

Research Article

ISSN: 2056-6360

Shoulder dystocia among parous parturients: Birth weight differences of the largest prior vaginal delivery and index pregnancy

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To compare the birth weight (BW) of largest prior vaginal delivery versus the index pregnancy with shoulder dystocia (SD). From three centers, births with SD were identified and compared to the largest birth weight of prior delivery at term. Among 304 patients, the mean difference in the BW of those with SD in the index pregnancy and largest prior vaginal delivery was $394 \pm 510\text{g}$ ($p<.0001$). The mean differences in BW of those with dystocia and subsequent brachial plexus injury (BPI; $614 \pm 569\text{g}$) versus those without BPI ($384.1 \pm 508.3\text{g}$) were also significantly different ($p=0.016$). There are significant birth weight differences between current and prior birth weight as a predictor of shoulder dystocia with/without BPI. Unfortunately, these findings cannot be used clinically because of the inaccuracy of estimating birth weight.

Introduction

Shoulder dystocia (SD) is defined as difficulty with delivery, marked by a shoulder-head interval of >1 min or as need for ancillary maneuvers to free the shoulder and occurs in 0.2–3% of vaginal births [1]. Since it can be associated with temporary or permanent injury to brachial plexus (BPI), and allegations of medical liability vs. maloccurrence, it is understandable why there is need to differentiate which pregnancy is at risk for an impacted shoulder [2–4]. The cause of shoulder dystocia and subsequent BPI has erroneously been assumed in the past to occur only following excessive lateral traction on the baby's head by the accoucheur [4]. However, it is now accepted that BPI, with or without shoulder dystocia, is associated with in utero causes such as, excessive pressure on the anterior/posterior shoulder over time and/or excessive twisting as the fetus passes through the pelvis often during precipitate deliveries [5]. Other, more rare, intrauterine causes BPI include; congenital malformations, fetal drug exposure, viral infections, and uterine malformations [6].

Retrospective studies have identified risk factors for shoulder dystocia, but such risk factors have such a low positive predictive value($<18\%$) they are not useful clinically in a index pregnancy [7]. Since macrosomia is more often associated with shoulder dystocia an awareness of newborns birth weight delivered previously might be predictive of recurrence. Certainly as a negative predictor, birth weight has proved helpful such as when a pelvis has been proven for a specific weight it is usually noted that the next pregnancy of a similar or lesser birth weight is not problematic [4]. Similarly, a patient who has delivered a macromomic newborn without difficulty, it is usually found that subsequent fetuses of a similar weight will delivery without difficulty. There is, however, no previous report on parous patients

and the differences in birth weight between the previous and current newborn when the latter is complicated by shoulder dystocia.

The purpose of this retrospective, multi-center study was to describe a cohort of parous parturients with shoulder dystocia in the index pregnancy versus the heaviest birth weight of prior newborn without dystocia or BPI, and to contrast parous parturients with a shoulder dystocia in the current gestation who had delivered a fetus $\geq 4,000\text{ g}$ compared to those who had not.

Materials and methods

Over a five year, in three tertiary centers, ICD-9 codes were used to document all parous patients who had shoulder dystocia with or without BPI. In addition, labor/delivery and operating room scheduling books were interrogated to insure that no patient with this diagnosis had been omitted. Finally, newborn records from the same time period were scanned to insure diagnostic accuracy to detect BPI following shoulder dystocia. From the records at each center we investigated the birth weight and obstetric history of the prior vaginal birth, as well as the index newborns' weight, which was complicated by shoulder dystocia. Additionally, we obtained the antepartum and intrapartum characteristics of the index pregnancy, the maneuvers used to resolve shoulder dystocia and whether the index newborn sustained any injury.

The inclusion criteria for this study using our database were women

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Received: April 15, 2015; **Accepted:** May 04, 2015; **Published:** May 06, 2015

with prior vaginal delivery at term, know birth weight of prior siblings and shoulder dystocia with the index (current) pregnancy. Twin pregnancy and cesarean section delivery without at least one vaginal term birth were excluded as were anomalous fetuses. The study was approved by Institutional Review Board at two centers and exempted from another.

Along with odds ratio (OR) and 95% confidence intervals (CI), Mann-Whitney or unpaired t-test were used where appropriate. P<0.05 and CI not crossing integer 1 were considered significant.

Results

Over a five year period there were 624 SD in the database, and 304 (49%) met the inclusion criteria and are the focus of the study. Only 3% (10/304) of the cohort had prior SD and none of them had a newborn with brachial plexus injury (BPI). The mean difference in the prior largest and the current BW with SD was 394 ± 510 g heavier. In the index pregnancy, 10% had instrument assisted vaginal birth, 7% (20/304) BPI, and 3% (10/304) a fracture of the clavicle or humerus (Table 1).

As noted on Table 1, 79% (241/304) of the cohort, the index pregnancy with SD was the heaviest newborn for parturient (Group I) and with 21% (63/304), a previous newborn delivered vaginally weighted more than current one (Group II). These two groups were similar with regard to diabetes, use of epidural anesthesia, whether or not they were induced/augmented and rate of spontaneous birth versus delivery with vacuum/forceps (Table 1). Paradoxically, the rate of recurrent shoulder dystocia was significantly lower in Group I than II (2% vs 10%; OR 0.16, 95% CI 0.04, 0.59). The two groups did not differ significantly regarding the mean number of maneuvers and whether ≥ 3 were used to relieve SD, the rate of BPI or fracture of clavicle/humerus.

Previously, 17% (54/301) of the cohort had delivered a macrosomic

fetus vaginally and yet 30% (16/54) had SD with neonates that weighed <4,000 g in the index case (Table 2). Maternal age was greater in those with prior macrosomic babies and they had a higher rate of shoulder dystocia (7vs 3, OR 12.58, CI 3.14, 50.45). The rate of diabetes, induced/augmented pregnancies, epidurals, instrumented deliveries, the number of maneuvers and whether or not BPI was present was not different between the two groups. As one would expect, the comparison in prior largest birth weight and the difference between the two was statistically significant (Table 2).

Backward stepwise logistic regression indentified that the five significant risk factors for BPI among parous parturients: 1) African American race (as compared to Caucasian) (OR 4.69; 95% CI 1.25-17.56); 2) use of epidural anesthesia (OR 6.95; 95% CI 1.66-29.07); 3) use of suprapubic pressure, (OR 6.42; 95% CI 1.33-31.0); 4) extraction of the posterior arm (OR 9.30; 95% CI 2.07-41.82) and 5) birth weight difference between the previous largest newborn and index pregnancy of 725 g or more (OR 4.10, 95% CI 1.41-11.91).

Discussion

There are three principal findings in our study. First, only 3% (10 out of 304) had a prior shoulder dystocia among women who delivered a baby complicated by shoulder dystocia in the index pregnancy. None of the infants with a prior shoulder dystocia had brachial plexus injury whereas 7% (20/304) had BPI and 3% (10/304) had fracture of the clavicle or humerus in the index pregnancy. Surprisingly, there were no differences in prior largest birth weight between those who had shoulder dystocia plus BPI (3496 ± 483 , p=.704). Likewise, birth weight >4000 gm was also not significantly different amongst the group with BPI compared to the group of patients with shoulder dystocia without BPI (p=.113). Between the two groups, the percent with a difference in birth weights of >10% were higher when the heaviest baby was the prior delivery (p=.024, Table 1). Accordingly, having had a prior

Table 1. Parous parturients with shoulder dystocia.

	Group I Largest BW with Index Pregnancy (N=241)	Group II Prior Delivery with Largest BW (N=63)	P/ Odds Ratio (95% confidence intervals)
Age	27.3 ± 5.3	29.5 ± 1.2	0.011^
Gestational age (weeks)	39.4 ± 1.1	39.1 ± 1.2	0.166^
Prior Largest (BW grams*)	3428 \pm 448	3945 \pm 381	< 0.0001*
Prior shoulder dystocia	2% (4)	10% (6)	0.16 (0.04, 0.59)
Diabetes – gestational or pregestational	7% (17)	8% (5)	0.88 (0.31, 2.49)
Induced/Augmented	68% (163)	93% (42)	1.04 (0.58, 188)
Epidural	62% (149)	63% (40)	0.93 (0.36, 2.32)
Spontaneous vaginal delivery	90% (216)	90% (57)	<0.0001*
Birth weight (g)	4013 ± 428	3635 ± 395	<0.0001^
Prior largest BW – Current BW (g)	333 ± 617	-273 ± 310	<0.0001^
Maneuvers	1.7 \pm 0.8	1.5 \pm 0.7	0.215
McRoberts	88% (213)	94% (59)	0.51 (0.17, 1.53)
Suprapubic	61% (148)	52% (33)	1.44 (0.82, 2.53)
Woods	16% (38)	8% (5)	2.17 (0.82, 5.77)
Extraction of arm	5% (13)	3% (2)	1.74 (0.38, 7.92)
Three maneuvers or more	13% (32)	8% (5)	1.78 (0.66, 4.76)
Fracture – clavicle or humerus	4% (9)	2% (1)	2.40 (0.29, 19.36)
Brachial plexus injury	7% (18)	3% (2)	2.46 (0.56, 19.91)

Data as mean \pm standard deviation or % (n) *BW = birth weight in grams

^Mann-Whitney test used (failed normality test) *Unpaired t-test

Table 2. Parous parturients with shoulder dystocia and prior vaginal delivery macrosomic fetus.

	Prior BW ≥ 4,000 g (N = 53)	Prior BW ≤ 3,999 g (N = 251)	P/ OR (95% CI)*
Age	30.1 ± 6.2	27.2 ± 5.3	0.002^
Gestational age (weeks)	39.4 ± 1.1	39.3 ± 1.1	0.880^
Prior Largest (BW grams*)	4222 ± 206	3390 ± 388	<0.0001^
Prior shoulder dystocia	13% (7)	1% (3)	12.58 (3.14, 50.45)
Diabetes – gestational or pregestational	6% (3)	8% (19)	0.88 (0.31, 2.49)
Induced/Augmented	66% (35)	68% (170)	0.93 (0.49, 1.73)
Epidural	68% (36)	61% (153)	1.36 (0.72, 2.54)
Spontaneous vaginal delivery	94% (50)	89% (223)	2.09 (0.61, 7.15)
Birth weight (g)	4179 ± 511	3883 ± 417	<0.0001*
≥ 4,000 g	70% (37)	38% (95)	3.73 (2.00, 7.19)
Prior largest BW – Current BW (g)	-66 ± 493	264 ± 627	<0.004*
% Difference	-2.4 ± 12.6%	12.0 ± 11.7%	<0.0001*
Maneuvers	1.7 ± 0.9	1.6 ± 0.8	0.824*
Three maneuvers or more	17% (9)	11% (28)	1.63 (0.72, 3.69)
Fracture – clavicle or humerus	6% (3)	3% (7)	2.09 (0.52, 8.37)
Brachial plexus injury	6% (3)	7% (17)	0.82 (0.23, 2.93)

Data as mean ± standard deviation or % (n) *BW = birth weight OR = odds ratio; CI = confidence intervals

^Mann-Whitney test used (failed normality test) *Unpaired t-test

Table 3. Parous parturients with shoulder dystocia and brachial plexus injury (BPI).

	Shoulder dystocia and BPI (N = 20)	Shoulder dystocia Without BPI (N = 284)	P/ OR (95% CI)*
Age	28.0 ± 4.7	27.7 ± 5.6	0.685^
Gestational age (weeks)	39.1 ± 1.2	39.6 ± 1.1	0.460^
Prior Largest (BW grams*)	3496 ± 486	3538 ± 483	0.704*
Prior shoulder dystocia	0	4% (10)	0.64 (0.03, 11.28)
Diabetes – gestational or pregestational	25% (5)	6% (17)	5.23 (1.70, 16.12)
Induced/Augmented	85% (17)	66% (188)	2.89 (0.82, 10.12)
Epidural	85% (17)	61% (172)	3.69 (1.06, 12.89)
Spontaneous vaginal delivery	70% (14)	91% (259)	0.22 (0.08, 0.64)
Birth weight (g)	4110 ± 514	3922 ± 441	0.113^
≥ 4,000 g	60% (12)	42% (120)	2.05 (0.81, 5.17)
Current BW			
Prior Largest BW (g)	614.5 ± 569.7	384.1 ± 508.3	0.016^
≥ 400 g	80% (16)	49% (139)	4.17 (1.36, 12.79)
% Difference	14.1 ± 14.9%	9.2 ± 12.9%	0.024^
≥ 10%	75% (15)	52% (146)	2.84 (1.00, 8.01)
Maneuvers	2.5 ± 0.9	1.6 ± 0.8	0.004^
McRoberts	100% (20)	89% (252)	5.28 (0.31, 89.41)
Suprapubic	90% (18)	57% (163)	6.68 (1.52, 29.35)
Woods screw	30% (6)	13% (37)	2.86 (1.03, 7.91)
Extraction of arm	25% (5)	4% (10)	9.13 (2.77, 30.11)
Three maneuvers or more	40% (8)	10% (29)	5.86 (2.21, 15.52)
Fracture – clavicle or humerus	35% (7)	1% (3)	50.44 (11.68, 217.76)

Data as mean ± standard deviation or % (n) *BW = birth weight OR = odds ratio; CI = confidence intervals

^Mann-Whitney test used (failed normality test) *Unpaired t-test

shoulder dystocia and/or macrosomia does not predict a recurrence of SD the occurrence of BPI.

Secondly, when comparing those where the index pregnancy with shoulder dystocia was the heaviest newborn (Group I) versus those where previous was the heaviest (Group II) the rate of recurrent shoulder dystocia was significantly higher in those in Group I versus Group II (2% vs 10%, OR 0.16, 95 CI 0.04, 0.59). Both these findings taken together would indicate that the previous birth weight, whether shoulder dystocia was present or not, cannot be successfully used to predict shoulder dystocia and/or BPI injury in the current or index

pregnancy. This is not surprising as even the majority of infants with macrosomia will not develop shoulder dystocia or have BPI [8]. Therefore, it would appear that intrauterine factors such as the attitude of the fetus in the pelvis as well as the conduct of labor may be more important than the actual birth weight in the occurrence of shoulder dystocia and/or BPI [2,5,9,10]. Moreover, the literature is replete with data demonstrating the lack of correlation of ultrasound prediction of birth weight antenatally and the actual birth weight [11-13]. Therefore, the significant difference in birth weight between those with shoulder dystocia and BPI (614 g) versus those with shoulder dystocia and no injury (384 g), while significantly different statistically (p=.016), is

not clinically helpful in detecting a 230gm difference because using current ultrasound techniques such discrimination is not possible and may be harmful to the infant by increasing the number of unnecessary cesarean deliveries [14].

Lastly, using stepwise logistic regression there were five significant factors for BPI amongst the parturient. First, shoulder dystocia but not BPI, has been noted to be more common in African American patients [15]. Cheng *et al.* [15] also found that occiput posterior (OP) position was protective from shoulder dystocia compared to OA position. However, if delivery occurred in the OP position, it was more likely to be associated with BPI whether or not shoulder dystocia was present. In any case, the positive predictive value of these factors are very low, therefore, one cannot use it clinically in an index pregnancy [7]. Likewise, the use of epidural anesthesia has been noted to be a risk factor for shoulder dystocia in other studies [10] and we add confirmatory data of these findings. It was surprising that the use of suprapubic pressure is a risk factor for BPI amongst parous patients, as every treatise, book chapter and article on the subject recommends this maneuver when SD is diagnosed. Whether this is only a statistical association or whether it was related the small numbers of BPI cases in our population is unknown. Accordingly, we feel that the current study does not provide enough evidence to remove suprapubic pressure from our lexicon, as it is a valuable technique for treating women with shoulder dystocia.

Extraction of the posterior arm during a shoulder dystocia is a known risk factor for BPI [16]. What has not been confirmed is whether the BPI occurs in the anterior shoulder after delivery of the posterior arm which is unlikely, or whether the BPI may occur in the posterior arm as risk of the extraction. This seems unlikely, since more of the posterior arm deliveries have been suggested early in the series of maneuvers (to follow the McRoberts/suprapubic pressure) by a large study from the MFM Network rather than resorting to other maneuvers [17]. In any case, this is an acceptable maneuver and should remain, like suprapubic pressure in the treatment algorithm for women with shoulder dystocia in our opinion.

Similarly, the birth weight difference between the largest previous newborn and the index pregnancy is unable to be used prospectively to predict BPI or shoulder dystocia. Obviously, the birth weight of the index pregnancy is not known until after delivery therefore, it cannot be used as a reliable risk factor because the previous pregnancy had no shoulder dystocia. Perhaps in those women a prior shoulder dystocia was present, and in a gestation where the index pregnancy is believed to be >4500 gms for a diabetic gravida (>5000 gms in euglycemic pregnancies), there might be a place for this factor to be used clinically [4]. However, as previously noted [11-13], antenatal prediction of fetal weight is linked with large errors and it cannot be used to accurately predict those who will clinically develop shoulder dystocia with or without macrosomia.

In conclusion, the previous birth weight in parous women who have a shoulder dystocia, is associated with several risk factors for SD in future gestations. However, we have not been able to show that any of these factors are clinically useful on a prospective basis in a future pregnancy.

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