

# The Influence of Timing of Elective Cesarean Section on Risk of Neonatal Pneumothorax

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**Objective** To determine whether the timing of elective cesarean delivery at term influences the risk of neonatal pneumothorax.

**Study design** Chart reviews confirmed gestational age, delivery modalities, and diagnosis of pneumothorax of 66,961 term infants delivered in the Veneto region of northern Italy. Of these neonates, 17,783 (26.5%) were delivered by cesarean section, including 9988 elective (56.1%) and 7795 emergency (43.8%).

**Results** In 5498 (55.0%) of neonates, an elective cesarean section was performed before 39 completed weeks. Fifty-nine neonates had pneumothorax diagnosed (0.88/1000 births). Neonates delivered by elective cesarean section had an increased incidence of pneumothorax (2.90/1000 births), in comparison with neonates delivered by emergency cesarean (1.53/1000 births; OR 4.21; 95% CI 2.02-8.74) or vaginally delivered (0.39/1000 births; OR 7.95; 95% CI 4.41-14.32). In elective cesarean sections there was a significant progressive reduction in the incidence of pneumothorax from week 37 0/7 to 37 6/7 onward ( $P < .01$ ).

**Conclusions** The timing of elective cesarean section influences the pneumothorax risk. A reduction in neonatal iatrogenic pneumothorax would result if elective deliveries were performed after the 39 completed weeks of pregnancy. (*J Pediatr* 2007;150:252-5)

Over the past 30 years, the rates of cesarean deliveries have increased in the Western world.<sup>1,2</sup> In particular, there has been an increase in the incidence of elective cesarean delivery at term, a result largely of the management of previous cesarean sections.<sup>3,4</sup> Elective cesarean delivery is believed to be less distressing for the fetus, but it has negative effects on the physiological responses to birth, resulting in an increased risk of iatrogenic respiratory distress syndrome (RDS) when performed at 37 or 38 weeks rather than 39 or 40 weeks of gestation.<sup>5</sup> The American College of Obstetricians and Gynecologists Committee on Obstetrics: Maternal and Fetal Medicine currently recommends that delivery by elective cesarean section at 39 weeks be based on accurate assessment of fetal maturity.<sup>6</sup>

Respiratory morbidity in infants with iatrogenic RDS is remarkably severe, and our previous studies suggested an increased risk because of the need for resuscitation and respiratory disorders after elective cesarean section.<sup>5</sup> The initial reports found pneumothorax in 10.3% to 34.0% of infants with iatrogenic RDS.<sup>3,7,8</sup> More recently, pneumothorax, severe persistent pulmonary hypertension, or both conditions have been noted in infants delivered by elective cesarean section.<sup>9</sup> These studies, however, have been biased by being limited only to infants admitted to neonatal intensive care units (NICUs) and were not large enough to allow differentiation between method of delivery and each week of pregnancy at term. The diagnosis of neonatal pneumothorax in infants born after an elective cesarean section remained less well characterized. This is relevant, considering that iatrogenic pneumothorax represents a life-threatening condition, one that needs a prompt recognition and therapy, and requires specialized care offered generally at tertiary referral centers.<sup>10,11</sup> We determined the incidence of pneumothorax in infants who were electively delivered at term and who were then transferred to the two Level-III referral NICUs of the Veneto region of Italy, to correlate their incidence with the vaginal or cesarean method of delivery, and to examine the risk during each week of gestation between week 37 0/7 and 41 6/7.

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NICU Neonatal intensive care unit RDS Respiratory distress syndrome

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## METHODS

### Study Design and Population

All patients with pneumothorax transported to the Veneto region in northeastern Italy, from January 1, 2002 through December 31, 2003 by two dedicated neonatal transport teams of the Pediatric Departments of the Universities of Padua and Verona, respectively, were eligible for inclusion in the study. Inborn neonates with pneumothorax cared for at the Level-III reference centers and those registered in four Level-II hospitals also were included. The transport teams, which include a neonatologist and a nurse, provide ground ambulance transport of neonatal critical care for all of the Veneto region, with a total population referral base of 4.3 million people with a radius of approximately 250 km. There are approximately 35,000 to 40,000 births per year in 42 delivery units. Of these units, 36 are classed as Level I (care for normal near-term and term infants), 4 as Level II (full resources for neonatal intensive care = intermediate care), and 2 as Level III (Padua and Verona educational hospitals with resources for obstetrics and complete neonatal intensive care).

Questions and outcome variables, as well as methods of analysis and exclusion criteria, were determined prospectively. Data for method of delivery, gestational age, birth weight, Apgar scores, need of resuscitation at birth, mode of respiratory support, postnatal age at diagnosis, management, underlying primary lung disease, presence of major congenital malformations, length of hospital stay, and mortality were recorded for all the patients. Deliveries were classified as spontaneous if the woman presented in spontaneous labor, emergency if a maternal or fetal obstetric or medical condition prompted delivery, and elective when the patient did not present in labor and no maternal or fetal condition warranting delivery was noted in the Maternal Fetal Medicine database or on review of the obstetric chart. Vaginal-delivered women with conditions that might influence the likelihood of an adverse neonatal outcome (breech presentation, twinning) were not excluded from the low risk population. Complications that occurred during or after delivery were not utilized in determining the criteria for inclusion because only factors that could be identified prenatally were considered to reflect the information available to the obstetrician when planning delivery. Resuscitation in the delivery room was done according to the International Guidelines for Neonatal Resuscitation.<sup>12</sup>

### Statistical Analysis

For initial analysis, the obstetric population targeted was searched for those women whose pregnancy was at term between 37 0/7 and 41 6/7 weeks gestation (estimated by last menstrual cycle period or, if uncertain, by the use of sonography).<sup>13</sup> Subsequently, the women were classified into two groups: (1) those women with vaginal delivery; and (2) those women with deliveries by cesarean section. Following initial analysis, the cesarean section group was further narrowed to

identify the group of women who underwent elective cesarean sections.

The diagnosis of neonatal pneumothorax was established on the basis of characteristic clinical signs and the radiographic findings.<sup>14</sup> All neonatal diagnoses were made at the time of the baby's discharge by an experienced neonatologist. The mode of delivery at term and the timing of births in each week from 37 0/7 to 41 6/7 in the Veneto region during the 2 year were computed from the Regional Register Database Certificate of Assistance to the birth. The study was approved by the Institutional Review Board of the involved hospitals.

The incidence of pneumothorax, OR, and the 95% CI with mode of delivery and for each week of gestation at term were calculated using the Confidence Interval Analysis: Microcomputer Program.<sup>15</sup> Testing for comparison across multiple proportions was performed using the Cochran-Armitage trend test. A *P* value of < .05 was regarded as significant.

## RESULTS

During the 2-year study period, 87,418 infants were delivered and 66,961 (82.5%) were infants born at term. Of these neonates, 17,783 were delivered by cesarean section (26.5%), including 9988 (56.1%) delivered by elective cesarean and 7795 (43.8%) by emergency cesarean section, and 49,178 (68.0%) vaginally delivered. Fifty-nine neonates had pneumothorax diagnosed (0.8/1000 births) and all were treated with thoracostomy. Neonates delivered by elective cesarean section showed an increased incidence of pneumothorax (2.90/1000), in comparison with neonates delivered by emergency cesarean (1.53/1000) or vaginally delivered (0.39/1000). Elective cesarean delivery was associated with an increased risk of pneumothorax with respect to both vaginal delivery (OR 7.95; 95% CI 4.41-14.32) and emergency cesarean delivery (OR 4.21; 95% CI 2.04-8.74). Also emergency cesarean delivery showed an increased pneumothorax relative risk with respect to vaginal delivery (relative risk 1.26; 95% CI 1.03-1.53) (Table I).

The numbers of infants born at each week of gestation by mode of delivery are shown in Table II. In 5498 (55.0%) neonates elective cesarean section was performed before 39 0/7 weeks. For the elective cesarean section there was a significant progressive reduction in the incidence of pneumothorax from the week 37 0/7 to 37 6/7 onward (*P* < .01; linear slope  $-2.48 \times 10^{-3}$ ). A similar but less significant trend was also evident for vaginal delivery (*P* < .01; linear slope  $-4.95 \times 10^{-3}$ ). For the group of babies born by emergency cesarean section there was no difference in the incidence of neonatal pneumothorax occurrence on testing across week 37 0/7 to 37 6/7 onward. In addition, in the group of babies born by elective cesarean section, the notable feature was the association with risk, in particular at 37 0/7 to 38 6/7 and 38 0/7 to 38 6/7 weeks.

No mortality occurred among vaginally and electively or emergency cesarean delivered neonates with pneumothorax. Nevertheless, pulmonary hypertension appeared to complicate

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