

BORN BY ELECTIVE CESAREAN SECTION AT TERM

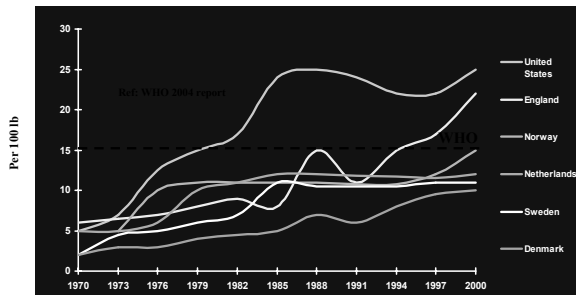
Is it Safe?

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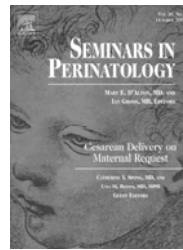
ELECTIVE CESAREAN DELIVERY (“Planned” CD)

- In 2004, 1.2 million or 29.1% of live births in the United States were born by cesarean delivery (CD)
- Primary CD: 845,361 or 20.5% of l.b.
 (~1/3 were elective CD ⇒ 7.5% of l.b.)
- Repeat CD: 354,639 or 8.6% of l.b.
 (~90% were planned repeat CD ⇒ 7.74% of l.b.)
- *Elective Cesarean Delivery (ECD)* accounted for almost ½ of the total CD (14.9% of l.b.)

CESAREAN DELIVERY RATES International Comparison



Cesarean Delivery on Maternal Request Maternal and Neonatal Outcomes



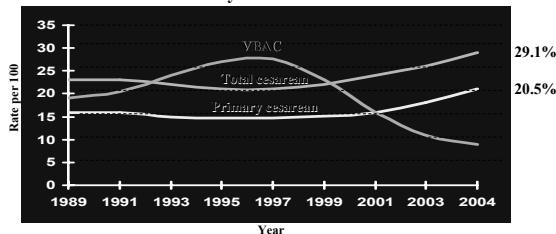
October 2006



December 2006

TREND AND INCIDENCE OF CESAREAN DELIVERY OVERTIME IN THE UNITED STATES (CDC - 1989 – 2004)

Total and Primary CD Rate and VBAC Rate



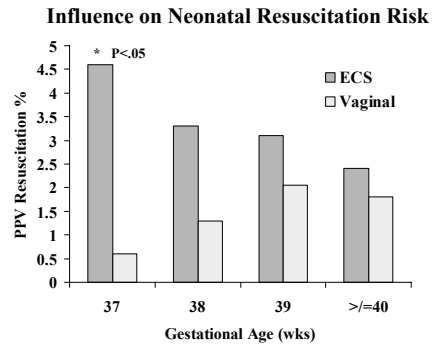
“In 2004, 1.2 million (29.1%) of live births were born by CD”

Ref: NIH, State-of-the-Science Conference Statement on CDMR, March 27-29, 2006

Cesarean Sections Are Here to Stay!

If Cesarean Sections are Here to Stay, Can We Make Them Safer?

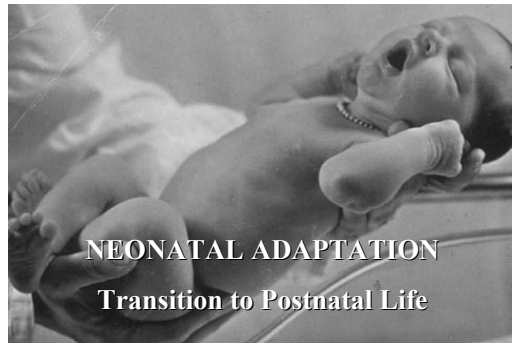
TIMING OF ELECTIVE C-SECTION AT TERM



BORN BY ELECTIVE C-S AT TERM Outcome Assessment

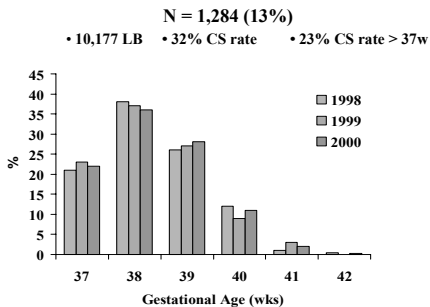
- I. Condition of the Infant at Birth
 - A. Neonatal Depression. Birth Trauma.
- II. Neonatal Morbidity
 - A. Delayed or Abnormal Transition
 - B. Risk of Respiratory Morbidity
 - C. Admission to SCN/NICU
 - D. Unexpected Iatrogenic Prematurity
 - E. Neonatal Length of Hospital Stay
 - F. Intracranial Hemorrhage
- III. Fetal and Neonatal Mortality
- IV. Long-term Outcome

CARDIORESPIRATORY ADAPTATION AT BIRTH



ELECTIVE CESAREAN SECTION AT TERM

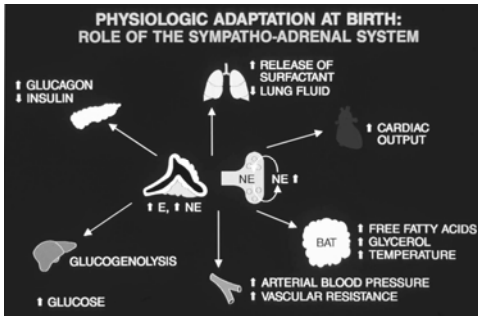
Incidence by each week of gestation at term



FETAL LUNG FLUID (~ 7 weeks).

- **DAILY PRODUCTION** : ~ 10% of body weight
- **COMPOSITION** :
 - Na (150 mEq/L) • Cl (153 mEq/L)
 - K (6.0 mEq/L) • Bicarbonate (2 mEq/L)
 - Protein (< 0.06 mg/dL) • pH 6.27
- **VOLUME AT TERM** : ~ 30 ml/K
- **REMOVAL**
 - Prenatal Removal
 - Pre-partum : 35% Decrease production
 - Intrapartum : 30% Resorption (lymphatics)
 - Postnatal Clearance : 35% Evaporation. Absorption

Ref: Bland, Semin Perinatol 1988, 12: 124



Ref: Faxelius, Arch Dis Child 1982; 142: 1004

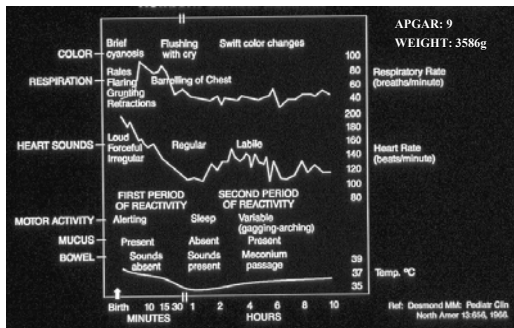
NEONATAL CARDIOPULMONARY TRANSITION AFTER ELECTIVE CESAREAN DELIVERY

Babies born by ECD are more likely to have:

- More lung fluid at the time of birth
- A more intense and prolonged First Stage (60'-120')
- Delayed improvement in lung compliance
- Delayed establishment of FRC (6h vs 3h)
- Slower decline of PVR
- Less than optimal respiratory control. They exhibit more sleep apneas of longer duration during quiet sleep.

- Boon – *J Pediatr* 98: 812-815, 1981
- Hagnevik – *Early Hum Dev* 27: 103-10, 1991
- Agata – *Biol Neonate* 68: 404, 1995
- Bader – *Acta Paediatr* 93: 1216-23, 2004

THE TRANSITIONAL PERIOD Newborn Clinical Stages



CARE OF THE NEWBORN IN TRANSITION

Early Recognition of Abnormal Transition



Normal Adaptive Changes
vs. Abnormal Transition

- The newly born as “recovery patient”
- The “intensive care” concept

THE TRANSITIONAL PERIOD

The First Few Hours of Life

- **FIRST STAGE** : 0 - 30 minutes
“First Period of Reactivity”
- **SECOND STAGE** : 30 minutes - 2 hours
“Period of Unresponsiveness”
- **THIRD STAGE** : 2 - 8 hours
“Second Period of Reactivity”

CLINICAL RESPIRATORY DISTRESS SCORING SYSTEM

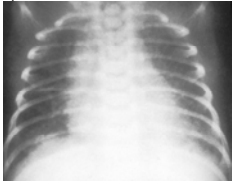
(Downes' Score : Clinical Pediatrics, 9:325, 1970.)

CLINICAL PARAMETERS	0	1	2
Respiratory rate (per min.)	60	60-80	> 80 or apneic episode
Cyanosis	None	In air	In 40% O ₂
Retractions	None	Mild	Moderate to severe
Grunting	None	Audible with stethoscope	Audible without stethoscope
Air entry*	Clear	Delayed or ↓	Barely audible

Severe : 7>, Moderate : 4- 6, Mild : <3

NEONATAL RESPIRATORY MORBIDITY FOLLOWING ELECTIVE CESAREAN DELIVERY

♀ 38 weeks 3080g 4 hrs old



Transient Tachypnea of the Newborn (TTN)

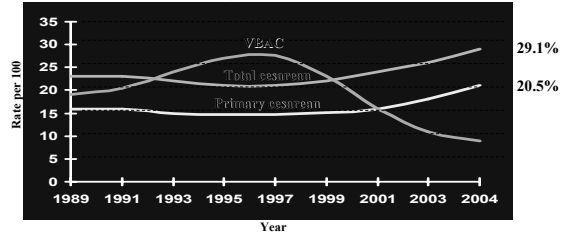
♂ 37 weeks 2860g 7 hrs old



Respiratory Distress Syndrome (RDS)

TREND AND INCIDENCE OF CESAREAN DELIVERY OVERTIME IN THE UNITED STATES (CDC - 1989 - 2004)

Total and Primary CD Rate and VBAC Rate



"In 2004, 1.2 million (29.1%) of live births were born by CD"

Ref: NIH, State-of-the-Science Conference Statement on CDMR, March 27-29, 2006

ELECTIVE C/S AND NEONATAL RESPIRATORY MORBIDITY

- Usher RH: RDS in infants delivered by c-section. AMJ Obstet Gynecol. 1964; 88: 806-15.
- Avery ME: Transient tachypnea of the newborn AMJ Dis Child. 1966; 111: 380.
- Hack M: Neonatal RD following elective CD. A preventable disease? AMJ Obstet Gynecol. 1976; 126: 43-47.
- Maisels MJ: Elective delivery of the term fetus. An obstetrical hazard. JAMA 1977; 238: 2036-9.
- Rawlings JS: Transient tachypnea of the newborn (TTN). An analysis of neonatal and obstetric risk factors AJDC 1984; 138: 869-871.

NEONATAL RESPIRATORY MORBIDITY FOLLOWING ELECTIVE C-SECTION AT TERM

1994-1998, Univ. Hosp. Vrije, Amsterdam, The Netherlands

Gestational Age (wks)	Totals	Respiratory Morbidity
37 - 37 6/7	505	40 (7.92)
38 - 38 6/7	1341	61 (4.54)
≥ 39	1100	13 (1.18)
TOTAL	2946	114 (3.86)

Adapted from: Table 3 in van der Berg. Eur J Obstet Gynecol Reprod Biol. 2001; 98:9-13

1980 NIH CONSENSUS DEVELOPMENT TASK FORCE STATEMENT ON CESAREAN BIRTH

➤ Rationale

- Rising rate of cesarean delivery (~18%)
- 98% repeat C/S in women with previous C/S
- Increasing reports of rising neonatal respiratory morbidity in infants born by elective C/D

➤ Recommendations

- Challenge the concept "once a C/S always a C/S"
- Trial of VBAC in an attempt to reduce repeat C/S
- "Properly selected" women should be encouraged to labor and deliver vaginally
- Efforts to reduce the rate of elective C/S both primary and repeat

Ref: Am J Obstet Gynecol, 139: 902-9, 1981

NEONATAL RESPIRATORY MORBIDITY FOLLOWING ELECTIVE CESAREAN DELIVERY AT TERM

Rate of NRM by Gestational Age

GA (wks)	ECD	Vaginal	Risk Ratio
37	10.0 %	1.8 %	12 (95 % CI 7-21)
38	5.8 %	1.5 %	7 (95 % CI 5-11)
39	2.8 %	0.4 %	3 (95 % CI 2-8)
40	3.5 %	0.4 %	-

Ref: Shrivastava, Arch Dis Child 1999; A 30 suppl: G62

ELECTIVE CESAREAN SECTION AND NEONATAL RESPIRATORY MORBIDITY

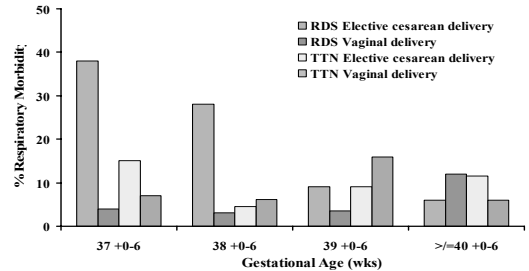
Benefit of Awaiting Onset of Labor

- NRM after onset of labor 11.2% vs 30% before onset of labor P < .002
- The risk of RM decreased 1.5 times for each week of advancing GA
- Labor significantly reduced the risk of RM, independently of GA P < .03

Ref: Cohen & Carson
Obstet Gynecol 65: 818-823, 1985

TYPES OF NEONATAL RESPIRATORY MORBIDITY RISK AND MODE OF DELIVERY AT TERM

Influence of Timing of Elective C-Section



(Padua Univ., Italy)

Reference: Zanardo V. Acta Paediatr 2004; 93:643-647.

NEONATAL RESPIRATORY MORBIDITY AFTER ELECTIVE CESAREAN DELIVERY

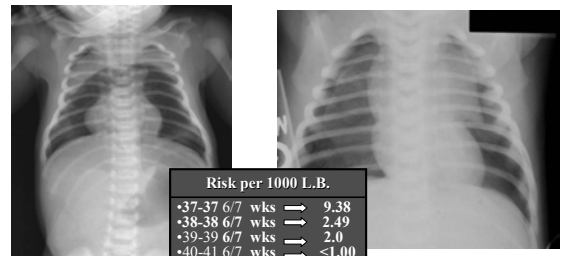
Does Labor Make a Difference?

- There is strong evidence of the benefits of labor prior to an ECD.
- Although ECD is an independent risk factor for NRM, this risk is reduced with labor before cesarean, but still remains elevated.

- Curet – *Int J Gynecol Obstet* 27: 165-70, 1988
- Morrison – *Br J Obstet Gynecol* 102: 101-6, 1995
- Hook – *Pediatrics* 100: 348-53, 1997
- Gerter – *Am J Gynecol Obstet* 193: 1061-4, 2005

ELECTIVE CESAREAN SECTION AT TERM Risk for Spontaneous Pneumothorax

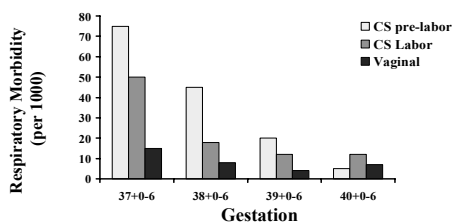
♂ 37 wks 2920g 3 hrs ♀ 38 wks 3140g 2 hrs



Ref: Zanardo, V y col:J pediatri; 150: 252-5

NEONATAL RESPIRATORY MORBIDITY AND MODE OF DELIVERY AT TERM

Influence of Timing of Elective C-Section



Ref: Morrison JJ: Br J Obstet Gynaecol 102: 101-106, 1995

SPONTANEOUS PNEUMOTHORAX IN TERM INFANTS Risk Based on Mode of Delivery

Mode	Nº	PNTx	Incidence per 1000 LB	Odds ratio (CI 95%)
Elective C/Section	9,988	29	2.90	7.95 (4.41 - 14.32)
Emergency C/Section	7,795	12	1.53	4.21 (2.02 - 8.74)
Vaginal	49,178	18	0.39	1.26 (1.03 - 1.53)

Ref: Zanardo; J. Pediatr 2007, 150: 252-5

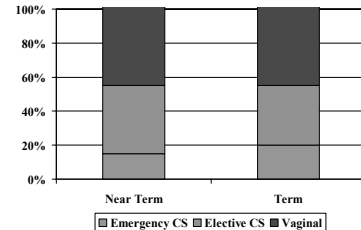
ELECTIVE CESAREAN DELIVERY AT TERM AND PERSISTENT PULMONARY HYPERTENSION

“The incidence of PPHN among neonates delivered by elective C/S has been reported to be almost fivefold higher than those delivered vaginally.”

- Levine EM, Obstet Gynecol 2001; 97: 439-42
- Keszler M, Pediatrics 1992; 89: 670-2
- Reece EA, Obstet Gynecol 1987; 70: 696-700
- Heritage CK, AMJ Obstet Gynecol 1985; 152: 627-9

Mode of Delivery of Infants ≥ 34 weeks Who Required ECMO for Respiratory Failure

(N° ECMO: 14,395 infants, 1989-2006)



Ref: Semin perinatal 30:296-304, 2006

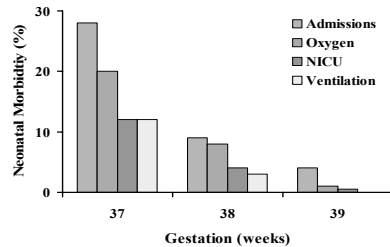
MODE OF DELIVERY AND NEONATAL RESPIRATORY CONDITIONS

Ref: Levine - Obstet Gynecol 2001; 97: 439

Mode of Del.	PPHN	TTN	RDS	Combine
➤ Vaginal del. (n = 21,017)	17 (.08%)	238 (1.1%)	33 (.16%)	288 (1.4%)
➤ Elective C/S (n = 1,889)	7 (.37%)	59 (3.1%)	4 (.2%)	70 (3.7%)
P	< .001	< .001	.18	< .001
Odds ratio	4.6	2.8	1.3	2.8
95% CI	1.9, 11	2.1, 3.8	.5, 3.8	2.1, 3.6

NEONATAL RESPIRATORY MORBIDITY FOLLOWING ELECTIVE CESAREAN SECTION AT TERM

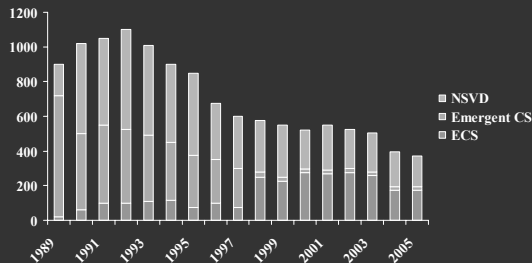
By Gestational Age at Delivery
1996-1997



Glasgow Royal Maternity Hospital, Scotland

Reference: Nicoll, Scot Med J 2004; 49:22-25.

ECMO Trends in the US from 1989 to 2006



Is there a potential role for antenatal corticosteroids in the planning of elective cesarean section at term?

ELECTIVE C/S AT TERM AND ANTENATAL BETAMETHASONE

Incidence of Neonatal Respiratory Distress

ECS	RESPIRATORY DISTRESS		
	TOTAL (%)	RDS (%)	TTN (%)
BETA 503	11 (2.2)	1 (0.19)	10 (1.98)
CONTROL 455	24 (5.3)	5 (1.09)	19 (4.17)
TOTAL 958	35 (3.6)	6 (0.63)	29 (3.05)

Ref: Stutchfield. BMJ. 2005; 331:662-667

ELECTIVE CESAREAN DELIVERY AND NEONATAL MORTALITY

(United States, CDC: 1998-2001)

Neonatal mortality rates were 2.9 times higher among infants delivered by primary elective cesarean delivery (1.77 per 1000 live births) than for those delivered vaginally (0.62 per 1000 live births).

	Vaginal	Cesarean
	(Rates per 1000 lb.)	
Total neonatal	0.62	1.77
Early	0.33	1.07
Late	0.29	0.69

Ref: McDorman, Birth 2006; 33 (3): 175-182. (Sep).

Is it safe to be born by Elective Cesarean Delivery at term?

CONCLUSIONS

- The incidence of CD without medical or obstetric indications is increasing. This trend is likely to continue. A component of this increase is cesarean delivery on maternal request (CDMR)
- ECD at term represents an obstetrical-neonatal hazard
- ECD should not be performed prior to 39 weeks of gestation or without verification of lung maturity
- Evidence indicates that respiratory morbidity (TTN, RDS, PPHN) is higher for ECD than for vaginal deliveries
- Neonatal mortality is 3 times higher among infants delivered by ECD than for those delivered vaginally