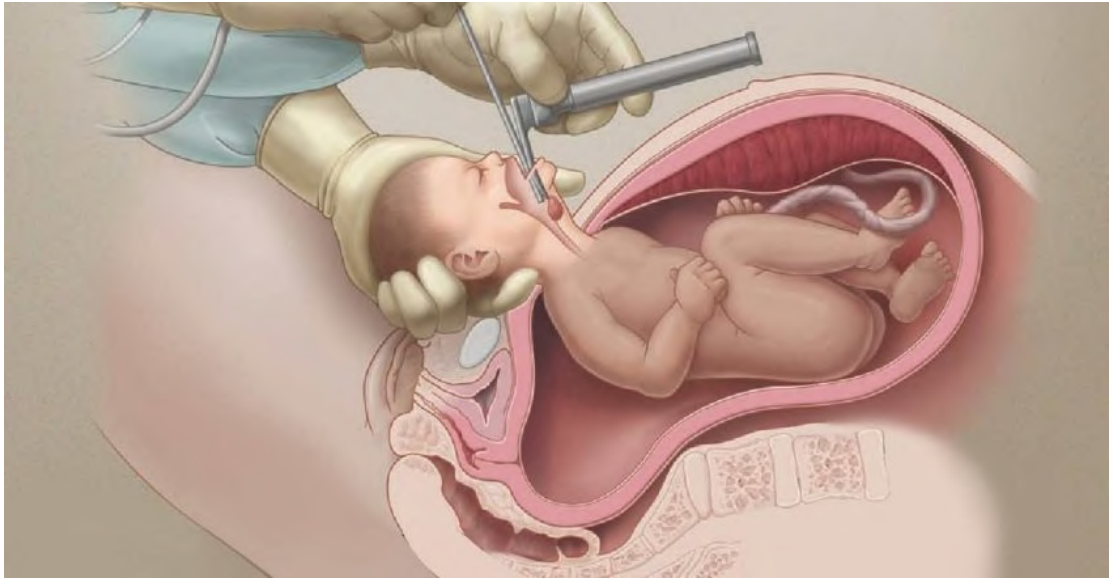
EXIT (Ex Utero Intrapartum Treatment)

Philippine Children's Medical Center Experience

MARICHU D. BATTAD, MD, MHA, DPBA, FPBA, FPSA



Disclosure

I have no actual or potential conflict of interest in relation to this presentation.

PHILIPPINE CHILDREN'S MEDICAL CENTER

Quezon Avenue corner Agham Road, Quezon City

The Perinatal Care and Neonatology Center
Fetal Therapy and Intrauterine Fetal Surgery Unit
Philippine Children's Medical Center

Outcomes

	EAMC (2021)	PGH (2016)	PCMC (2015)
Fetal diagnosis	Lymphangioma, neck	Lymphangioma, neck	Lymphangioma, neck; macroglossia
Pre-op size of mass	7.8 x 5.2 x 6.1cm left anterolateral neck involving the floor of the mandibular area (UTZ)	10.1 x 9.9 x 9.1cm left anterolateral neck (UTZ)	8.4 x 8.4 x 5cm anterolateral neck with facial involvement; tongue protruding from oral cavity (UTZ)
Fetal age	38 weeks AOG (term)	37 weeks 4 days AOG	35 weeks 3 days AOG
Status of procedure	Planned	Planned (2 aspirations of the mass done during C-section)	STAT
# of ET intubation attempts	2	Several (not specified)	Successfully intubated using C-MAC Miller blade 1, ETT 2.5 → tracheostomy Shiley size 3
Time to successful trache	12 mins	13.5 mins	14 mins
BW	3,610g	Not mentioned	2,510g
Post-natal imaging	9cm x 8cm x 10.5cm ant neck, lower half of the face (L>R), deep extension to prevertebral space, superior to lower mediastinum	Not mentioned	Not mentioned
Other comorbids	Pulmonary arterial HPN, pericardial effusion, lung infiltrares	Not mentioned	Congenital heart disease (PDA, PFO), macroglossia
Disposition of baby	Expired at 80th DOL (hypoxic respiratory failure secondary to sepsis & HCAP)	Doxycycline sclerotherapy done 2 weeks post-delivery	Intralesional bleomycin injection

LEARNING OBJECTIVES:

- **Identify the multidisciplinary concerns for EXIT**
- **Discuss the preparation for EXIT**
- **Enumerate critical steps in EXIT**

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Ex utero intrapartum Therapy (EXIT)
OR
Operation on Placental Support (OOPS) Procedure
Airway Management on Placental Support (AMPS)

- a controlled technique
- designed to allow partial fetal delivery via caesarean section
- establishment of a safe fetal airway by either intubation or bronchoscopy
- fetal oxygenation is maintained through attachment to placental circulation.

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Indications for the EXIT procedure

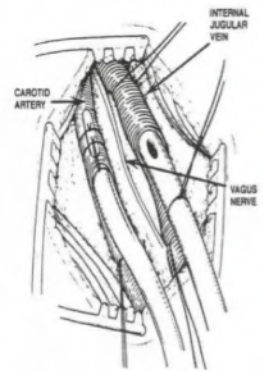
Diagnosis	Surgical procedures
Congenital airway obstruction	

• Congenital high airway obstruction syndrome (CHAOS)
  ◦ Laryngeal atresia/stenosis
  ◦ Tracheal atresia/stenosis
• Neck masses
  ◦ Teratoma
  ◦ Cystic hygroma
  ◦ Lymphangioma
  ◦ Hemangioma
	• Intubation
	• Excision of mass

Intrathoracic lesions	

• Lung and mediastinal masses
  ◦ Congenital cystic adenomatoid malformation (CCAM)
  ◦ Teratoma
  ◦ Lymphangioma
• Pulmonary arteriovenous malformation with pulmonary hypoplasia
	• Intubation
	• Excision of mass
	• EXIT to Extracorporeal membrane oxygenation (ECMO)

Congenital diaphragmatic hernia	• Reversal of tracheal occlusive device • EXIT to ECMO
Conjoined twins	• Separation of conjoined twins



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An EXIT involves two patients: MOTHER and FETUS
Both of whom are at high risk

Multidisciplinary team that includes representatives from the fields of:

- **Pediatric Radiology**
- **Obstetrics and Maternal-fetal medicine**
- **Pediatric and Obstetric Anesthesiology**
- **Pediatric Surgery**
- **Pediatric Otolaryngology**
- **Neonatology**
- **Pediatric Cardiology**
- **Nursing service (theatre and labour ward delivery nurses)**
- **Representatives from the blood bank**
- **Medical Ethics Committee**

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Radiologic Planning for an EXIT Procedure

- **Evaluation of fetal position and placental location**
  - Fetus in a cephalic position in flexion is ideal for an EXIT
- **Lesion location is evaluated**
  - Neck masses may cause hyperextension of the fetal neck, which may preclude appropriate delivery of the head.
- **Lesion characterization**
  - Highly vascularized masses can cause decompensation of the fetus at delivery

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Prepare,

Prepare,

Prepare!

Anticipate!!!

EXIT PROCEDURE TO-DO LIST

INDICATION FOR EXIT PROCEDURE
- ❑EXIT-to-Airway procedure
- ❑EXIT-to-Resection procedure
- ❑EXIT-to-ECMO procedure
- ❑EXIT-to-Separation procedure

SPECIALTY REFERRAL
- ❑Radiology
- ❑Obstetrics and Maternal-fetal medicine
- ❑Pediatric Surgery
- ❑Pediatric Otolaryngology
- ❑Pediatric and Obstetric Anesthesiology
- ❑Neonatology
- ❑Nursing Service
- ❑Medical Ethics (Parental Consent for the Procedure)

LABORATORY EXAMINATIONS

AIRWAY DEVICE PREPARATION
Maternal/ Fetal Airway Device
- ❑Suprglottic airway device
- ❑Oro/Nasopharyngeal airways
- ❑ Face mask
- ❑Oro / Naso endotracheal tubes

AIRWAY EQUIPMENT
- ❑Laryngoscope (Fetal blades 0, 00 & 1 and Adult blades)
- ❑Pediatric Rigid bronchoscope (2.5–3 mm)
- ❑Pediatric Flexible intubating bronchoscope (2.5 mm)
- ❑Pediatric Tracheostomy tray
- ❑Pediatric / Adult Ambu bag with manometer attached to oxygen source
- ❑Video laryngoscopy (Fetal blades 0, 00 & 1 and Adult blades)
- ❑Suction machine and catheters

MATERNAL / FETAL MONITORING DEVICE
- ❑NIBP: rapid infusion device
- ❑Pulse oximetry
- ❑Capnography
- ❑Temperature : fluid warming device
- ❑Electrocardiography
- ❑Fetal doppler ultrasound

PREOPERATIVE PREPARATION

The EXIT procedure is usually scheduled after the 35th week of pregnancy, ideally close to term but prior to the onset of labour.

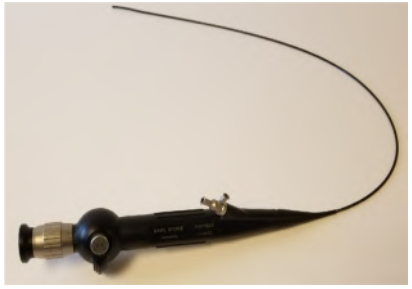
- **Preoperative multidisciplinary meetings, that include the parents and a member of the Medical Ethics Committee**

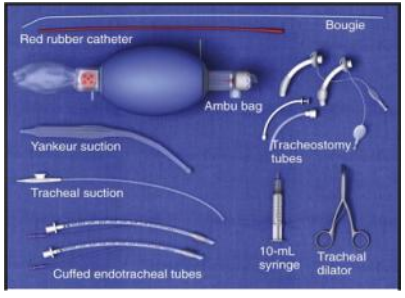
- **Informed consent**

- **details of the procedure being performed**
- **specific medications that will be administered**
- **potential adverse effects**
  - **Maternal bleeding and infection**
  - **Unpredictable outcome of the newborn airway**

Recommended Monitoring and Equipment for EXIT

PATIENT	EQUIPMENT
Parturient	Arterial line, multiple intravenous lines, rapid infusion device, fluid warming device, laryngoscope, endotracheal tubes, difficult airway equipment
Fetus	Fetal doppler ultrasound, pulse oximetry, suction equipment, laryngoscope, armoured endotracheal tubes, stethoscope, flexible bronchoscope, Capnography monitor





Fetal Intraoperative Anesthetic Requirements for the EXIT Procedure

Attention to the following issues is paramount in decreasing fetal morbidity related to the EXIT.

- **Maintaining feto-placental circulation to prevent placental separation following partial delivery of the fetus.**
- **Providing fetal anesthesia for fetal airway manipulations.**
- **Providing adequate fetal monitoring or surveillance until delivery - pulse oximeter dedicated for baby monitoring with foil placed over the pulse oximeter probe to decrease ambient light interference.**

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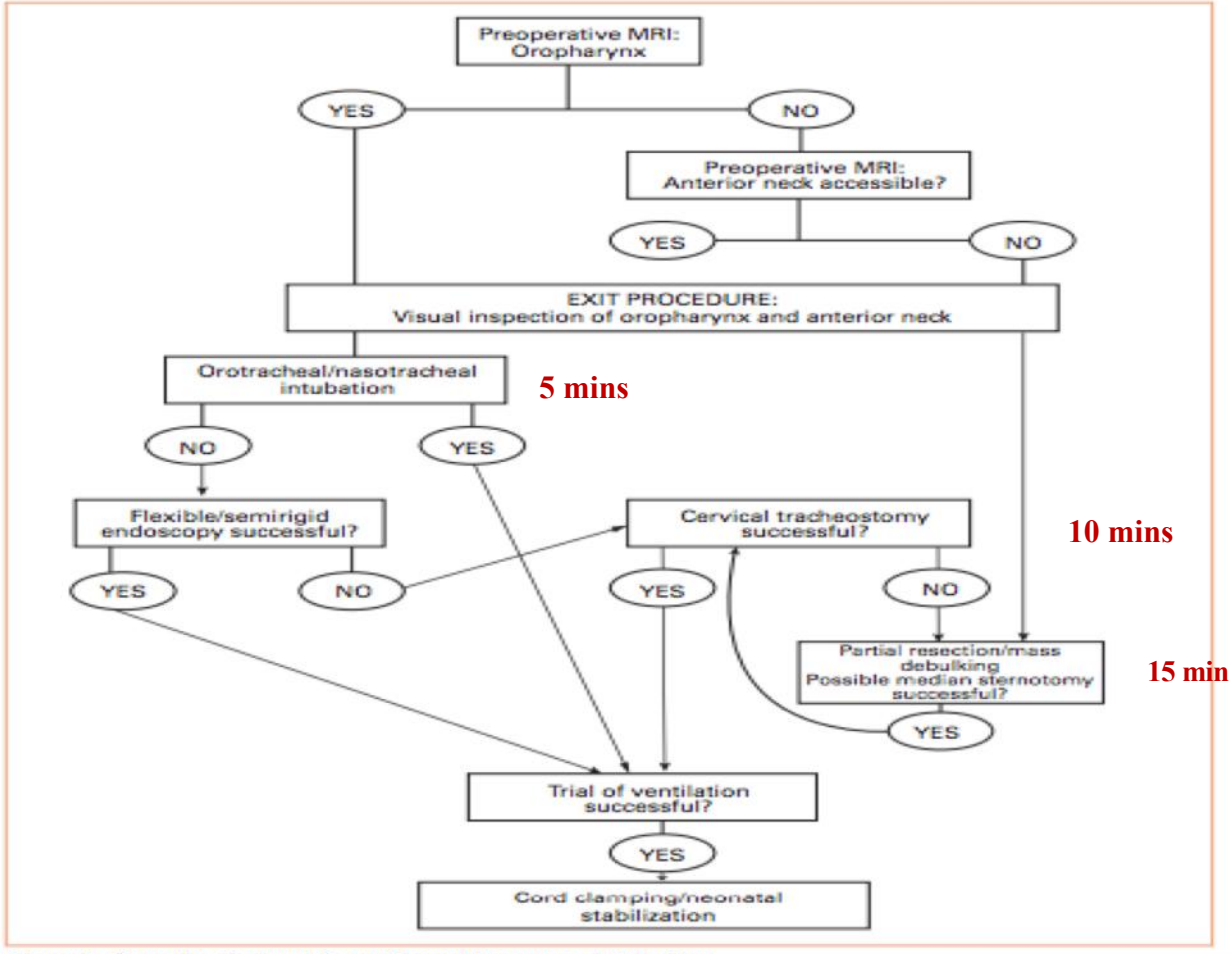
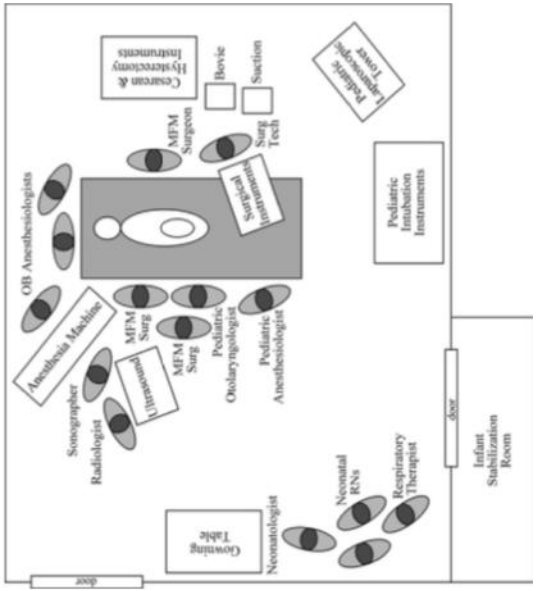
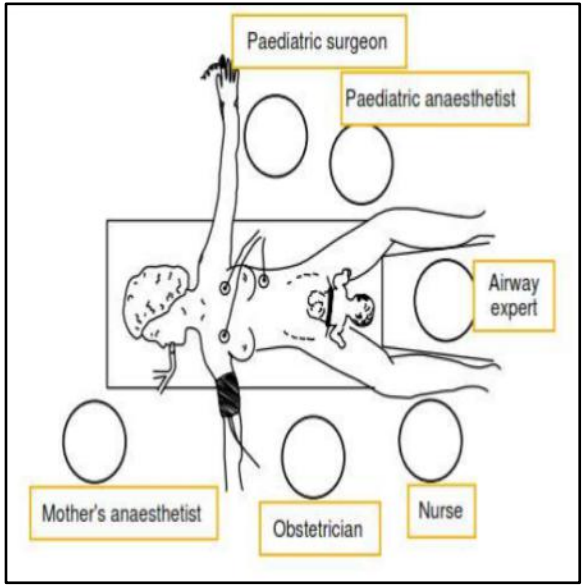


Figure 1. Operative Protocol: Fetal Airway Management Algorithm
Abbreviations: MRI, magnetic resonance imaging; EXIT, ex utero intrapartum treatment.

Simulation


Cesarean & Hysterectomy Instruments
Bovie
Suction
Pediatric Laryngoscope Tower
MFM Surgeon
Surg Tech
Surgical Instruments
Pediatric Intubation Instruments
OB Anesthesiologists
Anesthesia Machine
MFM Surg
MFM Surg
Pediatric Otolaryngologist
Pediatric Anesthesiologist
Ultrasound
Sonographer
Radiologist
door
Infant Stabilization Room
Neonatal RNs
Respiratory Therapist
Neonatologist
Isolette Table
door


Paediatric surgeon
Paediatric anaesthetist
Airway expert
Mother's anaesthetist
Obstetrician
Nurse

We are presented with a 35 year old Gravida 1 Para 0 (G1P0) parturient. Prenatal ultrasound at 25 weeks age of gestation (AOG) showed fetal neck teratoma. The patient was referred to Pediatric Anesthesia service for possible ex - utero intrapartum treatment (EXIT).

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- **EMERGENCY CS**
- **AOG – 34 WEEKS**
- **BW – 3500 g**
- **AS 1, 8**
- **FETAL CERVICAL MASS**
  right cervical area
  measures 15 x 14 x 14 cm

The fetal head and the upper torso of the fetus, including the right upper arm, were carefully delivered by the obstetricians.

Intubation of the fetus was attempted once the fetal head and neck have been delivered.

PHASES OF EXIT

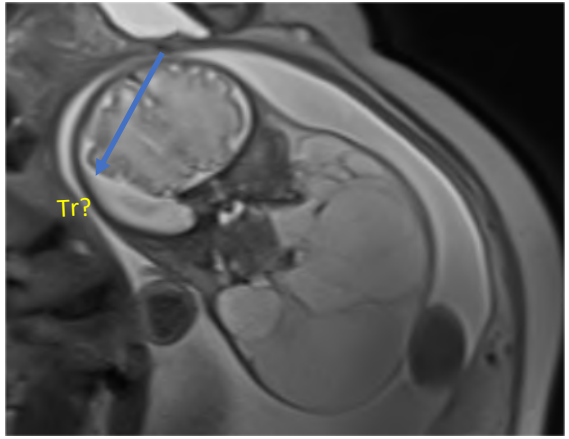
- Maternal anesthesia
  - Continuous epidural anesthesia .25% bupivacaine
  - General endotracheal anesthesia was maintained with 2-2.5% sevoflurane, and oxygen
- Hysterotomy
- Partial delivery of the neonate
  - Fetal head and the upper torso of the fetus, including the right upper arm
- Securing the fetal airway
  - orotracheal intubation , rigid bronchoscopy ,tracheostomy
- Management of bleeding
  - Uterotonic drugs
  - Uterine massage after delivery of the placenta
- Transport neonate to NICU

Cervical Lymphangioma

- **Mother: 36/F**
- **G6P4/ 35 weeks AOG**
- **Fetal Cervical Lymphangioma, right neck**
- **Referred for EXIT procedure**

Fetal MRI and Ultrasound

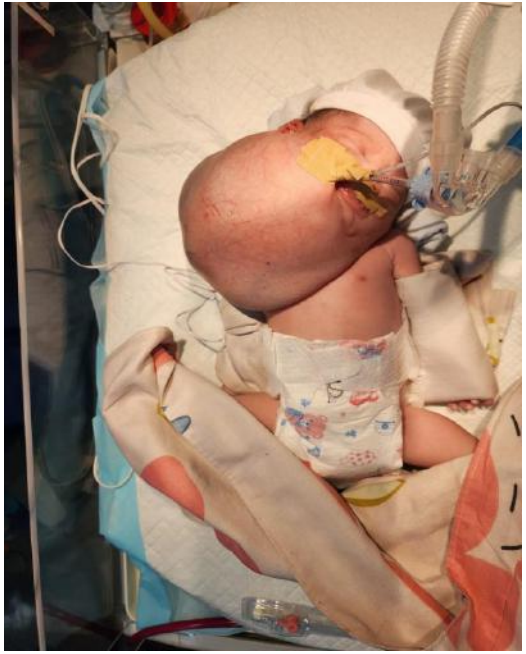
- **Huge 13 x 11 x 11cm (AP x W x CC), multi-septated high T2 single cystic mass along the right side of the face, from the orbito-temporo-occipital scalp region extending down to the right lower neck – upper chest.**
- **This appeared to cross the midline to the left and also extended into the superior mediastinum. The cystic extension to the mediastinum measured about 2.2 x 2.5 x 3cm.**
- **The carotid vessels including the internal jugular vein appeared encased.**
- **The mass appeared completely overlying the anterior neck without clearly delineated normal skin.**
- **Trachea was difficult to delineate, as it is not filled with air (presumably this is displaced or compressed by the overlying cyst).**
- **Left side of the face, scalp and upper neck appeared clear.**



- **Emergency CS due to Preterm Labor**
- **Total time from induction of GA to intubation of the fetus 8 minutes**
- **Total OR time: 1 hr 20 mins**

BABY Girl

- AOG 35 WEEKS
- BW 3680 g,
- AS 1,8 n 7 minutes
- FETAL CERVICAL MASS RIGHT CERVICAL AREA
  MEAS 17 X 13 X 14 CM



What were the emergency airway procedures performed?

- **Decompression**
- **Intubation**
  - **Laryngoscopy**
  - **Bronchoscopy**
- **Tracheotomy?**

Ultrasound guided aspiration of the Mass and intralesional Bleomycin injection

Despite the potential maternal and fetal complications, EXIT has proven to be an effective method to establish an airway in the newborn in a variety of situations.

From our team with

compassionate heart

competent hands

and exceptional

courage.

HAPPY TO SERVE

Perinatology plans

- Ongoing steroid administration
- Fetal MRI
- Fetal 2Decho
- Admission- possible EXIT procedure (ideally at >37 weeks or anytime if with preterm labor)
- Amnioreduction

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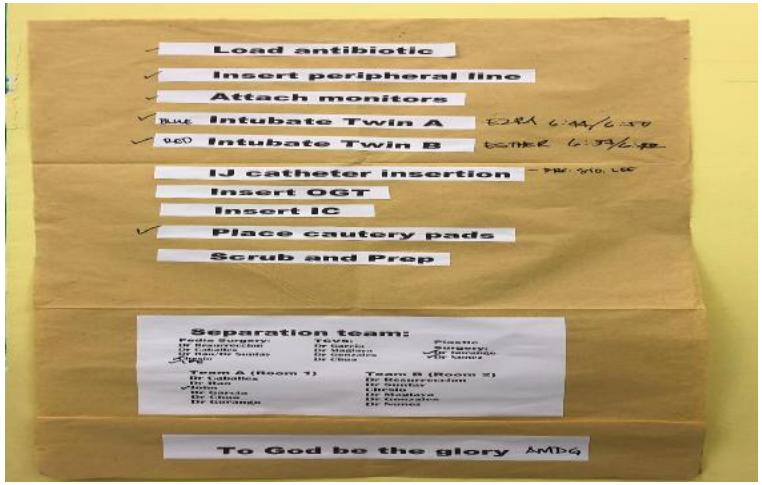

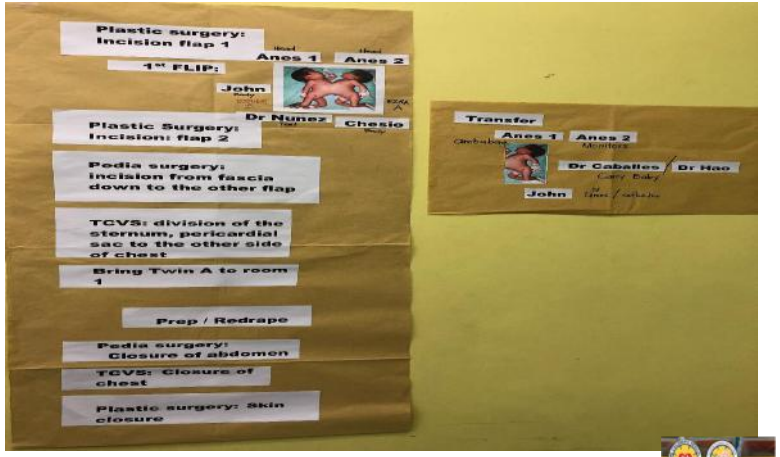

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Responsibilities

- **Maternal-Infant Anesthesiologist Team**
  - Obtains uterine relaxation to facilitate delivery of head and arm with minimum compromise of placental support
- **Maternal-Infant Specialist Team**
  - Does ultrasound placental mapping to avoid placental damage, low transverse hysterectomy

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Shiley
3.0 PED
REF
Designation
CE 0050
I.D. 3.0 mm
O.D. 4.5 mm
Length 39 mm
1
Quantity
MALLINCKRODT
Shiley
3.0 PED
SHILEY
3.0 PED
3.0 ID
4.5 OD

Preoperative Preparation[2,3]

- Assessment of maternal comorbidities
- Imaging studies for placental location, location of lesion, and fetal weight
- Ideal timing: Close to term, often 34 to 35 weeks of gestational age
- Multidisciplinary meeting (anesthesiologists, obstetricians, pediatric surgeons, pediatric cardiologists, neonatologists, radiologists, nurse, blood bank).
- Maternal aspiration prophylaxis.
- IV lines for hemorrhage preparedness.
- Arterial line to assess fetal perfusion.
- General anesthesia with intubation is most often used.

Set up and Run through

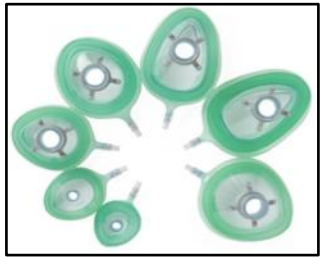
CONDUCT OF ANESTHESIA

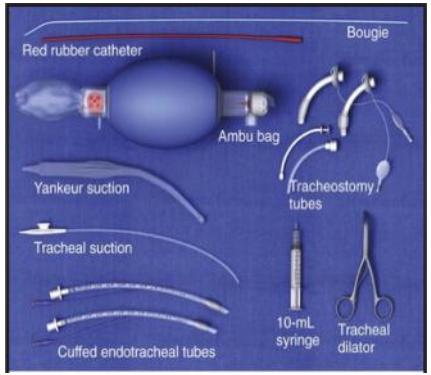
1. **The parturient was kept nil per orem for the procedure.**
2. **Metoclopramide for aspiration prophylaxis**
3. **Two 21-gauge peripheral intravenous access lines were placed.**
4. **The patient was placed supine with left uterine displacement.**
5. **Oxygen 3L/min via nasal canula was placed.**
6. **Continuous epidural catheter was inserted. A test dose of 3ml of 0.25% bupivacaine. Bupivacaine 0.25% 20 ml. was administered via lumbar epidural catheter 3 minutes after the test dose to obtain a level T4.**
7. **A rapid sequence induction of general anesthesia (with cricoid pressure) using Propofol 1.5 mg/kg TBW, Rocuronium 1.2 mg/kg TBW, Fentanyl 2 mcg/kg TBW . General anesthesia was maintained with 2-2.5% sevoflurane, and oxygen,**
8. **Systolic BPs were maintained at 120–140 mmHg,**

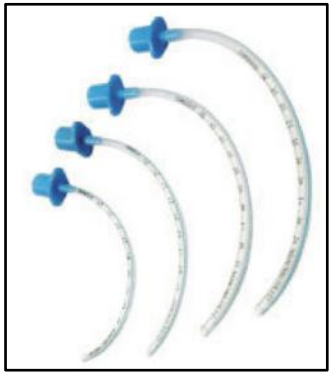

PCMC


PCMC


McGRATH®
MAC
PCMC




Red rubber catheter
Bougie
Ambu bag
Yankeur suction
Tracheostomy tubes
Tracheal suction
10-mL syringe
Tracheal dilator
Cuffed endotracheal tubes



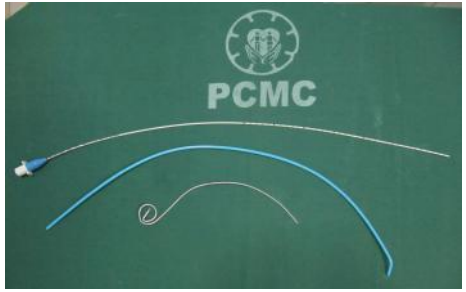

PCMC

Table 2
Information Provided by Fetal US vs Fetal MR Imaging Performed Prior to an EXIT Procedure

Information	US	MR Imaging
Size and location of the lesion	Yes	Yes
Infiltrative characteristics of the mass	Yes	Yes
Tissue characteristics of the lesion*	Yes	Yes
Fetal respiration function	Yes	No
Fetal swallowing function	Yes	Yes
Amniotic fluid volume	Yes	Yes
Fetal airway distortion	No	Yes
Anatomic location of the tongue	No	Yes
Presence of associated anomalies	Yes	Yes
Global anatomy (in conjoined twins)	No	Yes

*Depends on tissues involved; calcifications are variably seen at US.

Manjiri K. Dighe, S. E. (2011). EXIT Procedure: Technique and Indications with Prenatal Imaging Parameters for Assessment of Airway Patency. Radiographics, 31(2), 511-526

Fetal ultrasonography and fetal magnetic resonance imaging are complementary imaging modalities in the assessment of the fetus with potential airway obstruction.

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Review of Physiology

- **Mother's placenta provides oxygen to the fetus while in the womb**
  - **Fetal lungs are filled with fluid**

- **At birth:**
  - **Lungs are not yet inflated**
  - **First breath of the baby within about 10 seconds of delivery – newborn's central nervous system reacts to the sudden change in temperature and environment**
    - **Increased oxygen in the lungs cause a decrease in blood flow resistance to the lungs**
    - **Increased blood flow resistance of the baby's blood vessels**
    - **Fluid drains or is absorbed from the respiratory system**
    - **Lungs inflate → moves oxygen into the bloodstream and removes carbon dioxide by breathing out**

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CONDUCT OF ANESTHESIA

1. **The parturient was kept nil per orem for the procedure.**
2. **Metoclopramide for aspiration prophylaxis**
3. **Two 21-gauge peripheral intravenous access lines were placed.**
4. **The patient was placed supine with left uterine displacement.**
5. **Oxygen 3L/min via nasal canula was placed.**
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- AS 1, 8
- FETAL CERVICAL MASS
  right cervical area
  measures 15 x 14 x 14 cm

The fetal head and the upper torso of the fetus, including the right upper arm, were carefully delivered by the obstetricians. The lower torso, cord and the placenta were left inside the uterine cavity to minimize fetal heat loss and keep the uteroplacental circulation going.

Intubation of the fetus was attempted once the fetal head and neck have been delivered.

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PHASES OF EXIT

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  - General anesthesia was maintained with 2-2.5% sevoflurane, and oxygen
- Hysterotomy
- Partial delivery of the neonate
  - Fetal head and the upper torso of the fetus, including the right upper arm
- Securing the fetal airway
  - orotracheal intubation , rigid bronchoscopy ,tracheostomy
- Management of bleeding
  - Intravenous oxytocin infusion, 20 IU was given to enhance Intravenous methyl-ergonovine (0.2 mg). (methergine)
- Transport neonate to NICU

Responsibilities

- **Fetal Cardiologist**
  - Monitor the fetal heart rate, cardiac filling, cardiac contractility, and patency of the ductus arteriosus
- **Pediatric Anesthesiologist:**
  - Secure the airway by direct laryngoscopy
- **Neonatologist**
  - Oxygenation, heart rate monitoring, administration of medications, resuscitation
- **Pediatric Otolaryngologist**
  - Secure airway: laryngoscopy, bronchoscopy, tracheoscopy, tracheostomy
- **Pediatric Surgery**
  - Surgical emergencies

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Perinatology plans

- **Ongoing steroid administration**
- **Fetal MRI**
- **Fetal 2Decho**
- **Admission- possible EXIT procedure (ideally at >37 weeks or anytime if with preterm labor)**
- **Amnioreduction**

> **Fetal MRI result may suggest to do C-section with EXIT or usual C-section only**

➢ **Amnioreduction: 3% risk of preterm labor**

CONDUCT OF ANESTHESIA

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3. **The patient was placed supine with left uterine displacement.**
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6. **A rapid sequence induction of general anesthesia (with cricoid pressure) using Propofol 1.5 mg/kg TBW, rocuronium 1.2 mg/kg TBW, Fentanyl 2 mcg/kg TBW . General anesthesia was maintained with 3.5% sevoflurane, and oxygen,**
7. **Systolic BPs were maintained at 120–140 mmHg,**
8. **The fetus was partially delivered from the head to the thorax 5 min after skin incision, the airway was evaluated by the pediatric anesthesiologist; the neonate was intubated after one attempt using videolaryngoscope Miller blade 1 and delivered 10 min into the procedure.**
9. **Fetal heart rate and saturation were directly monitored during this time.**
10. **After delivery, sevoflurane was discontinued and general inhalation anesthesia was converted to total IV infusion with Propofol and IV rocuronium 0.3 mg TBW.**
11. **Intravenous oxytocin infusion, 20 units was given to enhance uterine contraction.**
12. **Total operative time was 42 min, with 1,000 cc of estimated blood loss. Both mother and neonate tolerated the procedure well.**

The “Ex-Utero Intrapartum Treatment” (EXIT) procedure allows to ensure fetal airway before completion of delivery and umbilical cord clamping while keeping uteroplacental circulation.

➢**On prenatal UTZ:**

- **multiseptated**
- **multilocular cystic mass,**

(13 x 11 x 10cm)

- **Polyhydramnios 33cm**
- **EFW 2048g**

Tracheotomy

EXIT DESCRIPTION
1. Personnel: Multidisciplinary team including anesthesiologists, pediatric surgeons, neonatologists, maternal-fetal medicine specialists, and operating room nurses.
2. Maternal anesthesia: Deep general anesthesia is used, in addition, an epidural catheter is placed to facilitate postoperative pain management of the mother. General anesthesia induction (remifentanil, propofol and rocuronium) is followed in rapid sequence by intubation and assisted ventilation. Before the uterine incision, deep inhalational anesthesia with sevoflurane is used to maintain uterine relaxation and preserve uteroplacental circulation and fetal gas exchange.
3. Access to the uterine cavity:
a. Low transverse laparotomy.
b. Once the uterus is exposed, intraoperative sterile ultrasonography is used to
c. map, carefully, the position of placenta and fetus.
d. The location of the hysterotomy is determined by the placental locations, and a margin of at least 5 cm from the lower placental edge is left.
e. Uterine progressive distractor, Satinsky vascular clamps, and a stapling device (Premium Poly Cs-57 Autosuture®) are used in this order to enter into the amniotic sac with minimum uterine bleeding (Fig. 1).
f. Amnioinfusion with Rintgen's solution is performed to keep uterine volume.
4. Fetal exposure: A gentle fetal extraction with the help of a single-use suction vacuum (Kiwi©) is performed and the fetus is exposed to the shoulders.
5. Fetal airway management: Fetal anesthesia is supplemented by an intramuscular shot (fentanyl, vecuronium, and atropine) immediately after fetal exposure. Then, the fetal head is positioned to allow access to the airway by direct laryngoscopy or bronchoscopy.
6. Delivery: Once the fetal airway management is completed and secured, the umbilical cord is clamped and divided. The placenta is delivered, the uterine tone is restored (carbetocin plus oxytocin). Finally, uterus and maternal abdominal wall are closed similar to a cesarean section.

EXIT PROCEDURE TO-DO LIST

INDICATION FOR EXIT PROCEDURE
- ❑EXIT-to-Airway procedure
- ❑EXIT-to-Resection procedure
- ❑EXIT-to-ECMO procedure
- ❑EXIT-to-Separation procedure

SPECIALTY REFERRAL
- ❑Radiology
- ❑Obstetrics and Maternal-fetal medicine
- ❑Pediatric Surgery
- ❑Pediatric Otolaryngology
- ❑Pediatric and Obstetric Anesthesiology
- ❑Neonatology
- ❑Nursing Service
- ❑Medical Ethics (Parental Consent for the Procedure)

LABORATORY EXAMINATIONS

AIRWAY DEVICE PREPARATION
Maternal/ Fetal Airway Device
- ❑Suprglottic airway device
- ❑Oro/Nasopharyngeal airways
- ❑ Face mask
- ❑Oro / Naso endotracheal tubes

AIRWAY EQUIPMENT
- ❑Laryngoscope (Fetal blades 0, 00 & 1 and Adult blades)
- ❑Pediatric Rigid bronchoscope (2.5–3 mm)
- ❑Pediatric Flexible intubating bronchoscope (2.5 mm)
- ❑Pediatric Tracheostomy tray
- ❑Pediatric / Adult Ambu bag with manometer attached to oxygen source
- ❑Video laryngoscopy (Fetal blades 0, 00 & 1 and Adult blades)
- ❑Suction machine and catheters

MATERNAL / FETAL MONITORING DEVICE
- ❑NIBP: rapid infusion device
- ❑Pulse oximetry
- ❑Capnography
- ❑Temperature : fluid warming device
- ❑Electrocardiography
- ❑Fetal doppler ultrasound

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PRESENT DESIGNATION AND AFFILIATION:	• SENIOR CONSULTANT PHILIPPINE CHILDREN'S MEDICAL CENTER • MEMBER, COMMITTEE ON PROMOTIONS AND APPOINMENTS PHILIPPINE CHILDREN'S MEDICAL CENTER • CHAIR, PEDIATRIC ANESTHESIA COUNCIL, PHILIPPINE BOARD OF ANESTHESIOLOGY
PAST APPOINTMENTS	• DEPARTMENT MANAGER, SURGICAL SERVICES, PHILIPPINE CHILDREN'S MEDICAL CENTER • HEAD, DIVISION OF ANESTHESIA, PCMC • HEAD, SECTION OF PEDIATRIC ANESTHESIA, PCMC • PAST PRESIDENT, PHILIPPINE SOCIETY FOR PEDIATRIC ANESTHESIA
INTERESTS:	• PEDIATRIC ANESTHESIA • ANESTHESIA FOR CHILDREN WITH SPECIAL NEEDS • ANESTHESIA FOR PROCEDURES OUTSIDE THE OPERATING ROOM

"You must do the thing you think you cannot do."
Eleanor Roosevelt

Thank you!

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- EMERGENCY CS
- AOG – 34 WEEKS
- BW – 3500 g
- AS 1, 8
- FETAL CERVICAL MASS
  right cervical area
  measures 15 x 14 x 14 cm

The fetal head and the upper torso of the fetus, including the right upper arm, were carefully delivered by the obstetricians. The lower torso, cord and the placenta were left inside the uterine cavity to minimize fetal heat loss and keep the uteroplacental circulation going.

Intubation of the fetus was attempted once the fetal head and neck have been delivered.

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CASE 1

We are presented with a 35 year old Gravida 1 Para 0 (G1P0). Prenatal ultrasound at 25 weeks age of gestation (AOG) showed fetal neck teratoma. The patient was referred to Pediatric Anesthesia service for possible ex - utero intrapartum treatment (EXIT).

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EXIT procedure versus standard Cesarean section major differences

1. Deep volatile anesthesia (e.g., above 2 MAC) is often employed
2. There is no need to limit induction of anesthesia, skin incision to delivery time
3. Maintenance of maternal hemodynamics might necessitate infusions of dopamine
4. Continuous infusion of nitroglycerine may be required to maintain uterine relaxation
5. The fetus is only partially delivered with maintenance of placental support
6. Direct fetal anesthesia for airway management might be necessary

Standard Monitoring for Parturient and Fetus

- **Pulse oximetry**
- **NIBP**
- **ECG**
- **Capnography**
- **Temperature**
- **Precordial or Esophageal stethoscope**
- **Precordial doppler probe**
- **Central venous pressure**

During EXIT

- Fetus is still attached to the placental circulation until an adequate airway is established to prevent fetal hypoxia
- Once airway is stabilized and secured, umbilical cord is clamped followed by delivery of the placenta, completion of the delivery and closure of the C-section
- Routine newborn care

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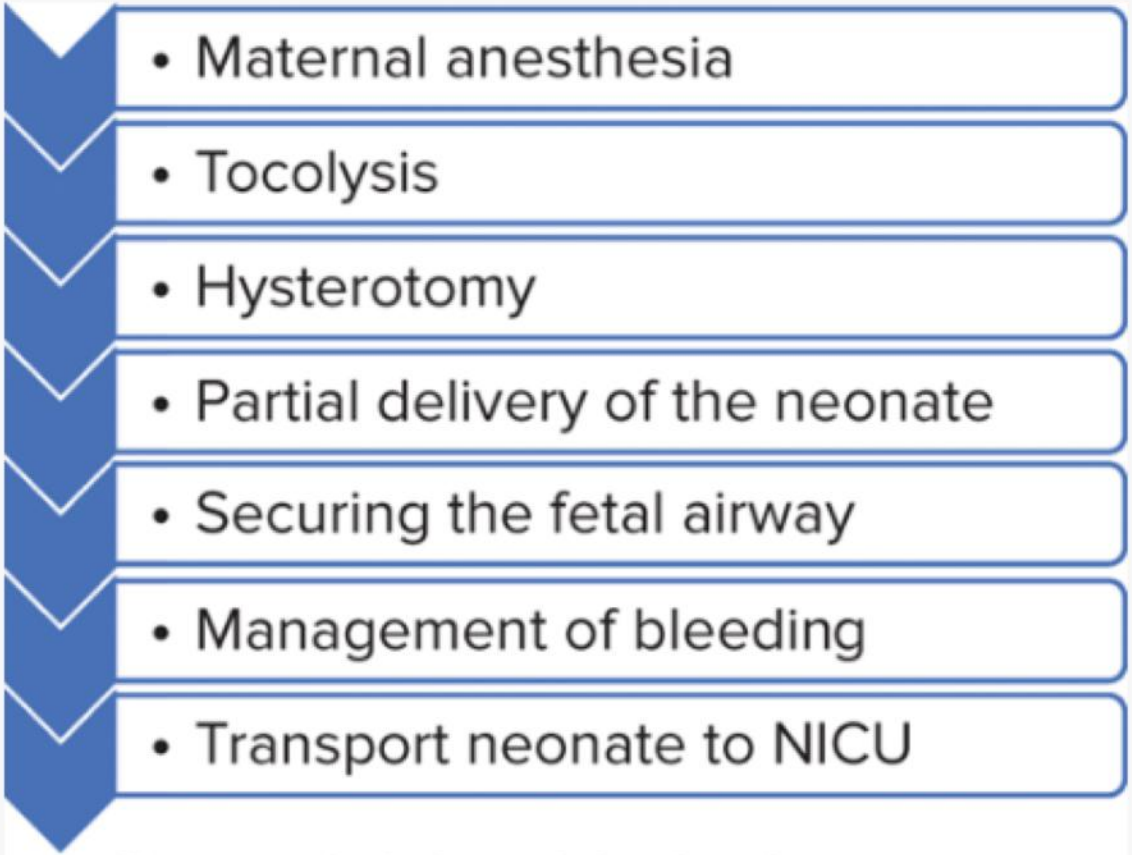
Phases of EXIT procedure.



Source: Philip E. Hess, Yunping Li, John J. Kowalczyk, Justin K. Stiles:
Obstetric Anesthesia: Quick References & Practical Guides
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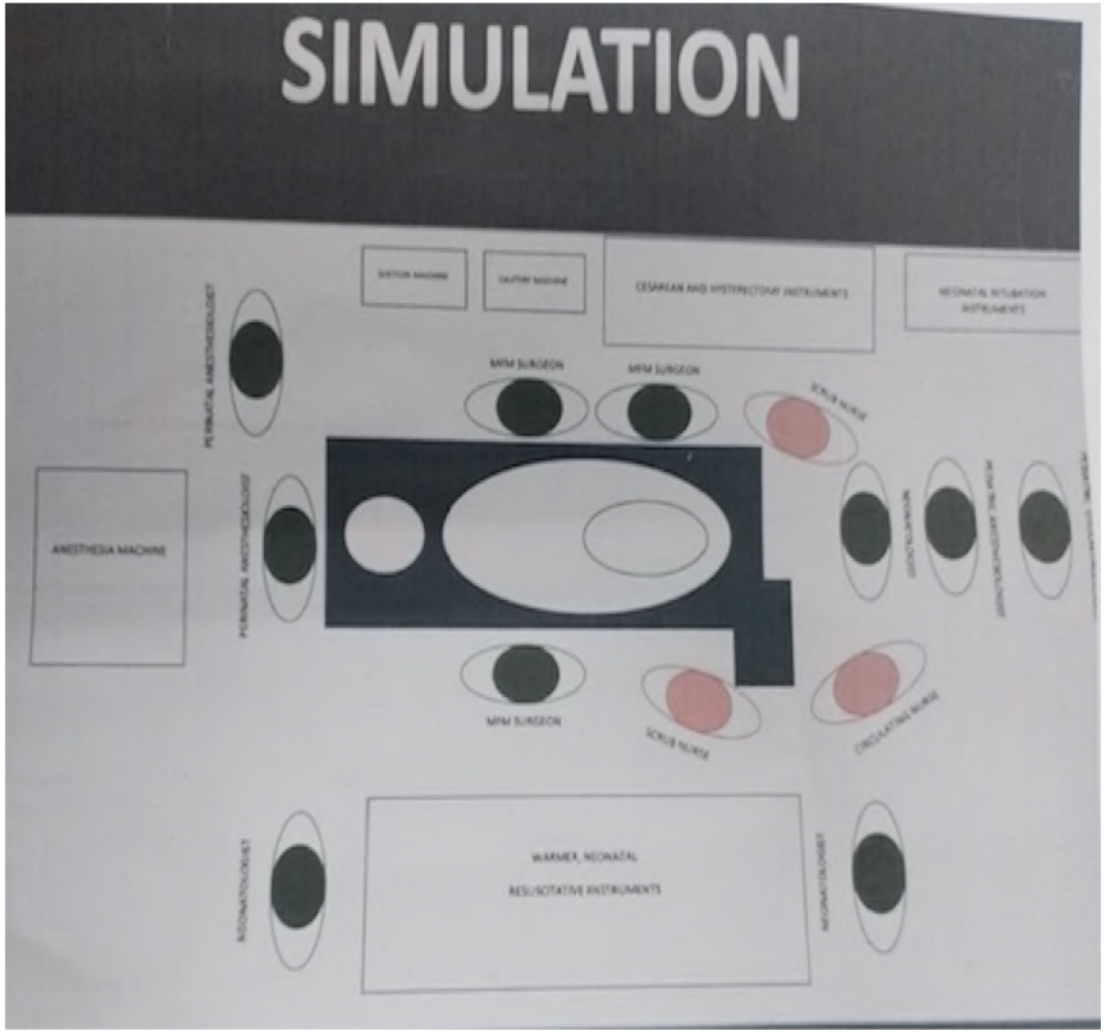
Ex utero intrapartum Therapy (EXIT)
OR
Operation on Placental Support (OOPS) Procedure
Airway Management on Placental Support (AMPS)

HALLMARK FEATURE FOR FETAL SAFETY

- **PLACENTAL PERFUSION**
- **PARTIALLY DELIVERED FETUS**


SIMULATION
SUCTION MACHINE
CAUTERY MACHINE
CESAREAN AND HYSTERECTOMY INSTRUMENTS
NEONATAL INTUBATION INSTRUMENTS
PERINATAL ANESTHESIOLOGIST
MFM SURGEON
MFM SURGEON
SCRUB NURSE
ANESTHESIA MACHINE
PERINATAL ANESTHESIOLOGIST
MFM SURGEON
SCRUB NURSE
CIRCULATING NURSE
WARMER, NEONATAL
RESUSCITATIVE INSTRUMENTS
NEONATOLOGIST
NEONATOLOGIST

The fetal head and the upper torso of the fetus, including the right upper arm, are carefully delivered by the obstetricians. The lower torso, cord and the placenta are left inside the uterine cavity to minimize fetal heat loss and keep the uteroplacental circulation going.

Intubation of the fetus is attempted once the fetal head and neck have been delivered.

Checklist

- Evaluation – pre-op/intra-op ultrasound
- Roles reviewed & clarified
- Equipment & instruments check
  - Airway Scopes
  - Camera system
  - Surgical instruments
  - Tracheostomy tubes

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