الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue

LEADING THE WAY
KHALĪFAH • AMĀNAH • IQRA' • RAḤMATAN LIL-ĀLAMĪN

RECOGNISING FETUSES AT RISK FOR HYPOVOLAEMIA AT BIRTH

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ABSOLUTE HYPOVOLAEMIA

- Feto-Maternal Haemorrhage
  - Blood loss / anaemia / hydrops
- Fetal Haemorrhage
  - Bleeding within the fetus
- Placenta Haemorrhage
  - Maternal Vessels – abruptio placenta / subchorionic haemorrhage
  - Fetal Vessels – vasa praevia / subamniotic haemorrhage / injury
- Feto-Placenta Haemorrhage

HYPOVOLAEMIA : EMERGENCY EVENTS AT BIRTH

- Acute bleeding from the fetal vessels
  - En Caul birth
- Feto-placenta haemorrhage associated to umbilical CORD COMPRESSION
  - Nuchal cord
  - Shoulder dystocia
  - Shoulder dystocia coexistent with Nuchal cord

FETOMATERNAL HAEMORRHAGE (FMH)

- Transfer of fetal blood into maternal circulation
- During antepartum, intrapartum, immediately after birth
- Occurs in majority of pregnancies, without any major consequences
- Massive (>80 mls or >150 mls) adverse pregnancy outcomes still birth, hypoxic encephalopathy, prematurity, severe neonatal anaemia

Cohort of still birth, neonatal anemia and fetal distress

- 64.5 % related to FMH

Incidence by trimester

4 % at first trimester,
12 % in second trimester,
45 % in third trimester
60 % during delivery

Incidence by amount of Bleeding

30 mL → 1:300 LB
80 mls → 1:1146 LB
150 mls → 1: 2813 LB

Sebring 1990
Troia et al 2018,

FETOMATERNAL HAEMORRHAGE

- Causes
  - Autoimmune / Isoimmune causes
  - Previous pregnancy with FMH
  - Obstetrics Procedures – amniocentesis, fetoscope
  - Trauma
  - Placental abruption / Preeclampsia,
  - Labour augmentation with oxytocin
  - Infections
  - Bleeding of the fetus

Able to compensate for blood loss:

➢Fetal tachycardia (increase cardiac output)

➢Fetal Doppler (middle cerebral artery associated with severity of anemia

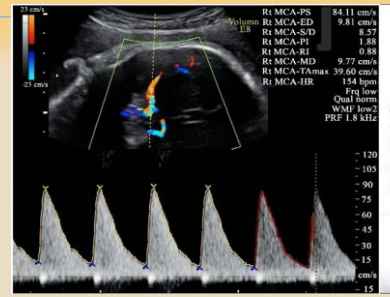
➢Infant with varying degrees of ANEMIA at birth

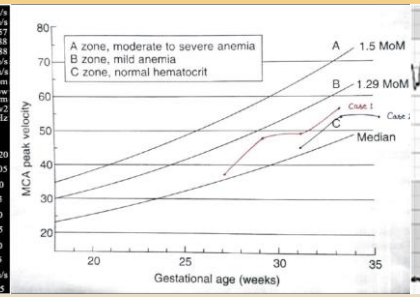
➢Higher neonatal erythroblast / Reticulocytes (increase in hemopoesis of placental and hepatic)

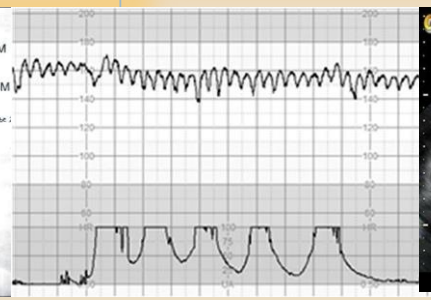
Uncompensated anemia:

- ➢ Decreased fetal movement + sinusoidal heart rate + HYDROPS FETALIS (high-output heart failure)
- ➢ Severe anemia or massive FMH.

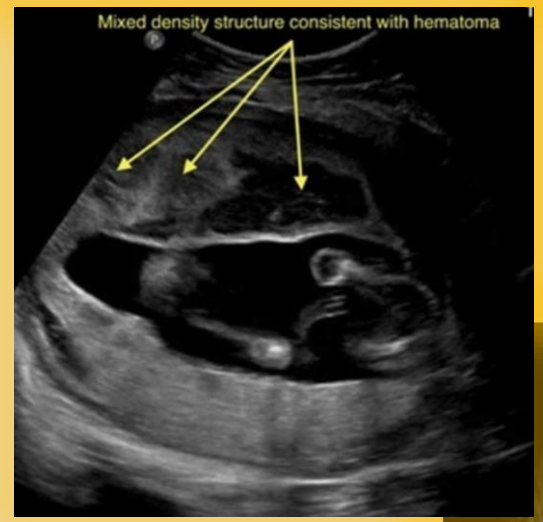
Kleihauer Betke Test

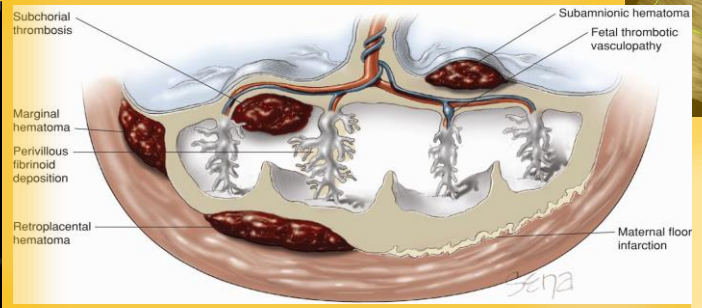


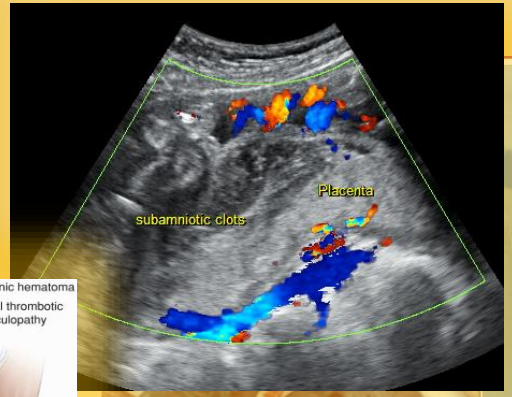




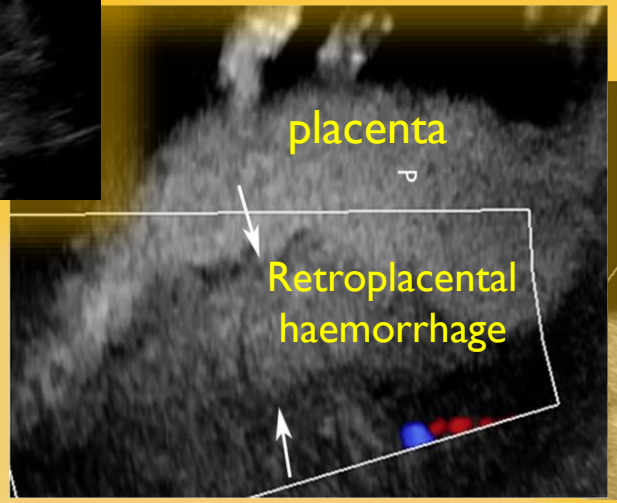
PLACENTAL HAEMORRHAGE FROM MATERNAL AND FETAL VESSELS

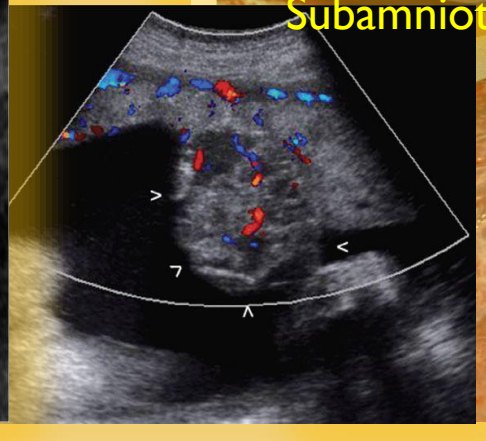


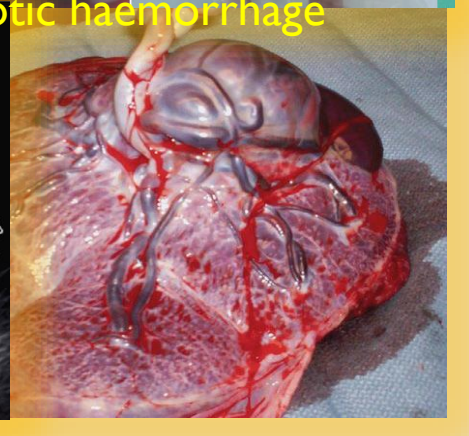




Subamniotic haemorrhage







Subchorionic Haemorrhage
Especially in velamentous / marginal cord insertion

HYPOVOLAEMIA : EMERGENCY EVENTS AT BIRTH

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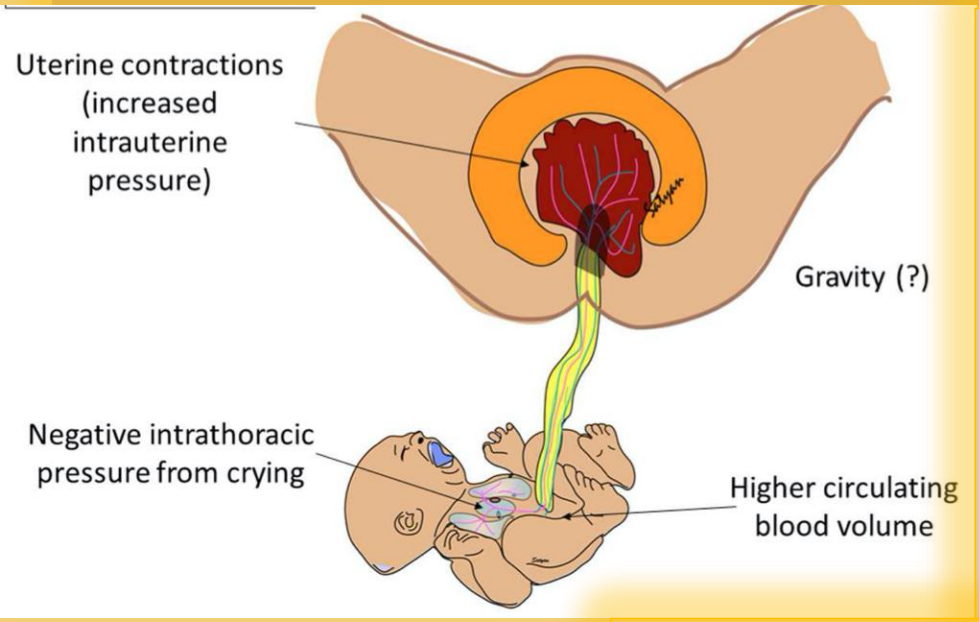
PHYSIOLOGY CHANGES AT VAGINAL BIRTH :



- Blood Flow in Healthy Term Infant :
  - Umbilical arteries continues for **45** seconds
  - Umbilical vein remains patent for about **THREE** minutes
- Lung ventilation from effect of crying + uterine contraction squeezes blood from the placenta to the newborn
  - ≋ promotes **PLACENTA TRANSFUSION**
- Net blood transfer to newborn ∽ **25-35 ml / kg**

Affected by :

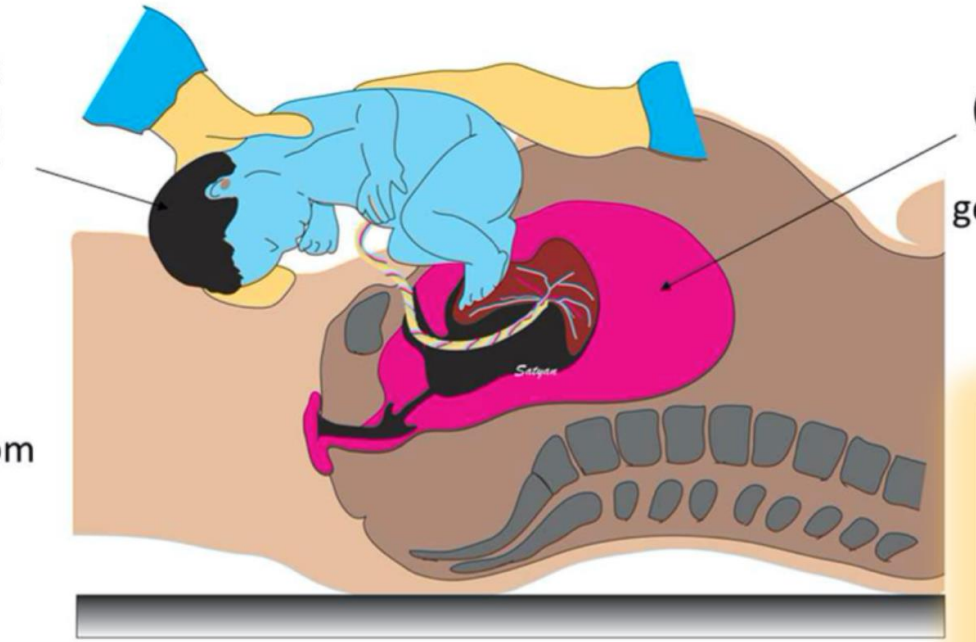
Gestational age
Timing of cord clamping
Position of infant at birth
Onset of respiration
Use of uterotonics in the mother

PLACENTA TRANSFUSION AT CAESAREAN BIRTH UNDER GENERAL ANAESTHESIA

B. Stat Cesarean delivery under general anesthesia for fetal distress / depression

Depressed infant that is not crying (asphyxia and/or effect of general anesthesia)

No assistance from gravity (?)



Atonic uterus (absence of labor and/or effect of general anesthesia)

Placenta transfusion lower or absent :

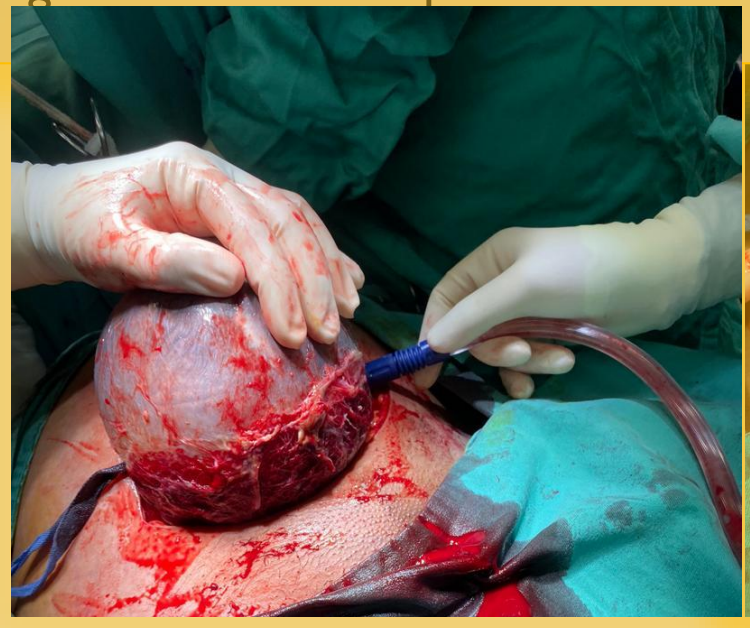
Non crying newborn / atonic uterus
Immediate cord clamping

EN CAUL OR VEIL BIRTH

Atraumatic Delivery

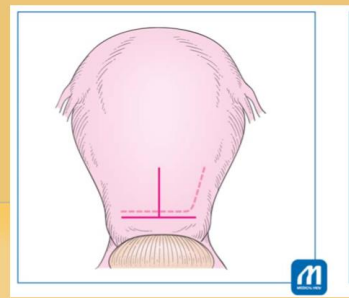
- Fetus delivered encased in amniotic fluid and membrane – protects the fetus against uterine wall and surgeon hand's
- Reduce birth trauma
- Reduce intracranial haemorrhage
- Higher arterial cord pH

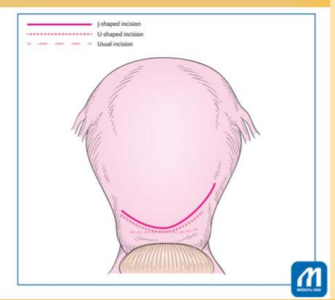
Disadvantage :
Neonatal anaemia

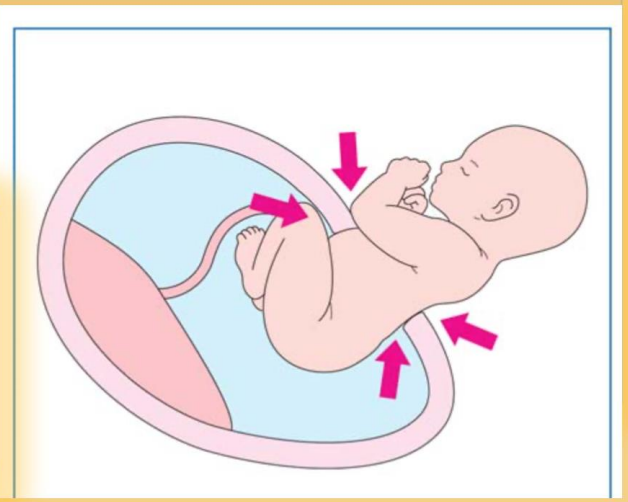


THE CHALLENGES DURING CAESAREAN FOR EXTREMELY PREMATURE

- **The uterus :**
  - Uterine wall is thick and difficult to incise lower segment
  - Classical vertical incision or reverse T-shape incision that carries risk of uterine rupture in future pregnancy
  - Uterine wall contract drastically at rupture of membrane – trapping the baby "Hug-me-tight-uterine"
- **The baby** :
  - Very weak for pressure of uterine wall or human hands
  - The skin is really premature and weak



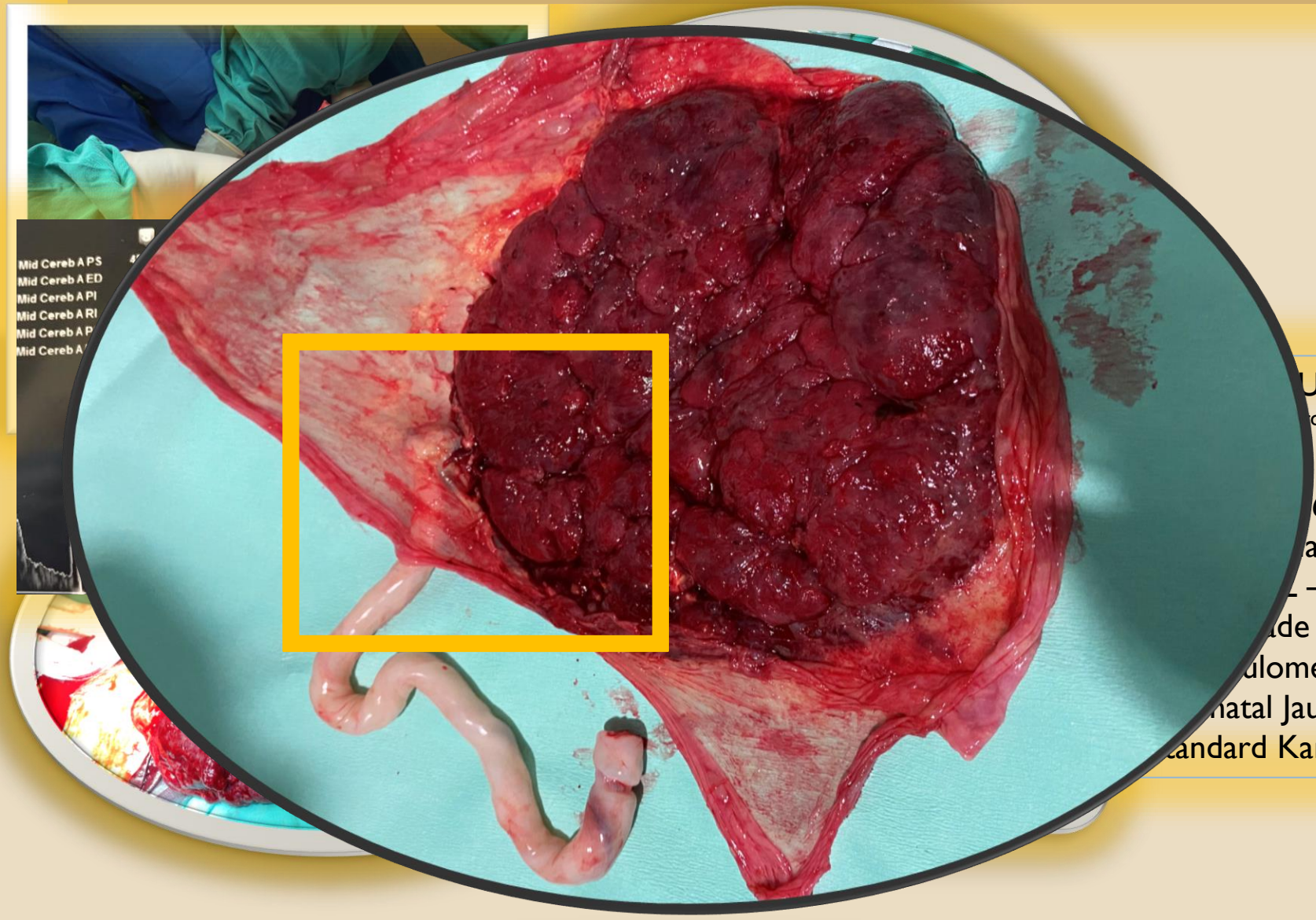




EN CAUL : CASE SERIES / REVIEW

Author		Description	outcome	Conclusion
Abouzeid et al 1999 Case series		24 cases (24-32 weeks) 12 delivered through en caul 5 ruptured before delivery 7 unclear when surgeon ruptured it	3 babies cord Hb < 5g/dL 11 required blood transfusions	The danger of causing blood loss is real Need randomized controlled trial before widespread application
Chia et al 2007 Prospective study		23 neonates (1.5kg or < 32 weeks)	15 Apgar > 7 at 5 min One with pH <7 Neonatal Hb 16.1 ±2.1g/dL	Technique was Effective / Easy Protect from pressure trauma and results in less uterine injury
Zhen Jin et al 2013 Retrospective review 2001-2010		< 37 weeks 211 en caul 836 lower segment caesarean All combined spinal-epidural Normal Fetal heart Asphyxia Apgar < 7 at five-minute	Successful en caul 68 % 92% success in <32 weeks 52 % success in > 34 weeks	Failed En Caul: Oligohydramnios Low Bishop score High birthweight

HYPOVOLAEMIA : EN CAUL CAESAREAN DELIVERY



UGR
d centile

6
ar breathing
– blood transfusion
de 1/no
ulomegaly
natal Jaundice
tandard Karyotype: 46,XY

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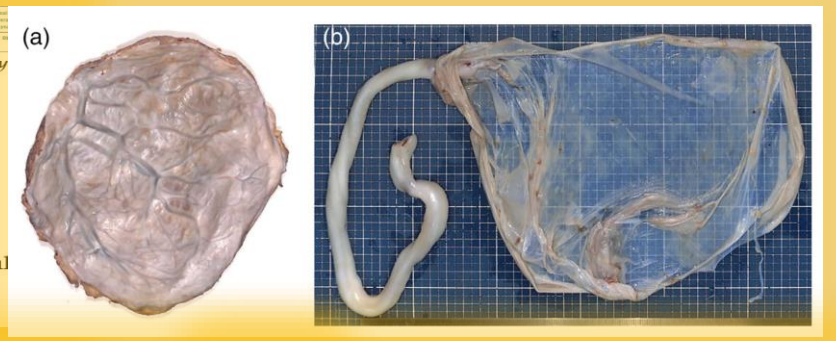
Obstetrics and Gynaecology Research
doi:10.1111/jog.14147
J. Obstet. Gynaecol. Res. Vol. 46, No. 1: 173–175, January

A disadvantage of cesarean section *en caul*: Umbilical velamentous insertion, a risk factor and proposed mechanism of neonatal anemia

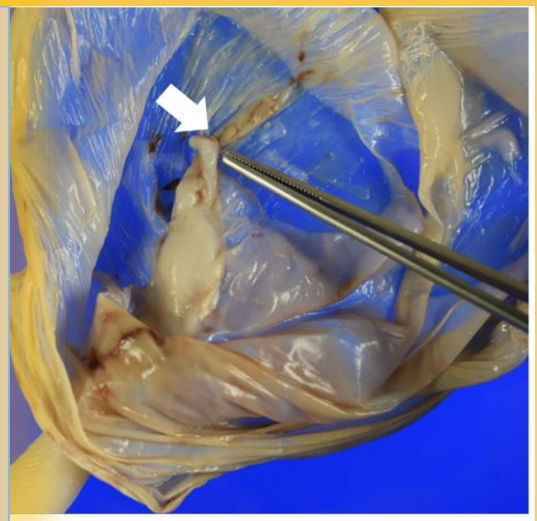
Takashi Shibata, Satoshi Nakago, Shigeki Nishikawa, Yasunori Fukuoka, Noriaki Iizuka and Fumikazu Kotsuji
Department of Obstetrics and Gynecology, Takatsuki General Hospital, Takatsuki, Japan



26 weeks gestation in labour.
En Caul caesarean
Placenta was not attached to the membrane sac and delivered spontaneously soon after delivery of the baby.
Severely anaemic baby : 6.7g/dL

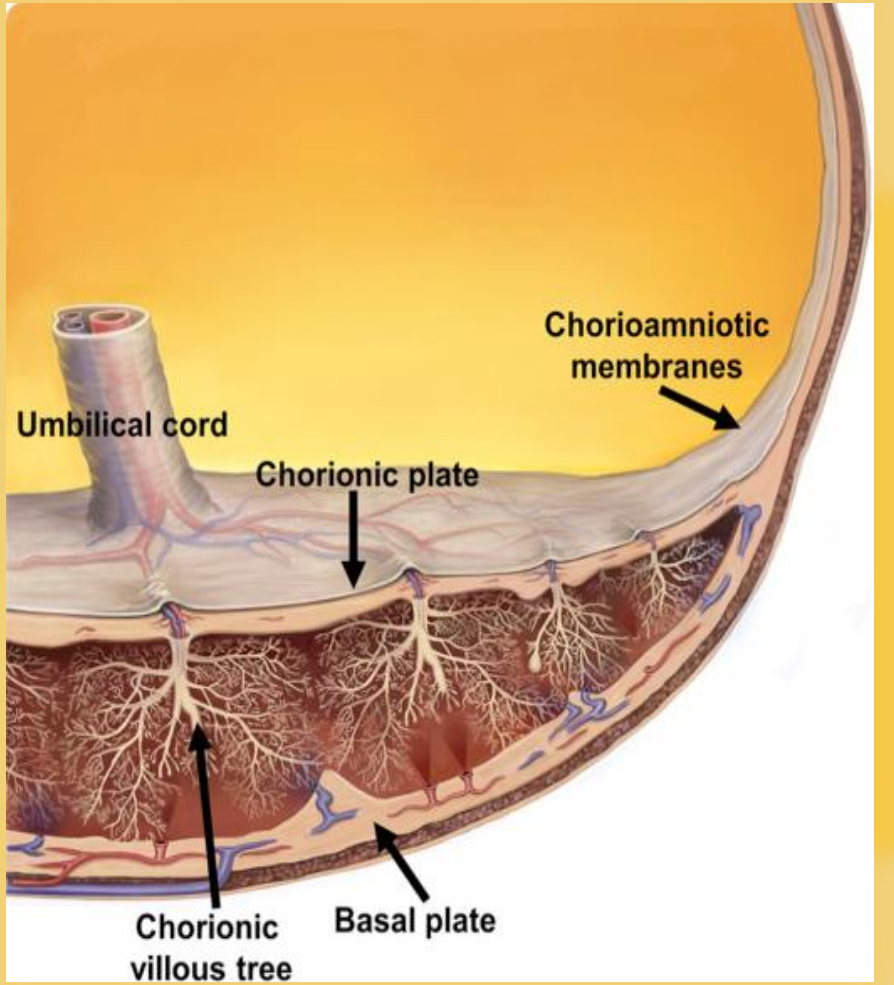
Blood was dripping from the vessels of the membrane.
Velamentous insertion of umbilical cord could be a cause of neonatal anemia associated with en caul cesarean delivery.

Suggested immediate cord clamping to reduce neonatal bleeding in presence of velamentous cord.



The tear of blood vessels along the membrane.

Takashi Shibata 2020



Aim : divide the maternal vessel behind the placenta – the plane is deep to the basal plate

Acute Fetal Haemorrhage

- ✓ Surgeon might damage fetal circulation by breaching the fetal vessel in placenta during procedure

“En Caul” Cesarean Delivery for Extremely Premature Fetuses: Surgical Technique and Anesthetic Options

Takeshi Murakoshi, MD, PhD[1]

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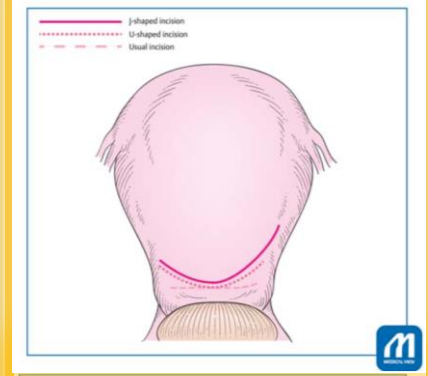
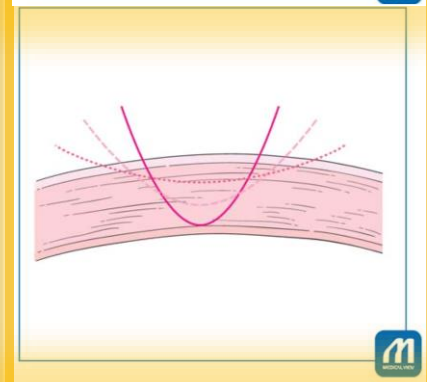
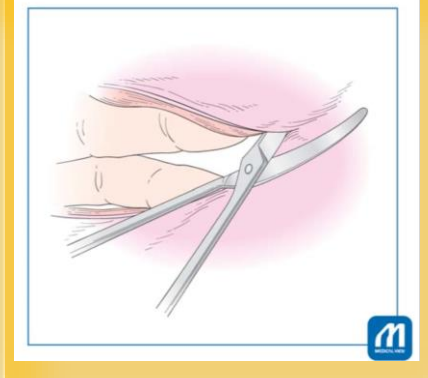
Surg J 2020;6(suppl S2):S104–S109.

Surgical Steps

1. Select adequate anesthesia and uterine relaxation
   (a) Combined spinal and epidural anesthesia.
   (b) IV injection of nitroglycerin just before uterine incision.[6]
   ↓
2. Laparotomy
   (a) Low abdominal vertical incision.
   (b) Low abdominal transverse (Pfannenstiel or Maylard) incision.
   ↓
3. Uterine incision
   (a) **U**- or **J**-shape incision.
   (b) Reverse T incision.
   (c) Classical vertical incision.
   ↓
4. “En caul” delivery
   (a) Additional IV injection of nitroglycerin for uterine relaxation, if needed.
   (b) Manually separate uterine wall and amniotic membrane.
   (c) Deliver fetus gently with uterine contraction.
   (d) Rupture the membrane and perform resuscitation.
   (e) Own blood transfusion through umbilical cord and placenta, if necessary.
   ↓
5. Repair the uterine wall and abdominal closure
   (a) As usual.







Takeshi Murakoshi, 2020

“En Caul” Cesarean Delivery for Extremely Premature Fetuses: Surgical Technique and Anesthetic Options

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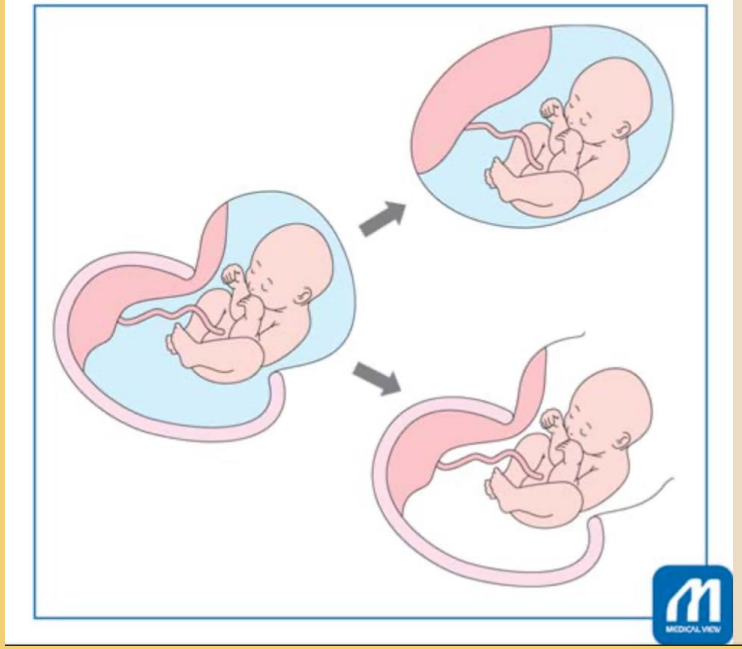
Baby’s delivered in wrapped amniotic fluid and the membrane
Protect against uterine wall or surgeon’s hands



Baby is handed to neonatologist by “En Caul’ (<1000gm) with the placenta within 30 seconds
Neonatologist rupture the membrane to resuscitate
Own blood transfusion can be made through umbilical cord and placenta if anemic / hypovolaemic

Partial ‘En Caul’ (<1500gm) -surgeon rupture the membrane at delivery and hand the baby to neonatologist

Takeshi Murakoshi, 2020

EN CAUL :
SELECTION CRITERIA AND PLAN PRIOR TO PROCEDURE

Selection of Cases

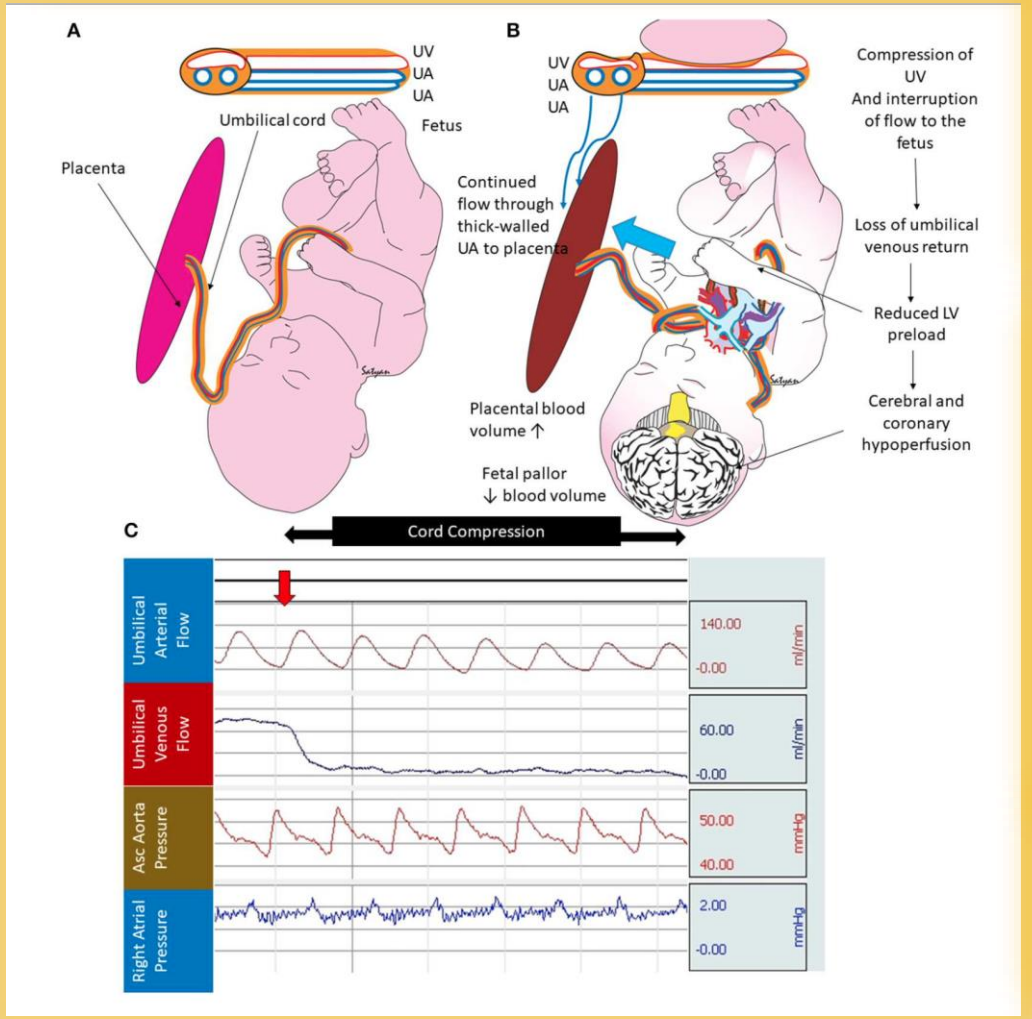
- Extremely Premature with weight <1500gm
- Ultrasound Imaging :
  - Fetal position and Trunk position – for maneuver during delivery
  - Cord Insertion and Placenta Localization

Appropriate Technique

- Spinal + Epidural
- Tocolysis
- Fetal weight <1000 En Caul and <1500 Partial En Caul
- Handed to Neonatologist within 30 seconds
- Velamentous cord insertion – membrane to be broken and immediate cord clamping

HYPOVOLAEMIA : CORD COMPR

Cord Compression
- ✓ Nuchal cord
- ✓ Shoulder dystocia
- ✓ Breech delivery
- ✓ Cord prolapse



- ➢ Obstruction in thin walled umbilical vein prevents blood flow to the fetus
- ➢ Fetus blood continues to be pumped out through thicker walled umbilical arteries.
- ➢ Hypovolaemia, acidosis and anemia

- Affect outcome of delivery with possible long-term effects on infants
- HIE : Cerebral Palsy, Epilepsy, intellectual / development
- Meconeum
- Fetal heart rate abnormalities
- Neurodevelopmental abnormalities
- Fetal Death

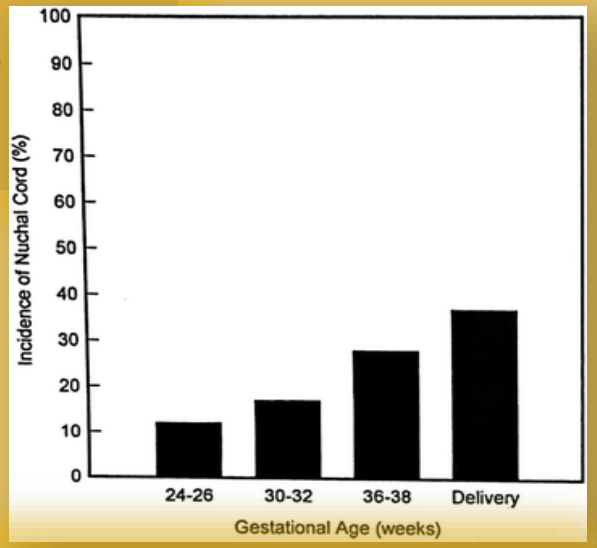
✓ Cord compression > 10 minutes → reduce cerebral vascular flow resistance along with a fall in pO2 pressure

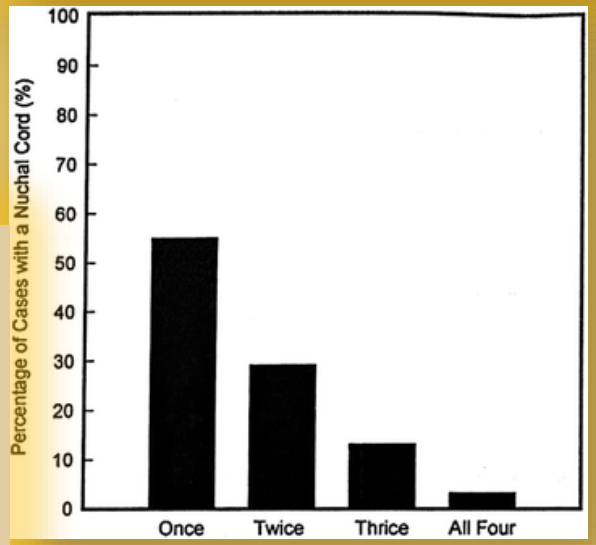
HYPOVOLAEMIA : NUCHAL CORD

Umbilical cord around the neck 360 degrees
Tight 6.6. % vs Loose 21.6 %
Worse in short or long cord

RISK FACTORS

- Excessive amniotic fluid
- Poor cord structure
- Twins or multiples pregnancy
- Excessive fetal movement
- Long umbilical cord

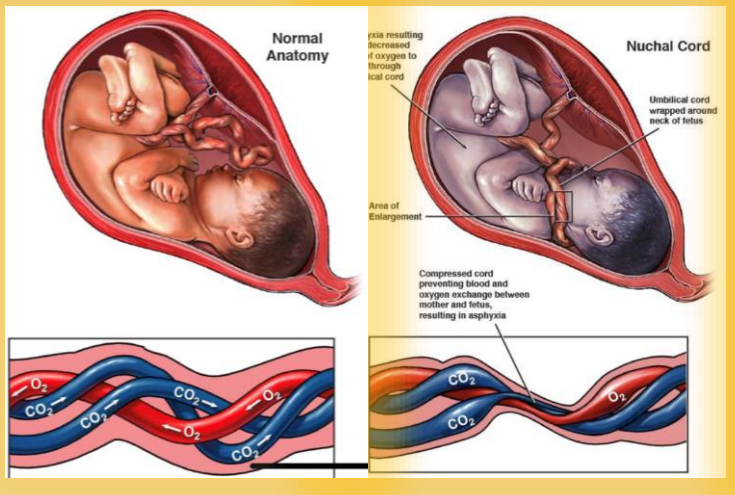


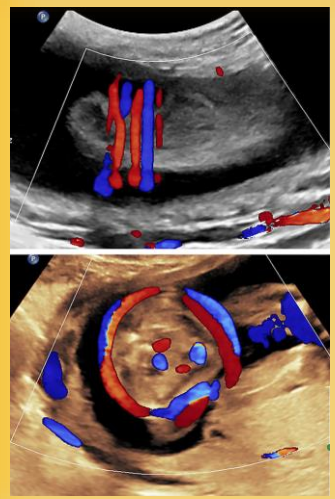


Henry 2015
Vasa 2018

FETAL HYPOVOLAEMIA : NUCHAL CORD

A loose cord does not cause problems Reed et al 2009
Fetal demise with multiple loop (8 loops) Wang et al 2010
Autistic children cohort 23 % had nuchal cord vs 6.3 % control (p=0.002)Zhang et al 2010
Keeping nuchal cord intact improve outcomes for babies Parr et al, 2014
No indication to undergo caesarean when identified antenatallyRCOG 2017





NUCHAL CORD : TCAN SYNDROME

Tight Cord Around the Neck

+

Cardio-respiratory

+

Neurological signs and symptoms

✓ with unique physical features

Grade 1
- ✓ Conjunctival haemorrhage and petechiae

Grade 2
- ✓ Duskiness of face
- ✓ Facial suffusion
- ✓ Pallor

Grade 3
- ✓ Respiratory distress, stupor, hypotonia requiring resuscitation
- ✓ Hyoid bone fracture / brain pathology

Compression Asphyxia (Forensic medicine)

Peesay 2011

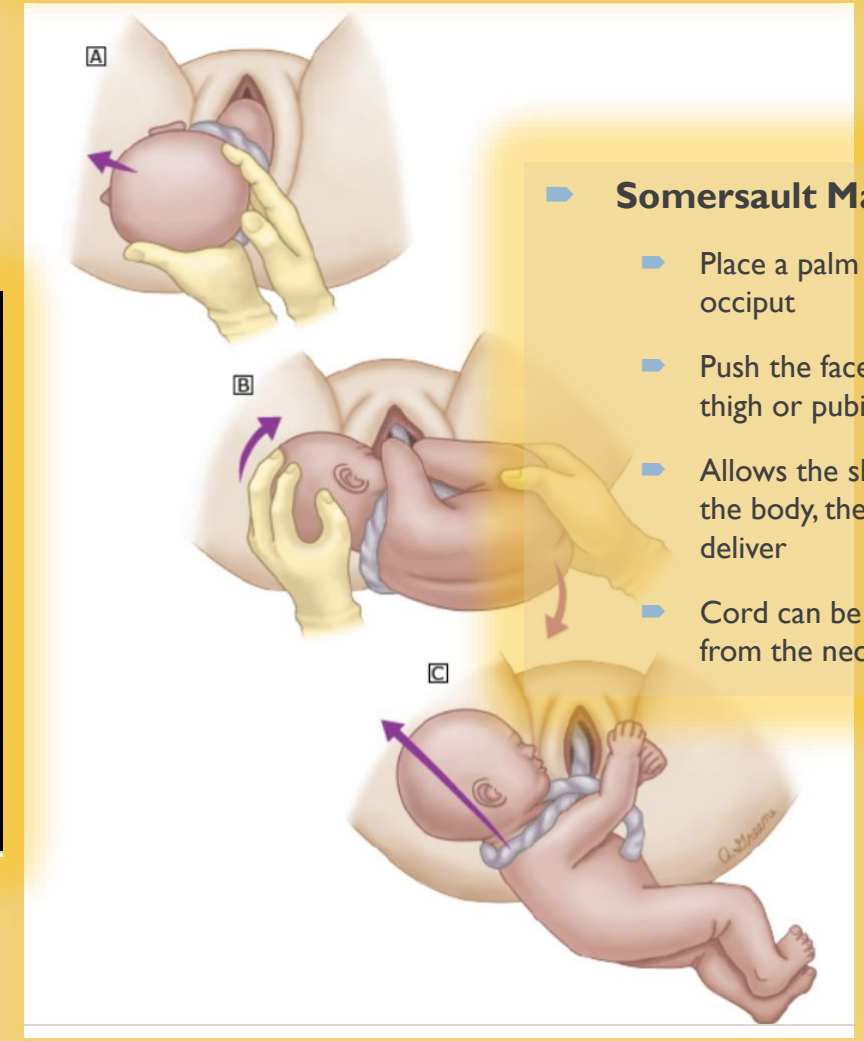
NUCHAL CORD : OBSTETRICAL CHALLENGES AT VAGINAL DELIVERY

Routine checking

Manouever Prior to Delivery of Shoulder

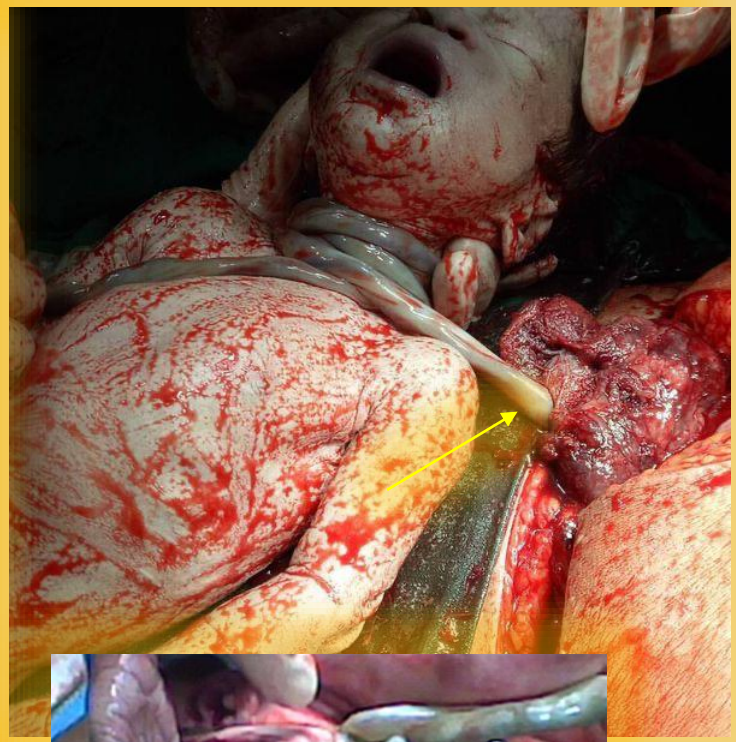
- Pull and unloop of the "loose loop"
- Loosen the cord or clamp and cut the cord of the "tight loop"

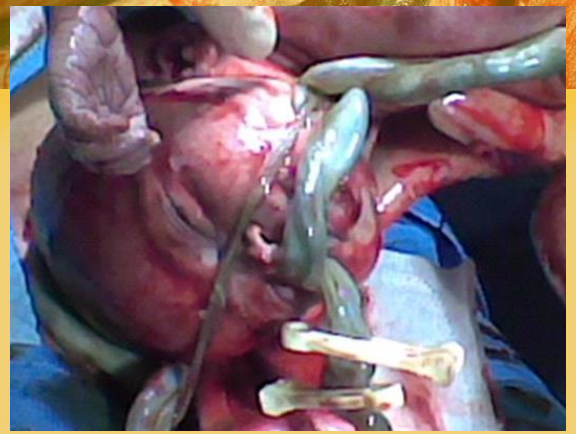
Iffy et al 2001
SChorn 1991
Mercer 2005
Jefford 2009



- **Somersault Maneuver**
  - Place a palm on the fetal occiput
  - Push the face into mother's thigh or pubic bone)
  - Allows the shoulder, then the body, then the legs to deliver
  - Cord can be unwrapped from the neck

NUCHAL CORD : OBSTETRICAL CHALLENGES AT CAESAREAN





- Release and umbilical cord milking
- Double clamp and transect near the placenta insertion and hand to neonatologist – cord milking together with resuscitation

NUCHAL CORD : FACTORS ASSOCIATE WITH POOR OUTCOME

The Cord:
- ✓ Multiple Loops : ≥ 2 or 3 loops
- ✓ Tight Nuchal Cord : Divot Sign
- ✓ Coexisting true knot
- ✓ Lack of Wharton Jelly

The Duration :
- ✓ Prolonged Persistent nuchal cord with poor fetal growth (prolonged partial asphyxia)

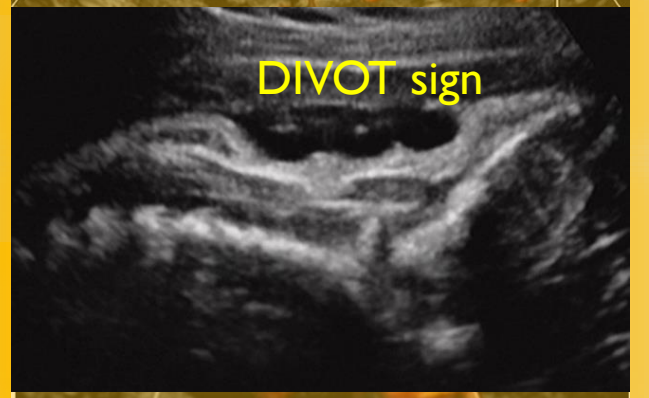
The Placenta
- ✓ Associated with placenta insufficiency
- ✓ Fetal growth restriction
- ✓ Oligohydramnios

The Fetal Heart :
Antepartum or Intrapartum CTG : poor variability / variable decelerations

Doppler :
Cerebro-Umbilical Resistance Index Ratio C/U RIR < 1.0
Rather then the Pulsatility Index

APGAR Score and Umbilical artery pH : non sensitive indicator of acid base balance or hypoxia

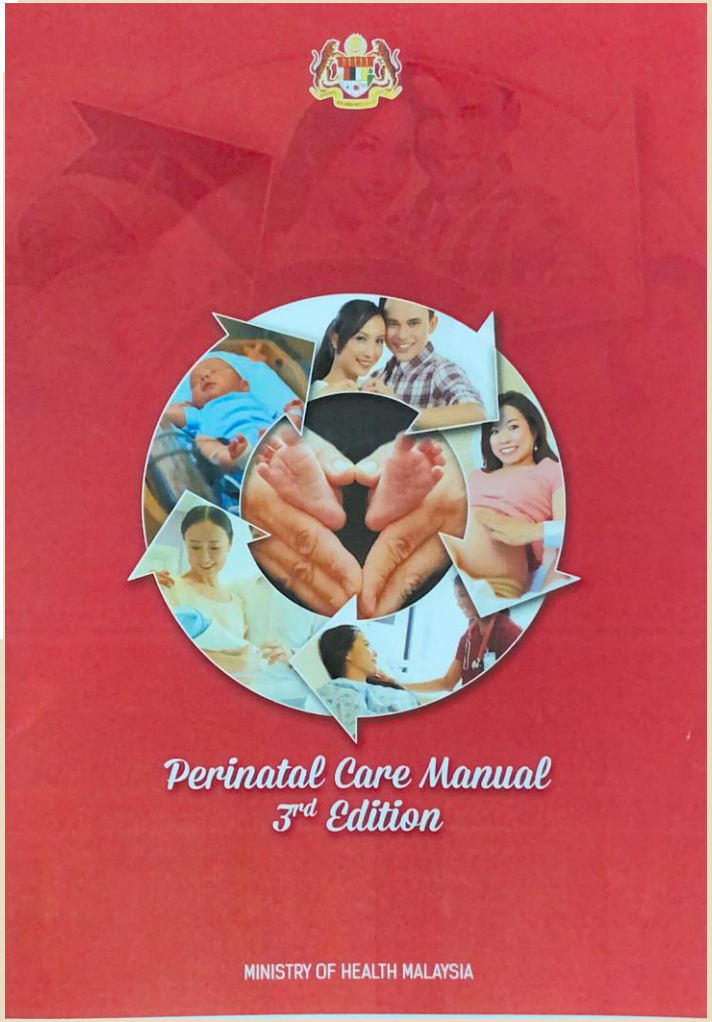
Ranzini 1999
Xu et al 2007
Hashimoto et al 2003
Sherer et al 2020



Birth injury and nuchal cord attorneys

If a nuchal cord is present, doctors should carefully monitor and manage this condition. In some cases, babies with a nuchal cord may still be delivered vaginally (there are specific maneuvers that can help to prevent complications). However, there are circumstances under which a C-section or emergency C-section is necessary (2). **It is paramount that the medical team handling a pregnancy be skilled in handling complications like nuchal cords**. It is medical negligence if doctors do not monitor and treat the mother and baby properly, or do not follow **standard of care**. If the baby is injured, this is **medical malpractice**.

ABC Law Centers



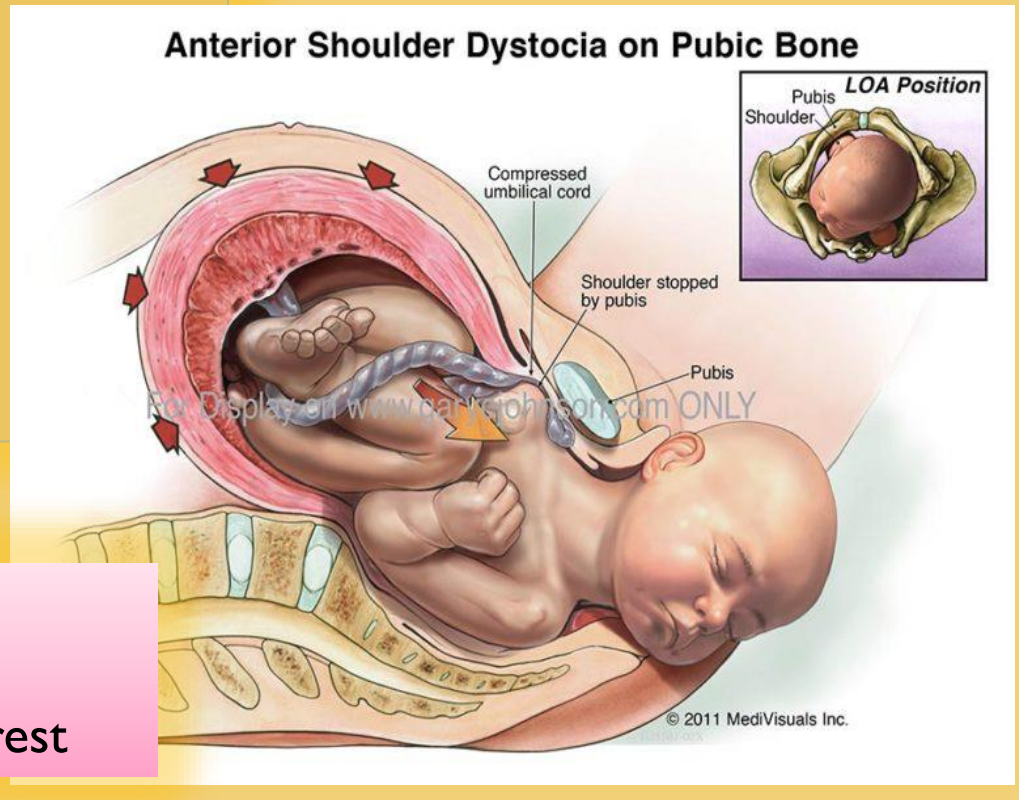
SHOULDER DYSTOCIA

Compression of umbilical cord between fetus and birth canal

- ✓ Reduce venous return to the fetus
  - → Umbilical vein compression
  - → **Increased intrathoracic pressure**
- ✓ Continuous blood flow from fetus to placenta
  - → Umbilical artery thicker muscle

➢ **Net retention**

- ➢ **fetal blood in the placenta**



- ✓ **Immediate cord clamping**
  - ➢ worsen hypovolaemic condition
  - ➢ profound bradycardia and cardiac arrest

SHOULDER DYSTOCIA – CARDIAC ASYSTOLE THEORY

In the first few minutes of SD

- Fetal hypovolaemia is compensated by peripheral vasoconstriction due to vaginal muscles – birth canal act as an anti-shock defense
- Umbilical cord pH / blood gases – remain stable up to 1hr after obstruction
- Lactate might increase due to anaerobic metabolism in cord erythrocytes, leucocytes, endothelial cells and placenta

At birth :Within one hour of life

External body compressions cease,

- Blood pressure falls dramatically with consequent acute hypovolaemia/hypoperfusion
- Rapid redistribution of blood into peripheral circulation
- Severe central hypoperfusion, hypovolaemic shock, severe bradycardia → **Cardiac arrest**

Severe metabolic acidosis of newborn within ONE hour of life indicate COMPLETE cord obstruction

→ blood sequestration within placenta

→ severe fetal hypovolaemia

Mercer et al 2014

HYPOVOLAEMIA : SHOULDER DYSTOCIA

Severely depressed newborn with shoulder dystocia

- ✓ Normal fetal heart tracings
- ✓ Head Body Delivery Interval (HBDI) < 5min
- ✓ No evidence of pathological acidemia or anaemia (cord blood)
- ✓ Raised lactate (cord blood)

Complete cord obstruction with blood sequestration within placenta

Neonatal venous blood

- ✓ Severe anaemia
- ✓ Severe metabolic acidosis

Volume-depletion
Need to resuscitate with volume expansion
Potential benefit of early fluid resuscitation

Gina Ancora et al 2020

SHOULDER DYSTOCIA + NUCHAL CORD
CATASTROPHIC OUTCOME

**** Pale colour and poor fetal tone equate with hypovolaemia of infant.**

Management of cord prior to birth of shoulders :

- Cutting tight nuchal cord prior to birth of shoulders carries potential risk of asphyxia, cerebral palsy or death
- Maintain an intact cord as far as possible
- Avoid cutting nuchal cord immediately after delivery
- "Somersault Manoeuvre"

Management of cord AFTER shoulders are free

- If needs to be divided immediately after birth
  - Rapidly milking the cord two to four times from introitus to infant
  - Rapid restoration of infant's blood volume
- Delay in cord clamping - blood volume to equalize after birth and assist with transition to neonatal life

Successf
obstetri
shoulder

The NRP does not recommend delayed cord clamping in asphyxiated newborns
Recent studies suggest that in term infants:

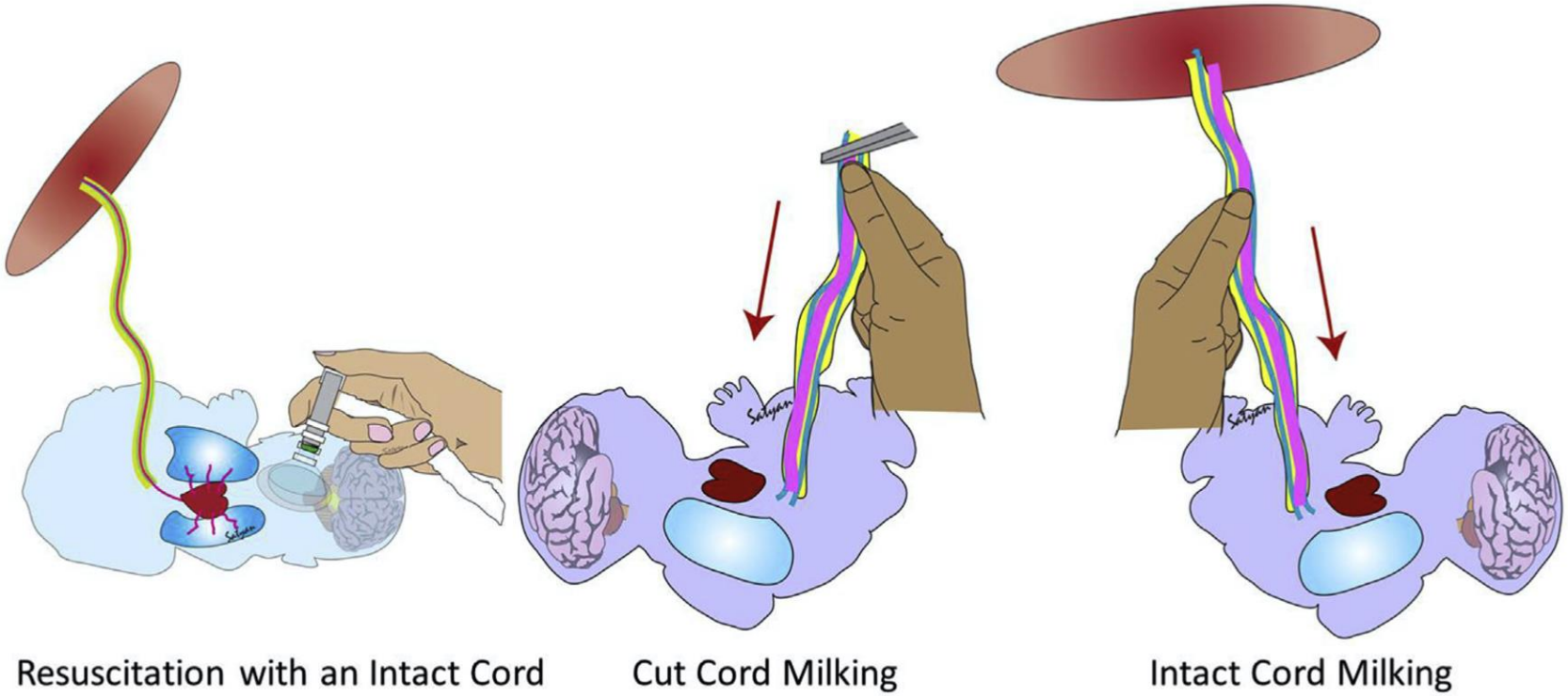
- resuscitation with an intact umbilical cord is associated with a better recovery than routine resuscitation
- umbilical cord milking appears to be a safe therapy when resuscitation is needed

In premature infants : multicenters research is ongoing

Neonatologist, pediatricians, obstetrician, anaesthesiologist to understand this catastrophic event

Duley et al 2017
NRP 7th

PLACENTAL TRANSFUSION STRATEGIES



Stefano Ghirardello et al 2018
Cesari 2019

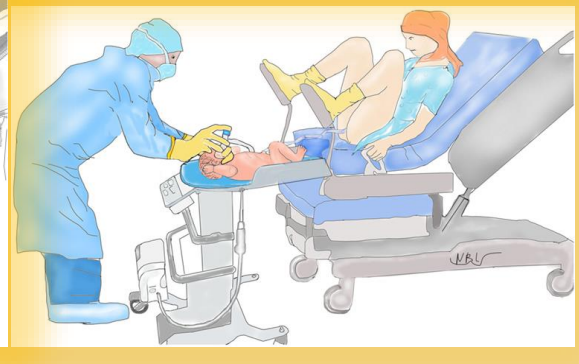
BEDSIDE RESUSCITATION WITH INTACT CORD

How did the trolley or resuscitation on the mom compare with moving the infant to a standard radiant warmer? (n = 110)	
Short cord	21
Poor access to the baby	17
Difficulty accessing equipment	14
Uncomfortable with parents watching	9

Did the resuscitation on the cord impede your care?	Not at all	Slightly	Moderately	Very	Extremely	N/A
Neonatal providers (n = 61)	29 (47.5)	17 (27.9)	4 (6.6)	2 (3.3)	2 (3.3)	29 (47.5)
Maternal providers (n = 49)	26 (53.06)	19 (38.8)	7 (14.3)	1 (2.0)	0	0

How would you characterize the process of providing the baby's resuscitation at the mother's bedside?	Strongly negative	Negative	Neutral	Positive	Strongly positive	NA
Neonatal provider (n = 61)	2 (3.3)	5 (8.2)	15 (24.6)	19 (31.1)	12 (19.7)	6 (9.8)
Maternal providers (n = 49)	0	3 (6.1)	9 (18.4)	14 (28.6)	16 (32.7)	3 (6.1)

How would you characterize utilizing the LifeStart bed as a platform for resuscitation compared to using the radiant warmer?	Strongly negative	Negative	Neutral	Positive	Strongly positive	NA
Neonatal providers (n = 61)	2 (2.3)	7 (11.5)	16 (26.2)	11 (18.0)	7 (11.5)	13 (21.3)
Maternal providers (n = 49)	0	1 (2.0)	9 (18.4)	16 (32.7)	8 (16.3)	12 (24.5)



Majority parents – positive experience
16 % neonatal and maternal providers feeling uncomfortable

Katheria et al 2018

TAKE HOME MESSAGE

- Hypovolaemia at birth can lead to detrimental sequelae
- Prompt recognition and resuscitation should include volume replacement
- En Caul Delivery : appropriate case selection and good technique
- Nuchal Cord : identification of factors associate with poor outcome
- Shoulder Dystocia : close monitoring of infant within one hour although born vigorous
- Midwives / Obstetrician / Neonatologist need to keep updated on management of umbilical cord

THANK YOU