Improving Neonatal Outcome Through Practical Shoulder Dystocia Training

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OBJECTIVE: To compare the management of and neonatal injury associated with shoulder dystocia before and after introduction of mandatory shoulder dystocia simulation training.

METHODS: This was a retrospective, observational study comparing the management and neonatal outcome of births complicated by shoulder dystocia before (January 1996 to December 1999) and after (January 2001 to December 2004) the introduction of shoulder dystocia training at Southmead Hospital, Bristol, United Kingdom. The management of shoulder dystocia and associated neonatal injuries were compared pretraining and posttraining through a review of intrapartum and postpartum records of term, cephalic, singleton births in which difficulty with the shoulders was recorded during the two study periods.

RESULTS: There were 15,908 and 13,117 eligible births pretraining and posttraining, respectively. The shoulder dystocia rates were similar: pretraining 324 (2.04%) and posttraining 262 (2.00%) (P=.813). After training was introduced, clinical management improved: McRoberts' position, pretraining 95/324 (29.3%) to 229/262 (87.4%) posttraining (P<.001); suprapubic pressure 90/324 (27.8%) to 119/262 (45.4%) (P<.001); internal rotational maneuver 22/324 (6.8%) to 29/262 (11.1%) (P=.020); delivery of posterior arm 24/324 (7.4%) to 52/262 (19.8%) (P<.001); no recognized maneuvers performed 174/324 (50.9%) to 21/262 (8.0%) (P<.001); documented excessive traction 54/324 (16.7%) to 24/262 (9.2%) (P=.010). There was a significant reduction in neonatal injury at birth after shoulder dystocia: 30/324 (9.3%) to 6/262 (2.3%) (relative risk 0.25 [confidence interval 0.11–0.57]).

CONCLUSION: The introduction of shoulder dystocia training for all maternity staff was associated with improved management and neonatal outcomes of births complicated by shoulder dystocia.

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LEVEL OF EVIDENCE: II

Shoulder dystocia is an uncommon and largely unpredictable event[1,2] with serious potential morbidity for both mother and baby, particularly obstetric brachial plexus injury,[3–6] which may be exacerbated by inappropriate management.[7–9] Training for shoulder dystocia has been shown to improve the management of simulated shoulder dystocia.[10–12] Shoulder dystocia training is now mandated by the Clinical Negligence Scheme for Trusts in the United Kingdom[13] and recommended by the Joint Commission on Accreditation of Healthcare Organizations in the United States,[14] but there is currently no evidence of any associated improvement in neonatal outcome.[6] Indeed, a recent study from a U.K. hospital reports a significant increase in the rate of brachial plexus injuries associated with shoulder dystocia between 1991 and 2005 despite the introduction of training.[15]

The aim of this study was to compare the management of shoulder dystocia and neonatal injury associated with shoulder dystocia before and after the introduction of shoulder dystocia training for all staff in a single maternity unit.

METHOD

This retrospective, observational study compares the management and neonatal outcome of births complicated by shoulder dystocia before and after the intro-

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duction of shoulder dystocia training during a multiprofessional, 1-day obstetric emergency training course established at Southmead Hospital in 2000.[16] Annual attendance by all midwifery and obstetric staff was mandated by hospital management. The training course included a 30-minute practical session on shoulder dystocia management, run jointly by a midwife and an obstetrician, for multiprofessional groups of five to eight staff. All training was performed on a prototype shoulder dystocia training mannequin (PROMPT Birthing Trainer, Limbs and Things Ltd, Bristol, United Kingdom, Prototype II from 2000 until August 2003 and Prototype III from September 2003 onward) (Fig. 1). Training covered risk factors, recognition, demonstration of resolution maneuvers, and documentation of shoulder dystocia, as well as a simulated shoulder dystocia scenario. The training aimed to simplify the management of shoulder dystocia using a stepwise approach of calling for help, McRoberts' position, suprapubic pressure, and internal maneuvers (delivery of the posterior arm or rotation of the fetal shoulders). Eponymous maneuvers (eg, Woods' screw, Rubin II) were simplified to demonstrate their mechanical concepts (ie, rotation of the fetal shoulders out of the anterior-posterior diameter of the pelvis and into the oblique by pressure on the posterior fetal shoulder) rather than relying on memorization of their original descriptions.

All infants born during the 9-year period from January 1, 1996, to December 31, 2004, were identified using a standard U.K.-based maternity database (STORK). Training was commenced in July 2000; therefore all births during 2000 were excluded. Births between January 1, 1996, and December 31, 1999, were analyzed as "before training," and births between January 1, 2001, and December 31, 2004, were analyzed as "after training." Infants were excluded from analysis if they were born by cesarean delivery or if they were breech presentation, twins or higher multiples, premature (gestation less than 37 weeks), stillborn, or not born at Southmead Hospital.

Maternal notes in which "difficulty with the shoulders" had been recorded on the STORK maternity database were obtained from the medical records department. Maternal intrapartum notes were reviewed for evidence of shoulder dystocia (shoulder dystocia, tight/difficult shoulders, traction, additional maneuvers used) by an obstetrician (J.C., J.A., L.W.). If shoulder dystocia was confirmed, data regarding the management of shoulder dystocia (maneuvers used, traction, head-to-body delivery time, anterior fetal shoulder at the time of the dystocia, and grade of the accoucheur at the time of delivery of the head and body) were collected using a standardized maternal form. The maternal postnatal notes were reviewed by an obstetrician (J.C., J.A., L.W.) for any evidence of suspected neonatal injury (decreased arm movement,

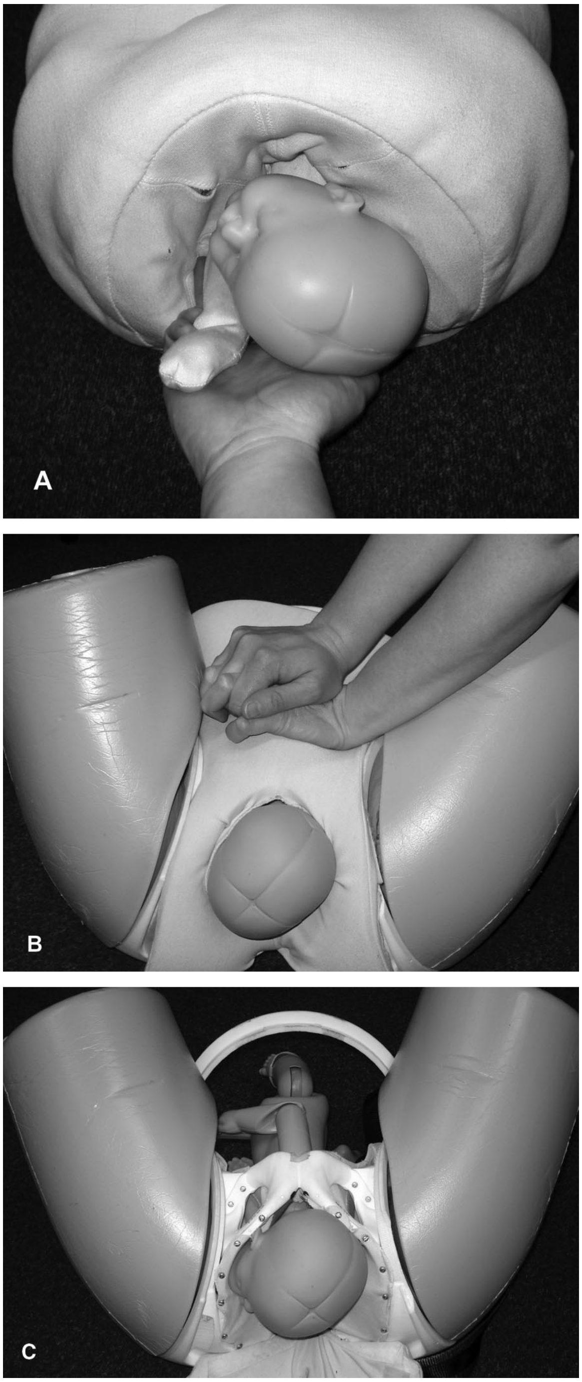

Fig. 1. Birth training mannequins used for shoulder dystocia training. **A.** Prototype 2. **B.** Prototype 3 with skin on. **C.** Prototype 3 with skin off.

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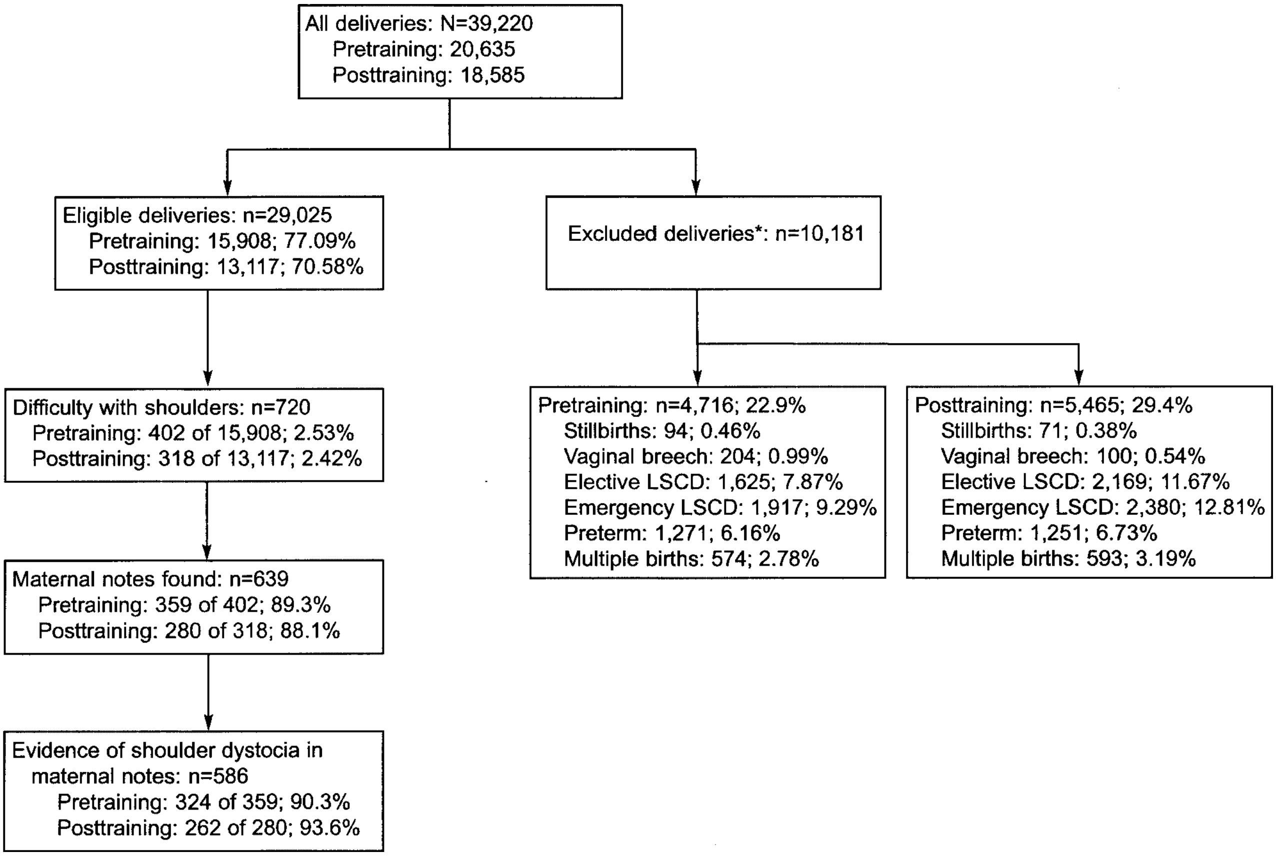

Fig. 2. Flow chart showing deliveries studied and reasons for exclusion. *Some births excluded for more than one reason. LSCD, lower-segment cesarean delivery.

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suspected fracture, other). Where the maternal notes were suggestive of neonatal injury, neonatal notes were obtained from medical records and reviewed by a neonatologist (A.W.). Details of any neonatal injury were recorded (injury and duration) using a standardized neonatal form.

Results are reported in proportions (%), with P values, relative risks, and 95% confidence intervals where appropriate. χ^2 testing was used in all comparisons of proportions, and the Student's t test was used for all continuous outcome variables. A 5% level of significance was used throughout. The statistical software used was Stata 8 (StataCorp LP, College Station, TX).

Ethical committee approval was obtained from the North Bristol NHS Trust Local Research Ethics Committee.

RESULTS

There were 20,635 births during the pretraining period and 18,585 births during the posttraining period at Southmead Hospital, Bristol, United Kingdom. Of these births 15,908 (77.09%) and 13,117 (70.58%) met the eligibility criteria pretraining and posttraining, respectively. Figure 2 shows the births and exclusions. The proportion of infants born by elective and emergency cesarean section was higher in the posttraining period (Fig. 2). "Difficulty with the shoulders" was recorded in 402 (2.53%) eligible deliveries pretraining and 318 (2.42%) posttraining; of these, maternal notes were available for review in 359 (89.3%) pretraining and 280 (88.1%) posttraining deliveries. Shoulder dystocia was confirmed in 324 (90.3%) pretraining notes and 262 (93.6%) posttraining notes reviewed.

There was no significant difference in the proportion of births coded for "difficulty with shoulders" or with confirmed shoulder dystocia before and after the introduction of training (Table 1). Women delivering in the posttraining period were older and had a higher body mass index than those delivering in the pretraining period. Women were also more likely to be primiparous, have their labor induced, and have an instrumental delivery in the posttraining period. There was no difference in the gestational age at

Table 1. Baseline Characteristics and Mode of Delivery

	Pretraining n=15,908	Posttraining n=13,117	*P*
Confirmed shoulder dystocia	324 (2.04)	262 (2.00)	.813*
Primiparous, n (%)	6,667[†] (41.91)	5,879[‡] (44.82)	<.001*
Maternal age (y), mean (SD)	28.6 (5.3)	29.1 (5.8)	<.001[§]
Maternal BMI, mean (SD)	24.2[‖] (4.4)	24.7[¶] (4.8)	<.001[§]
Maternal diabetes mellitus, n (%)	65 (0.41)	77 (0.59)	.030*
Spontaneous onset of labor, n (%)	12,534[#] (78.81)	10,099** (77.02)	<.001*
Instrumental delivery, n (%)	2,393 (15.04)	2,095 (15.97)	<.001*
Gestational age, mean (SD)	39.8 (1.1)	39.8 (1.2)	.872[§]
Birth weight (g), mean (SD)	3,457[††] (473)	3,443[‡‡] (477)	.009[§]
Babies of male gender, n (%)	8,168 (51.35)	6,626 (50.51)	.159*

SD, standard deviation; BMI, body mass index.
* Chi squared test.
† n=15,891.
‡ n=13,089.
§ Student *t* test.
‖ n=14,689.
¶ n=12,473.
\# n=15,904.
** n=13,112.
†† n=15,883.
‡‡ n=13,099.

delivery, although babies born in the posttraining period were on average 14 g lighter than those born pretraining. The incidence of maternal diabetes mellitus was higher in the posttraining period (Table 1), although there was no difference in the rate of diabetes mellitus in births complicated by shoulder dystocia.

In births complicated by shoulder dystocia, the mean birth weight was lower by an average of 99 g in the posttraining period, but there was no significant difference in the gestational age at delivery or the rate of spontaneous labor between the two study periods (Table 2). The instrumental delivery rate was higher in births complicated by shoulder dystocia in the posttraining period.

The documented management of shoulder dystocia was significantly different after the introduction of training (Table 3). Before training, none of the maneuvers recommended for the resolution of shoulder dystocia (McRoberts' position, suprapubic pressure, internal rotation, delivery of the posterior arm, All-Fours-Maneuvers) were used in 50% of shoulder dystocias, whereas after training, at least one recommended maneuver was used in more than 90% of cases of shoulder dystocia. There was also a significant reduction in the proportion of shoulder dystocias in which "excessive traction" (any record of traction not preceded by minimal, mild, routine, or normal) was documented. Examples of excessive traction documentation included "very hard pull on shoulders," "three good pulls," "came with very hard tug," "a lot of downward traction needed to release anterior shoulder," "shoulders not delivered despite a lot of traction to head, head first rotated to right and then

Table 2. Characteristics and Mode of Delivery in Births Complicated by Shoulder Dystocia

	Pretraining n=324	Posttraining n=262	*P*
Primiparous, n (%)	94 (29.0)	105 (40.1)	.005*
Maternal age (y), mean (SD)	28.6 (5.3)	29.8 (5.9)	.009[†]
Maternal BMI, mean (SD)	25.1[‡] (5.2)	25.5[§] (4.8)	.384[†]
Maternal diabetes mellitus, n (%)	6 (1.9)	1 (0.4)	.103*
Spontaneous onset of labor, n (%)	227 (70.1)	188 (72.0)	.602*
Instrumental delivery, n (%)	73 (22.5)	71 (27.1)	.250*
Gestational age, mean (SD)	40.1 (1.0)	40.1 (1.1)	.879[†]
Birth weight (g), mean (SD)	4,106 (424)	4,007 (470)	.009[†]
Babies of male gender, n (%)	178 (54.9)	158 (60.3)	.192*

* Chi squared test.
† Student *t* test.
‡ n=309.
§ n=250.

Table 3. Comparison of Shoulder Dystocia Management Before and After the Introduction of Training

	Pretraining (n=324)	Posttraining (n=262)	*P**
McRoberts' position (%)	95 (29.3)	229 (87.4)	<.001
Suprapubic pressure (%)	90 (27.8)	119 (45.4)	<.001
Internal rotational maneuver (%)	22 (6.8)	29 (11.1)	.020
Posterior arm (%)	24 (7.4)	52 (19.8)	<.001
McRoberts' and SPP only (%)	40 (12.3)	69 (26.3)	<.001
McRoberts', SPP, and internal maneuver (%)	13 (4.0)	29 (11.1)	.010
No recommended maneuvers performed (%)	174 (50.9)	21 (8.0)	<.001
Fundal pressure (%)	5 (1.5)	0 (0.0)	.100
Lithotomy or lateral positioning (%)	23 (6.7)	3 (1.1)	<.001
Excessive traction documented (%)	54 (16.7)	24 (9.2)	.010
Head-to-body delivery time documented (%)	86 (25.1)	157 (59.9)	<.001
Median head-to-body delivery time (range)	3 min (0.5 to 16) n=86	2 min (0.3 to 16) n=157	Not performed†
Delivery of shoulders completed by (%)			
Student midwife or doctor	14 (4.1)	7 (2.7)	.399
Midwife	221 (64.6)	169 (64.5)	.391
Junior grade doctor	17 (5.0)	11 (4.2)	.692
Middle grade doctor	61 (17.8)	68 (26.0)	.045
Consultant (attending) obstetrician	0 (0.0)	4 (1.5)	.084
Unknown	11 (3.2)	3 (1.1)	.133

SPP, suprapubic pressure.
* Chi squared test.
† Statistical comparison not performed because head-to-body delivery time was documented in only 25.1% of deliveries pretraining.

left," and "two good pulls combined with firm downward traction." The documentation of inappropriate use of fundal pressure, lithotomy, and left lateral positioning also was reduced after the introduction of training.

After the introduction of training, there was a significant reduction in the proportion of babies born with an obstetric brachial palsy injury (Table 4, Fig. 3). Persistent obstetric brachial plexus injuries (injuries still present at 6 and 12 months of age) were less common after training was introduced but did not reach statistical significance. Posttraining reductions in neonatal fractures and low 5-minute Apgar scores also were not statistically significant.

DISCUSSION

The introduction of annual, mandatory, multiprofessional obstetric emergency training for all maternity staff at Southmead Hospital, Bristol, was associated with improved management of and clinical outcome after shoulder dystocia. Three previous studies[10–12] have illustrated that the management of simulated shoulder dystocia can be improved with training; however this study demonstrates that shoulder dystocia training can be associated with improved clinical outcomes.

The Confidential Enquiry into Stillbirths and Deaths in Infancy,[9] the National Health Service of England and Wales Litigation Authority,[7] and the SaFE study[11] all identified a common theme regarding shoulder dystocia: failure to perform (and document) standard maneuvers. Our data concur; before the instigation of training, at least one recommended shoulder dystocia resolution maneuver was used in only 49% of births complicated by shoulder dystocia, increasing significantly to 92% after training.

Inappropriate actions, eg, fundal pressure and excessive traction, may also result in harm.[17] Before

Table 4. Neonatal Morbidity Associated with Shoulder Dystocia

	Incidence (%)		
	Pretraining (n=324)	Posttraining (n=262)	Relative Risk (95% CI)
Neonatal injury at birth	30 (9.3)	6 (2.3)	0.25 (0.11–0.57)
Brachial plexus injury at birth	24 (7.4)	6 (2.3)	0.31 (0.13–0.72)
OBPI at 6 mo	9 (2.8)	2 (0.8)	0.28 (0.07–1.13)
OBPI at 12 mo	6 (1.9)	2 (0.8)	0.41 (0.1–1.77)
Fractured clavicle or humerus	6 (1.9)	2 (0.8)	0.41 (0.1–1.77)
Apgar score less than 7 at 5 min	12 (3.7)	6 (2.3)	0.61 (0.24–1.57)

CI, confidence interval; OBPI, obstetric brachial plexus injury.

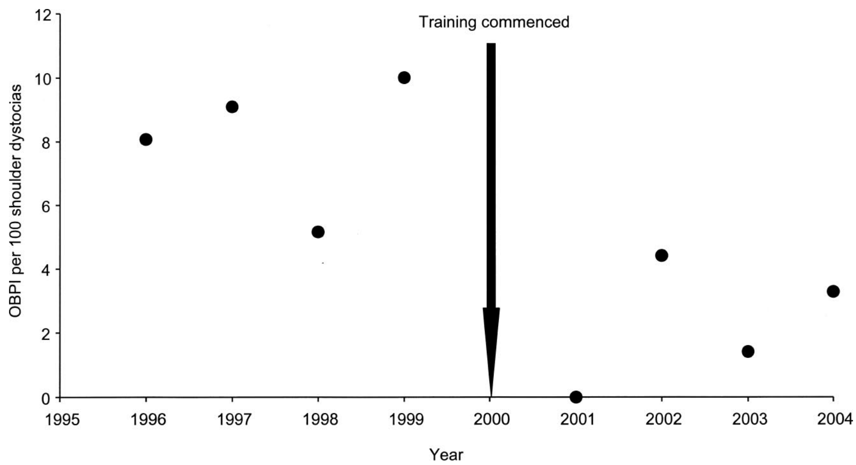

Fig. 3. Obstetric brachial plexus injuries (OBPIs) associated with shoulder dystocia per year.

training, fundal pressure was documented in 1.5% cases of shoulder dystocia and 7% of injuries; it was not documented at all after training. Excessive traction was documented in 17% and 9% of shoulder dystocias pretraining and posttraining, respectively.

The reported incidence of neonatal complications associated with shoulder dystocia is wide because of the subjective diagnostic criteria. Studies analyzing more than 200 cases of shoulder dystocia report incidences of obstetric brachial plexus injury at birth of 8.3%,[15] 8.5%,[18] 13.3 %,[19] and 16.8 %.[4] In our study, the rate of obstetric brachial plexus injury at birth was 7.0% before training and 2.3% after training. Rates of permanent obstetric brachial plexus injury associated with shoulder dystocia of 1.4%[4] and 0.5%[20] have been reported previously. Before training, our rate of permanent obstetric brachial plexus injuries after shoulder dystocia was 1.8%; after training, the incidence was 0.8%.

We classified a birth to have been complicated by shoulder dystocia if "shoulder dystocia" was documented, additional maneuvers were used after delivery of the fetal head,[21] traction more than routine was applied, or there was documentation of "difficult" or "tight" shoulders. Our retrospective review relies on midwifery coding of "difficulty with the shoulders" onto the STORK maternity database after a birth complicated by shoulder dystocia. We acknowledge that not all cases of shoulder dystocia will have been identified through the database; however, the recording of shoulder dystocia on the maternity database did not change during the study period, and the STORK Maternity Information database used is recognized to be largely accurate and consistently recorded.[22]

A further potential criticism of the study methodology is the reliance on documentation to determine management; some staff may have learned to more carefully document their care due to an increased awareness of the medico-legal implications. A prospective study of the potential benefits of training for shoulder dystocia could address this confounder.

The introduction of training coincided with other changes, including an increase in consultant (attending) cover.[13] The impact of this, however, is likely to be small—only 1.5% of posttraining births complicated by shoulder dystocia were delivered by a consultant.

Shoulder dystocia is an unpredictable, acute, life-threatening emergency, and therefore it is difficult to train staff during the actual event. Management involves practical skills, and hence practical training is intuitive; however, training has been repeatedly recommended since 1996[23] without any evidence that it is associated with improved clinical outcome. A recent retrospective review of shoulder dystocia cases from 1991 to 2005 (with training from 2001) in one U.K. hospital reports improvements in clinical management of shoulder dystocia after the introduction of training (McRoberts' position used in 51% and 91% cases of shoulder dystocia pretraining and posttraining, respectively); however, there was a significant increase in the rate of obstetric brachial plexus injury, from 5% in 1991 to 10% in 2005.[15] Similar increases have been reported in other U.K. hospitals: 0.7% in 1995[24] to 25% in 2003.[25] Our data compare favorably; the rate of obstetric brachial plexus injury associated with shoulder dystocia was 8.1% in 1995 and 3.3% in 2004 (Fig. 3). The differences in training employed in these hospitals need to be explored further to determine the "active ingredients of effective training." Our shoulder dystocia training may have been effective because 100% of staff were trained and/or because the training was situated where the emergency occurs, utilized a high fidelity model, and simplified the actions required to safely deliver the infant.

Shoulder dystocia is largely unpredictable and unpreventable. Therefore, practical training of all staff may be the single most effective method of optimizing neonatal outcomes after this difficult and potentially dangerous obstetric complication.

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