OBPP and 2.3% of them develops clavicular fracture (1,7-9). In our study, this ratio was found to be lower (1.3%). The reason for this can be the inclusion of newborns delivered only in a hospital setting. However, clavicular fracture rate (22%) was found to be significantly higher in our study. This finding supports the protective role of clavicular fracture against OBPP while the absence of humerus fracture in our cases underlined the importance of up-to-date medical care. The more frequent appearance of clavicular fracture in low-grade OBPP cases suggests that this fracture prevented the progression of OBPP during delivery. This information was an unprecedented feature in the earlier literature.

The risk factors for OBPP in newborns are high birth weight, breech presentation, usage of forceps and/or vacuum, excessive strain during delivery, neck injury, and difficult delivery (1). In physical examination, it is possible to derive considerable information from clinical observations such as Moro reflex, tonic neck reflex and resting position of extremities (10). The use of forceps in our study was found to be higher than in other studies. The reason for this finding can be due to the application of cesarian section as a method of delivery among pregnant applied to the hospitals at an early stage but the ongoing usage of forceps among pregnant who didn't apply to the hospitals in an early stage. Additionally, one newborn experienced facial palsy in our study. In this case, it was assumed that the pathology developed due to forceps use.

Compared to other delivery traumas, the incidence of OBPP remained stable in the last 50 years in which the frequency of cesarian section increased. It raised to question the role of fetal presentation disorders and squeezing of the posterior part of the shoulder in sacral promontorium as a reason of OBPP (2,11). However, these cases included the ones which can be classified as non-difficult deliveries or were born via cesarian section. In our study, since we enrolled only newborns delivered via the normal vaginal route, it would not be correct to assume the intrauterine factors as a reason for the development of OBPP.

The detection of newborns with an intrauterine breech presentation in early pregnancy period and performing cesarian section for these cases have decreased the development of OBPP. In our study, a number of newborns with the breech presentation was also less and it was inconsistent with previous studies (2,3).

The difficulty in the passage of shoulder and high birth weight are two important risk factors related to congenital brachial plexus palsy (12). Some authors reported that training of medical staff of delivery room on the management of difficulty in passage of shoulder reduced development of OBPP significantly. Additionally, performing cesarian section for fetuses with high birth weight also reduce the risk for development of OBPP (2,3,13). It was reported that delivery of newborns with birth weight over 4,000 grams via vaginal route significantly increased the risk for OBPP (12). In our study, the average birth weight of the subjects was 3,888 grams and most of the subjects were above 4,000 grams. Our results suggested that the management of births at the centers specialized for deliveries of newborn with a birth weight of over 4,000 grams can reduce the frequency of OBPP. There have been some alternative ideas on this issue (11). It was suggested that the cases with torticollis originated from non-muscular reasons are mostly related to OBPP. Three cases (4.4%) in our study had torticollis in addition to OBPP. In previous retrospective studies reported the frequency of concurrent torticollis and OBPP up to 43% but they couldn't find any relation between the presence of torticollis and severity or recovery rate of OBPP (14). In our study, the number of newborns with concurrent OBPP and

torticollis was less compared to the previous studies. The reason for this can be due to overlooking mild torticollis cases or rapid recovery of torticollis until the beginning of the treatment for OBPP or non-registered torticollis cases.

In our study, OBPP was seen more frequently among the newborns with boy gender, mostly over the right side and in the sibling of the first pregnancy. These findings were consistent with the literature. There were some studies reporting that OBPP was more common in mothers with the first pregnancy, younger or elder maternal age. In our study, the youngest and the eldest maternal age were 18 and 41 years, respectively. This condition is closely related to the effort and workload seen during the delivery (3). Additionally, it is known that presence of mother without experience related to the delivery process in her first pregnancy is also a very important factor in the development of OBPP. In our study, it was revealed that these factors which seemed insignificant were actually very important.

In our study, the frequency of mothers graduated from a university or its equivalent was noticed to be significantly low. We assumed that this finding was important in the development of OBPP. However, there has been no study in the literature over such relation or there has been no study primarily focused on this subject. Thus, in our study, it may not be scientific to make a conclusion on this issue. Additionally, the number of mothers performed regular pregnancy follow-up was also significantly low. Even though, it was observed that most of the mothers preferred to deliver in the hospital setting. Thus, it may seem logical to assume that this preference may have an effect on the low rate of OBPP.

Most of the cases with OBPP were observed to recover by itself within the following three months. However, according to severity and the extent of the involvement, the degree and duration of the recovery may change. The main target in the treatment of OBPP should be the prevention of joint contracture and dysfunction in addition to increasing functional and physical usage of the arm and the extremity (15). The prognosis of brachial plexus injuries happened during the delivery is usually well. Near-total or total recoveries are observed up to 80% to 90% of the cases spontaneously. Approximately 10% to 20% of the cases develops permanent and important disorders (16). If conservative measures do not work in the treatment of such patients, microsurgical approaches can provide significant improvements an inconsiderable number of these patients. In studies involving newborns with OBPP, full recovery was reported for 70% to 95% of the patients (17). However, nearly 10% of the subjects have to continue their life with a permanent disability. Narakas classification is strongly related to this outcome (17).

According to meta-analyses, subjects in Narakas Group I, II have significantly better outcome compared to subjects in Group III, IV (18). Despite physiotherapy programs, recovered babies can show some degree of elbow and shoulder contractures which can affect functional capacity

(19). We didn't plan any primary study involving long-term outcome and treatment of the subjects with OBPP. Of the cases we took to work, 39 were cases in the Grade 1 where the prognosis was the best, but two of the cases were the worst prognosis in the Grade 4 case. In this aspect, our study was in parallel with the literature (17).

## CONCLUSION

OBPP is commonly seen the complication in newborns but its frequency was observed to be similar to the average of the world. The reason for this may be thought to be due to the increase in the number of highly-skilled obstetricians and performing the most of the deliveries in the hospital settings even the significant portion of the pregnancies were not under regular maternity visits. However, we have also shown that the clavicle fracture might have a protective effect of especially on high-grade OBPP.

*Competing interests: The authors declare that they have no competing interest.*

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*Ethical approval: The study was approved by the Inonu University Ethics Committee. This was emphasized in the results section of the study.*

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