OBJECTIVE: Brachial plexus injury may be unrelated to manipulations performed at the time of delivery, occurring in the absence of shoulder dystocia and in the posterior arm of infants with anterior shoulder dystocia. To further support the hypothesis that some of these nerve injuries appear to be of intrauterine origin, we present a series of brachial plexus palsies associated with atraumatic cesarean delivery among fetuses presenting in the vertex position.

STUDY DESIGN: We performed a computerized search of all deliveries from 1991 to 1995 for the discharge diagnoses of brachial plexus injury and cesarean section. Inclusion criteria included cephalic presentation at the time of delivery and the absence of traumatic delivery.

RESULTS: We noted six cases of Erb’s palsy, with four palsies in the anterior shoulder and two in the posterior arm. Among those five patients undergoing cesarean section because of labor abnormalities, two had uterine cavity abnormalities whereas one had a prolonged second stage of labor. One brachial plexus palsy occurred in the absence of active labor. All nerve injuries were persistent at age 1 year.

CONCLUSIONS: Brachial plexus palsy can be associated with cesarean delivery. Such palsies appear to be of intrauterine origin and are more likely to persist. (Am J Obstet Gynecol 1997;177:1162-4.)

Key words: Brachial plexus palsy, intrauterine origin, cesarean section

Neonatal morbidity resulting from shoulder dystocia ranges from 21% to 42%, with brachial plexus injuries occurring in 8.4% to 22.7% of cases.1,2 Permanent brachial plexus injury is the basis for a significant proportion of the litigation associated with shoulder dystocia. It is commonly alleged that brachial plexus palsy is a direct consequence of excessive lateral traction applied to the baby’s neck during the delivery process.

A number of studies have evaluated the development of brachial palsy injury after vaginal delivery. In these reports risk factors have included maternal diabetes mellitus, fetal macrosomia, instrumented midpelvic deliveries, prolonged second stage of labor, postdates gestation, multiparity, and, most significantly, shoulder dystocia.3-5 Others have shown that brachial plexus injury may be unrelated to manipulations performed at the time of delivery. Brachial plexus palsy has been noted to occur in the absence of shoulder dystocia6-9 and in the posterior arm of infants with anterior shoulder dystocia.10,11 The strongest support for the position that factors other than lateral traction on the anterior shoulder are etiologic, however, comes from cases of brachial plexus injury noted after atraumatic cesarean delivery. To date, only seven such cases have been briefly mentioned in four reports.11,12,13 To further support the hypothesis that some of these nerve injuries appear to be of intrauterine origin, we present a series of brachial plexus palsies associated with atraumatic cesarean delivery among fetuses presenting in the vertex position.

Material and methods

We performed a computerized search of all deliveries occurring between 1991 and 1995 for the International Classification of Diseases, ninth edition, discharge diagnoses of brachial plexus injury and cesarean section. Maternal and neonatal records were reviewed. Exclusion criteria were noncephalic presentation or the presence of traumatic delivery. We defined the latter as difficulty with elevation of the fetal head or difficult delivery of the fetus through the uterine incision.
Table I. Cases of brachial plexus palsy at cesarean section among infants in vertex presentation

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Maternal age (yr)</th>
<th>Parity</th>
<th>EGA (wk)</th>
<th>Indication</th>
<th>Birth weight (gm)</th>
<th>Diabetes mellitus</th>
<th>Maternal weight gain (lb)</th>
<th>First stage (hr)</th>
<th>Second stage (hr)</th>
<th>Oxytocin exposure (hr)</th>
<th>Location of brachial plexus palsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37</td>
<td>1</td>
<td>38 wk + 4 days</td>
<td>Arrest of dilatation</td>
<td>2850</td>
<td>No</td>
<td>31</td>
<td>473</td>
<td>24</td>
<td>243</td>
<td>Left posterior</td>
</tr>
<tr>
<td>2</td>
<td>26</td>
<td>0</td>
<td>39 wk + 1 day</td>
<td>Arrest of descent</td>
<td>4225</td>
<td>No</td>
<td>24</td>
<td>312</td>
<td>244</td>
<td>244</td>
<td>Right anterior</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>0</td>
<td>40 wk + 2 days</td>
<td>Arrest of dilatation</td>
<td>3900</td>
<td>No</td>
<td>36</td>
<td>241</td>
<td>241</td>
<td>13.1</td>
<td>Right anterior</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>2</td>
<td>41 wk + 4 days</td>
<td>Elective repeat</td>
<td>3410</td>
<td>No</td>
<td>39</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>Right anterior</td>
</tr>
<tr>
<td>5</td>
<td>38</td>
<td>3</td>
<td>36 wk + 5 days</td>
<td>Arrest of dilatation</td>
<td>4140</td>
<td>Yes</td>
<td>29</td>
<td>365</td>
<td>26</td>
<td>18.3</td>
<td>Left posterior</td>
</tr>
<tr>
<td>6</td>
<td>37</td>
<td>1</td>
<td>40 wk</td>
<td>Arrest of dilatation</td>
<td>3500</td>
<td>No</td>
<td>41</td>
<td>211</td>
<td>211</td>
<td>28.4</td>
<td>Right anterior</td>
</tr>
</tbody>
</table>

EGA, Estimated gestational age.

Results

During the study period there were 58,565 total deliveries. Of these, 8451 (14.4%) were by cesarean section. Among the 50,114 vaginal deliveries, there were 303 cases of shoulder dystocia (0.61%) and 48 cases of brachial plexus injury (0.096%). We identified 17 cases of brachial plexus palsy after cesarean delivery. We excluded 9 cases of brachial plexus injury associated with breech delivery and 2 cases in which the operative report documented difficulty with delivery of the fetal head during cephalic presentations. Both of these latter cases occurred when the fetal head was lodged deep in the maternal pelvis, with cesarean section performed because of arrest of descent. The six cases are summarized in Table I and are described here.

Case reports

Case 1. A 37-year-old woman, gravida 4, para 1, at 38 weeks 4 days’ gestational age underwent primary low-transverse cesarean section because of arrest of dilatation at 9 cm. A 6 × 7 cm anterior lower-uterine-segment leiomyoma was noted intraoperatively. The male infant, with a birth weight of 2850 gm and Apgar scores of 6 and 8. A right-sided brachial plexus injury (anterior shoulder) was noted at birth. This nerve injury was present at age 13 months.

Case 2. A 26-year-old woman, gravida 1, para 0, at 39 weeks 1 day of gestation underwent low-transverse cesarean section because of arrest of descent at station 0. She had experienced a 4-hour second stage of labor until operating room space became available. The female fetus, weighing 4225 gm, had right-sided Erb’s palsy (anterior shoulder) that persisted at age 12 months.

Case 3. A 25-year-old woman, gravida 2, para 0, at 40 weeks 2 days’ gestational age was in latent labor with a 3-day history of ruptured membranes when she was first seen. After 13 hours of oxytocin augmentation, she experienced arrest of dilatation at 8 cm. Via primary low-transverse cesarean section, she was delivered of a 3920 gm female infant, with Apgar scores of 9 and 9. Pediatric evaluation confirmed right-sided Erb’s palsy (anterior shoulder) and right facial nerve palsy. At age 13 months the facial nerve palsy had resolved but the brachial plexus palsy was still present.

Case 4. A 28-year-old woman, gravida 3, para 2, at 41 weeks 4 days’ gestational age was in early labor (cervix 1 cm dilated) when she was first seen. She had undergone two prior cesarean deliveries because of malpresentation and desired an elective repeat cesarean. At the time of surgery exploration of the uterine cavity revealed an intrauterine septum. She was delivered of a 4140 gm female infant with Apgar scores of 6 and 8. A right-sided brachial plexus injury (anterior shoulder) was noted at birth. This nerve injury was persistent at age 13 months.

Case 5. A 38-year-old woman, gravida 5, para 3, underwent oxytocin induction at 36 weeks 5 days of gestation because of severe preeclampsia. Her prenatal course was also remarkable for insulin-requiring gestational diabetes mellitus. Eighteen hours later the patient underwent a primary low-transverse cesarean delivery because of arrest of dilatation at 9 cm. She was delivered of a 4140 gm female infant with Apgar scores of 9 and 9. Left-sided Erb’s palsy (posterior shoulder) was noted at birth. The injury persisted on examination at age 16 months.

Case 6. A 37-year-old woman, gravida 2, para 1, underwent a successful external cephalic version at 40 weeks of gestation because of breech presentation. Her antepartum course was significant only for penicillin treatment of primary syphilis. Oxytocin induction was begun immediately after the version; after 28 hours of oxytocin, she underwent primary low-transverse cesarean delivery because of arrest of dilatation at 6 cm. The male infant weighed 3500 gm with Apgar scores of 9 and 9 and had right-sided Erb’s palsy (anterior shoulder). This injury persisted at age 14 months.

Comment

Brachial plexus palsy is commonly attributed to excessive lateral traction applied to the fetal neck by the physician during attempts to free the shoulder from behind the symphysis pubis. Some authors have argued that with worsening severity of the shoulder dystocia and increased efforts of the operators the impact of this traction force becomes more pronounced on the brachial plexus. The injury attributed to excessive lateral traction ranges from limited nerve dysfunction to root avulsion with subsequent permanent injury.

We have presented 6 cases in which it is virtually certain that this mechanism played no role. It is also remarkable that in all 6 of the described Erb’s palsies there was...
Among the 34 neonates who had at least 1 year of pediatric follow-up, complete resolution of the nerve injury occurred in all but 3 cases (8.8%).

The persistence of the palsy in all 6 of these infants suggests a qualitatively different mechanism of injury. Long-standing in utero stretching of the brachial plexus may represent a common unifying basis accounting for such injuries. Our data also imply that some cases of permanent brachial plexus injury may be related to events antedating the actual delivery, especially in light of the fact that one patient underwent cesarean delivery while in early labor.

Several possible mechanisms for the in utero injury have been proposed. When the fetal shoulders remain in a persistent anteroposterior orientation at the pelvic brim, the anterior shoulder is impacted behind the symphysis pubis. With further descent of the vertex through the pelvic outlet, the anterior brachial plexus undergoes intruterine stretching. This mechanism may explain the injury in our patient with a 4-hour second stage. The posterior shoulder may also become temporarily lodged behind the sacral promontory, resulting in application of excessive force to the posterior brachial plexus. Finally, abnormal intrauterine pressures arising from uterine anomalies may be etiologic. Dunn and Engle described an infant with brachial plexus injury and phrenic nerve palsy attributed to a bicornuate uterus. Two of our cases were associated with abnormalities of the uterine cavity.

Although not performed in our 6 cases, electromyography or magnetic resonance imaging done soon after delivery could help ascertain the time of the brachial plexus injuries. Normally it takes approximately 10 days for muscle to display electromyographic evidence of denervation. The finding of reduced voluntary motor unit activity, nonconductivity of peripheral nerves, and denervation sharp wave potentials immediately after delivery would suggest an intruterine origin of brachial plexus palsy. Magnetic resonance imaging may also be beneficial in determining whether an embryologically abnormal brachial plexus is present. It has been suggested that excessive upward force may be applied during elevation of the fetal head during cesarean section, thereby stretching the posterior brachial plexus. However, the majority of the nerve injuries described in this series occurred in the anterior shoulder. We likewise were careful to exclude those cases with reported difficulty in delivering the fetal vertex. Failure to rotate the fetal vertex to the occipitoanterior position before attempted delivery may also transfer lateral force to the brachial plexus.

Neonates with abnormal neurologic development may have evidence of brachial plexus dysfunction when first seen. However, pediatric evaluation revealed that all of the infants in the present series were otherwise neurologically normal. Finally, although brachial plexus injury could theoretically be associated with external cephalic version as a result of excessive force applied to the fetal head, a recent review did not mention this finding. The occurrence of such injuries therefore strongly suggests causes other than the usually suspected stretch or avulsion method of injury.

REFERENCES