Ex utero intrapartum treatment (EXIT), a resuscitation option for intra-thoracic foetal pathologies

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Summary

The *ex utero* intrapartum treatment (EXIT) procedure is designed to guarantee sufficient oxygenation for a foetus at risk of airway obstruction. This is achieved by improving lung ventilation, usually by establishing an airway during caesarean delivery whilst preserving the foetal-placental circulation temporarily. Indications for the EXIT procedure have extended from its original use in reversing iatrogenic tracheal obstruction in congenital diaphragmatic hernia to naturally occurring upper airway obstructions. We report our experience with a new and rarely mentioned indication for the EXIT procedure, intra-thoracic volume expansions. The elaboration of lowest risk scenarios through balancing risks with alternative options, foetal or neonatal intervention and coordination between professionals from various disciplines are the most important conditions for a successful EXIT procedure. The EXIT procedure requires a caesarean section that specifically differs from the traditional caesarean section during which uterine tone is maintained to minimize maternal bleeding. To guarantee foetal oxygenation during the EXIT procedure, profound uterine relaxation is desired. To gain time with optimal placental oxygenation in order to safely perform an airway intervention in a baby at risk of hypoxia may require deep inhalation anaesthesia and/or tocolytic agents. We review the EXIT procedure and present a case series from the University Hospital of Geneva that contrasts with the common indication for the EXIT procedure usually based on upper airway obstruction by its exclusive indication for intra-thoracic malformations/diseases.

Key words: EXIT procedure; foetal intra-thoracic pathologies; resuscitation

Introduction

Modern technologies, including ultrasonography and magnetic resonance imaging (MRI), have improved prenatal diagnosis of anatomic malformations. Early diagnosis is the condition for foetal or perinatal interventions and planning of targeted resuscitation procedures. Techniques to control uterine tone were developed specifically for foetal surgery allowing prolonged and complicated interventions. In principle, the ex utero intrapartum treatment (EXIT) procedure is designed to establish adequate ventilation and oxygenation by securing the airway during delivery, mainly a caesarean section, in a foetus at risk of delayed respiratory adaptation, whilst temporarily preserving the foetal-placental circulation. The EXIT procedure was initially developed as a means of re-establishing an airway after iatrogenic occlusion of the foetal trachea to promote lung growth in congenital diaphragmatic hernia [1, 2]. Over time, its use has expanded to include management of a variety of situations, including all kinds of extrinsic (teratoma, lymphangioma) [3] or intrinsic (laryngeal atresia, congenital upper airway obstruction) [4] obstructive malformations of the upper airways and more recently intra-thoracic lesions [5] such as congenital hydrothorax and pleural effusions [6]. Various interventions have been performed with EXIT support including intra-tracheal intubation, bronchoscopy, surfactant instillation, tracheotomy, tracheoplasty and, more rarely, ablative surgery of compressive tumours [1, 2, 5, 7–11].

Effective neonatal resuscitation aims to secure sufficient tissue oxygenation at all times between intra-uterine foetal life and neonatal life, whether breathing becomes completely autonomous or requires ventilator support. The EXIT procedure

provides a means to maintain oxygenation in neonates with short-lived respiratory insufficiency or any condition that may significantly improve following a short medical intervention. A number of case reports and some case series originating mainly from two American centres [1, 5, 10, 12, 13] report on the management of iatrogenic tracheal occlusion and some expanded indications for naturally occurring upper airway obstructions. Reports on intra-thoracic indications for the EXIT procedure remain exceptional [5, 6, 9, 10]. Besides reviewing general aspects of the EXIT procedure, the current report focuses on intra-thoracic and lung pathologies that compress the normal lung in which intra-thoracic volume can be significantly

increased by a short invasive procedure able to improve spontaneous or mechanical ventilation.

The EXIT procedure commonly requires a caesarean section (CS) that specifically differs from the traditional CS. In contrast to the routine CS where uterine tone is maintained to minimize maternal bleeding and where uterine atony is dreaded, for the EXIT procedure, profound uterine relaxation using deep anaesthetic inhalation agents is desired, thus increasing maternal risks. In some cases, tocolytic drugs may further be necessary. In addition, a dedicated team skilled in complex neonatal resuscitation during maternal oxygenation of the partially or completely delivered foetus is essential.

Case series

We report our experience in a small case series of EXIT procedures with unusual indications managed at our hospital between 2000 and 2005 for intra-thoracic expansion reducing the volume of the 'normal' underlying lung tissue, thus putting the newborn at very high risk for postnatal hypoxia. Even an optimized and targeted neonatal resuscitation with immediate postnatal thoracocentesis was expected to lead to cardiopulmonary compromise with a high likelihood of several minutes of asphyxia.

In all five cases, an important polyhydramnios led to the diagnosis of the foetal pathology between 14 and 38 weeks gestation (figure 1). A pathologic volume expansion occupied more than half the intra-thoracic space leading to a deviation of the mediastinum in all cases. Although still rare in occurrence, such intra-thoracic pathologies are now more common than upper airway obstructions. The general characteristics of the five cases are reported in table 2. Two foetuses had a beginning hydrops, a condition known to considerably worsen the prognosis [14–17]. None of the pathologies was easily accessible for surgery *in utero* because of foetal and/or placental position such that thoracocentesis was considered impossible without harm, or at least high risk, to vital organs of the mother or foetus. Insertion of a pigtail catheter for drainage and multiple punctures were attempted in one foetus (CN) with congenital cystic adenomatoid lung malformation (CCAM),

but these interventions remained ineffective in producing lasting release of compression in several large cysts and hydrothorax.

In contrast to the classical EXIT procedure mainly used to manage and secure obstructed upper airways, the procedure was adapted for pathologies affecting lung volume. The aim was to increase intra-thoracic space for ventilation of the remaining functional lung tissue by aspiration of the liquid components of the pathologic expansion and to establish an airway for postnatal support. We aimed for a short and minimally invasive procedure to avoid lengthy interventions with increasing maternal morbidity [9].

The interventions were planned with a multidisciplinary team after decision on the lowest risk scenario. Special attention was paid to supplying detailed information to the parents, particularly as severe lung hypoplasia was impossible to exclude in all our cases with large intra-thoracic expansion pathologies. An ultrasound control was performed shortly before, and in some cases during the EXIT procedure, in order to localise and map the placenta before hysterotomy as well as estimating foetal umbilical cord length (to plan positioning of the newborn after delivery) and anticipate the ideal anatomical puncture site for thoracocentesis or drainage.

The first three CS were performed in the obstetric

Figure 1

Foetal magnetic resonance imaging – T2 weighted **A** Longitudinal section of the amniotic cavity and foetus. Note the considerable amount of amniotic fluid and the compressed lung surrounded by a hydrothorax. **B** Transverse section of the foetal thorax in abundant amniotic fluid. The foetal lung is outlined for volume determination.
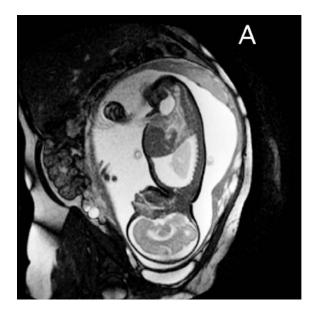
Figure 2

Example of EXIT procedure with positioning of the baby at right angle to the mother on padded sterile surface. Note that the umbilical cord length just allows this position. Whilst the obstetrician is sensing cord pulsatility, the newborn resuscitation team is withdrawing pleural effusion and establishing an airway shortly after confirming the optimal drainage location by ultrasound.

theatre under spinal anaesthesia and specific uterine relaxation was induced only in one. Due to the potential immediate involvement of the paediatric surgical team in the two subsequent cases, the EXIT procedures were performed under general anaesthesia in a larger paediatric surgery theatre with two complete surgical and anaesthetic teams for the mother and neonate, in addition to the neonatal resuscitation team (figure 2).

For ease of access to the thorax and abdomen the foetuses were completely delivered and positioned approximately at placental level. No polycythaemia resulted in such position from the delayed cord clamping (table 2). CN, AY responded to volume therapy for hypotension in the labour ward, but none required catecholamines. During the neonatal procedure the obstetrician continuously monitored pulsatility of the umbilical cord avoiding stretch and compression. In one case (CG), the procedure

was hastened after 4 minutes due to fading umbilical pulses. All babies, except LV, rapidly developed motor activity and breathing efforts despite sedation and analgesia to the mother (table 3). Umbilical cord pH after clamping and early neonatal adaptation was good in all five cases (table 4).

A short EXIT procedure time of 4 to 9 minutes was required to insert drainage and aspirate hydrothorax or cystic fluid or, in one case, ascites. Establishment of an airway was performed during placental circulation in two cases, as the neonates started breathing spontaneously after withdrawal of 60 to 400 ml of liquid in all other cases and the upper airways were easily accessible for conventional resuscitation. All neonates except one (CG), required high frequency oscillation (HFO) ventilation for 5 to 44 days. CN and AY had pulmonary hypertension (PHT) managed with nitric oxide (table 2). Thoracic drainage in all neonates was continued for 3 to 32 days, except in one (LV) where the main complication was ascites. All survived and left hospital after 11 to 56 days, CN and AY with home oxygen (<25% FiO2) for less than 3 months.

Three babies had secondary surgical treatment, two after 3 days and one after 11 months (table 4). CN had a congenital cystic adenomatoid malformation and AY a broncho-pulmonary sequester. An inferior lobectomy was performed without complications. LV, also with a congenital cystic adenomatoid malformation had an excellent clinical follow-up and a right inferior lobectomy was finally performed at 11 months. Clinical follow-up of all infants except CN was normal at 9 months or later. Since 2004 infants have been included in the formal neurodevelopmental follow-up. CN shows a mild cognitive and mod-

Table 1

Foetal and obstetric characteristics.

Initials	Diagnosis GA (wks)	Polyhy-dramnios	Amnio-drainage	MRI	MRI lung volume (ml)	Lesion	Placenta location	Blood loss (ml)	Pre-/post OP Hb* (g/l)
MO	38	yes	no	no		bilateral	anterior	500	12.9/10.7
CG	37 4/7	yes	no	no		left	posterior	500	12.9/11.8
CN	13 6/7	yes	yes	yes	NA	left	posterior	400	11.6/10.8
LV	27	yes	yes	yes	10.8	right	anterior	500	12.0/10.6
AY	30 3/7	yes	yes	yes	2.8	right	anterior	1000	11.1/ 7.3

* Lowest post-OP Hb

Table 2

Neonatal characteristics.

Initials	Sex	BW (g)	Birth GA (wks)	Diagnosis	EXIT procedure	EXIT duration (min)	Liquid removed (ml)	Haemoglobin g/l (Haematocrit %)
MO	f	3670	38	bilat. hydrothorax	bilateral drainage	4	400	150 (42.9)
CG	m	2770	38 1/7	hydrothorax	drainage	4	60	177 (53.9)
CN	m	3500	39 1/7	CCAM*	drainage	5	60	142 (39.9)
LV	f	2500	33 1/7	CCAM*	drainage**	4	170**	177 (51.9)
AY	m	2670	33 2/7	sequester	drainage	9	60	184 (51.9)

* CCAM = congenital cystic adenomatoid malformation
** Ascites

Table 3

Anaesthetic considerations.

Initials	Uterine relaxation	Medication PP	Sedation	Analgesia	CS duration (min)
MO	no	ocytocin*	midazolam 2 mg	fentanyl 25 mcg	70
CG	yes	ocytocin*	midazolam 1.5 mg	fentanyl 75 mcg	70
CN	no	ocytocin*	midazolam 2 mg	fentanyl 100 mcg	35
LV	yes	ocytocin*	general anaesthesia	fentanyl 250 mcg	45
AY	yes	ocytocin*	general anaesthesia	fentanyl 300 mcg	60

*5 U IV bolus (all cases) followed by 20 U/6 hrs

Initials	APGAR 1', 5', 10'	pHa	pHv	PHT	O2 (d)	Ventilation (d)	Drainage (d)	Surgery	Hospital Stay (d)
MO	9/10/10	n/a	n/a	no	3	5 (HFO)	10	no	24
CG	8/9/10	7.19	7.31	no	1	0	3	no	11
CN	1/6/–	7.22	7.28	yes	56*	44 (HFO, NO)	32	At day 3	56
LV	–/–/–	7.02	7.14	no	1	5 (HFO)	no	At 11 mths	25
AY	3/–/–	7.2	n/a	yes	51*	11 (HFO, NO)	9**	At day 3	51

* Home oxygen <25%
** pericardic drain 4 d   NO = nitric oxide   PHT = pulmonary hypertension

erate motor delay at 26 months. Following a bronchiolitis at 4 months and again at 17 months of age he required home oxygen for several months.

Maternal outcome was uncomplicated in all cases and no uterine atony occurred. In order to reduce blood loss during CS our usual technique is to allow spontaneous delivery of the placenta after cord clamping, induced by 5 U of oxytocin IV [18]. Blood losses ranged from 400–500 ml, except in one case where the deepest uterine relaxation was used and losses were more important (1000 ml). However, no transfusion was required (table 1).

Literature review and discussion

The EXIT procedure

Foetal management of congenital diaphragmatic hernia *in utero* with temporary occlusion of the trachea ('Plug the Lung Until it Grows' technique) has led to the EXIT procedure as a means of re-establishing the trachea during delivery in safe conditions [1, 19] and this remains its most frequent indication. Its successful use in this specific therapeutic situation has been adapted for naturally occurring pathologic obstruction of the upper airway [1, 2]. Upper airway obstructions are very rare neonatal occurrences but are associated at birth with a high morbidity and mortality [1, 2]. The use of the EXIT procedure for management of intra-thoracic pathologies is novel and only very limited case reports figure in the literature [5, 6, 9, 10]. To the best of our knowledge this is the first case series with this specific indication.

The prenatal diagnoses of pathologies susceptible to benefit from the EXIT procedure allow anticipation of a controlled delivery and specifically targeted neonatal resuscitation, usually following a brief invasive or surgical intervention. The EXIT procedure provides extra 'safe' time to perform the interventions expected to significantly improve neonatal adaptation capabilities but at the cost of an increased maternal risk. The choice of prenatal therapeutic options depends primarily on the type and severity of the foetal pathology as well as the gestational age of the foetus at diagnosis. A key requirement for a successful EXIT procedure is the orchestration of multiple medical specialists from varied disciplines (obstetrics, neonatology, anaesthesia, and paediatric surgery). Different scenarios to optimise foetal outcome without increasing unnecessary maternal risks must be discussed beforehand and a common agreement must be found on the anticipated strategy or strategies. The possibility and risks of a foetal procedure *in utero* must be balanced with those of the planned EXIT procedure (table 5).

Anaesthetic management

An epidural or spinal anaesthesia may be used for short procedures as in our series but preference should be given to general anaesthesia, particularly when longer interventions may be necessary. The anaesthetic management of the EXIT procedure differs from that of a conventional caesarean delivery in that uterine relaxation is a condition for its success, best achieved with an inhalation agent [20–22]. The dose of volatile anaesthetics as determined by the end-tidal concentration of the halogenated volatile agent (isoflurane, desflurane, sevoflurane), is kept at approximately 2–2.5 MAC (**M**inimal **A**lveolar **C**oncentration), more than two orders of magnitude higher than that usually administered for caesarean section. An additional

	Pluridisciplinary preparation for EXIT procedure
Participants	Obstetrician, anaesthetist, neonatologist (paediatric surgeon, paediatric cardiologist)
Risk assessment	risks and feasibility of foetal intervention
	risks and feasibility of EXIT intervention
Information	Parental information
	Team information: lowest risk scenarios for planned and emergency CS
Anatomic presentations	Type and lateralisation of intervention
	Placental position (preservation during CS)
	Umbilical cord length (positioning of newborn)

aim of uterine relaxation is foetal anaesthesia, which might be desirable for the planned invasive procedure. However, as utero-placental flow critically depends on maternal haemodynamics, close maternal monitoring and fine-tuning of volatile agents remain essential.

Maternal intra-operative blood losses during an EXIT procedure may be exacerbated by the relaxed state of the uterus as well as the prolonged duration of the procedure. Some EXIT procedures have been reported to last up to 2 to 3 hours [12, 20, 23]. For a safe use of high concentration volatile agents, especially in such prolonged procedures, careful control of maternal systemic blood pressure often requires an alpha-adrenergic support such as ephedrine and neosynephrine [24] and is preferred to volume expansion due to the potential risk of pulmonary oedema. Therefore, invasive arterial blood pressure monitoring should be considered [20].

Although not widely used, nitroglycerin at doses ranging from 100 to 500 µg IV, if necessary followed by continuous infusion at rates of 1–20 µg/kg/min has proven effective and safe in some cases requiring rapid uterine relaxation [25–27]. Advantages of its use include rapid onset of action, effective uterine relaxation, short half-life, intravenous administration and it may particularly be an interesting alternative in those cases where general anaesthesia should be avoided. Although pharmacokinetic studies have demonstrated placental transfer of nitroglycerin, no significant foetal haemodynamic effects have been reported [21, 27], most likely due to a rapid placental metabolism, a short half-life, and a high maternal-foetal gradient.

Obstetric management

The EXIT procedure must be performed in an operating theatre with sufficient space for different specialist teams to take care of the mother and the foetus simultaneously. On the operating table the mother is preferentially placed in supine position with a left lateral tilt in order to reduce or avoid inferior vena cava and aorta compression. After induction of anaesthesia the obstetric team will perform a CS choosing the hysterotomy site such that the placenta, usually its inferior margin, remains unharmed so as to leave the utero-placental circulation intact.

The foetus is partially [1, 10–12] or completely [6] delivered taking care to avoid stretching or compressing the umbilical cord. In our case series as access to the thorax and trunk was required and short intervention times planned, the foetus was fully delivered and positioned about level with the placenta so as to avoid hydrostatic pressure on the placental-foetal circulation. The absence of polycythaemia and the risk of hypovolaemia after thoracocentesis, a condition encountered in two of our cases, may even suggest a lower positioning when possible. To allow the neonatology team easy access to the foetal head and thorax, the obstetrician placed the baby as permitted by umbilical cord

length, either on maternal legs or on a narrow padded table at right angel to the mother, head facing away from her (figure 2). Access for manoeuvres and resuscitation was from either side of the maternal legs in the first case and with slightly better access all around the baby when cord length allowed positioning on the prepared side-table, which however compromises the obstetricians' space. While the neonatology team immediately starts the intervention on the foetus, the obstetrical team focuses on accurate maternal haemostasis and persistence of umbilical cord pulsatility. The foetus is expected to remain cyanotic unless ventilation becomes efficient. A sterile pulse-oxymeter may be placed on the foetal hand to monitor oxygen saturation, but foetal oxygen saturations as low as 60% (2.7–3.0 kPa) must be expected and should not discourage continuation of the procedure [10, 11, 28–30]. Although a pulse-oxymeter may be useful especially for foetal heart rate over longer procedures, obtaining a good reading often proves cumbersome. Longer procedures also require accurate thermoregulation achieved with warm saline. Manual cord pulsatility provides easy and rapid information on uterine perfusion for short procedures.

Oxytocin (5U IV) is administered immediately after clamping of the umbilical cord to regain uterine tone (for doses used in case series see table 3). In order to reduce significant blood loss during CS we wait for a maximum of five minutes for spontaneous delivery of the placenta [18]. Surgical closure is standard. Additional utero-tonics such as prostaglandins PGE2 (sulprostone 3 × 500 mcg over 90 minutes IV) may be used, if necessary [31].

Neonatal management

The classical EXIT procedure provides time to overcome obstruction and secure the upper airways [1], either through intubation, bronchoscopy or through an operative approach with tracheotomy or even open neck surgery. A surgical approach requires planning for a longer procedure and adequate foetal analgesia, which may be obtained by injection of intramuscular opiates and curare if necessary [10]. In our reported cases, we opted for a short, minimally invasive procedure, a thoracocentesis or drainage, to improve lung function by reducing intra-thoracic compression of the hypothesized normally functioning, but compressed, lung. Withdrawal of hydrothorax or cystic fluid between 60–400 ml (table 2) thus allowed ventilation of compressed lung after a theoretical intra-thoracic space gain of 60% to 360% calculated from the generally accepted normal lung volume (30 ml/kg bodyweight). Following this short invasive procedure, the airway was obtained and secured unless spontaneous breathing and improved colour indicated adequate spontaneous ventilation. However, securing the normal airway in our cases was optional. Only then, was the umbilical cord clamped and the neonate taken to a fully equipped resuscitation table for continued

conventional resuscitation. All except one case required mechanical ventilation and pulmonary hypertension was common.

Risks of the EXIT procedure

As the EXIT procedure has to guarantee utero-placental blood flow for foetal gas exchange by keeping the uterus relaxed and avoiding placental delivery, the most serious and immediate maternal risk during the EXIT procedure is intra-operative haemorrhage as a result of uterine atony or placental injury, a condition more likely to occur during prolonged procedures or after severe polyhydramnios [9]. Increased occurrence of postpartum haemorrhage due to uterine atony may be expected as a result of prolonged relaxation during the intervention, but we did not encounter this maternal complication in our small series and no other group has so far reported this complication. Maternal blood losses were slightly higher in the EXIT group than is usual at our facility but remained lower than reported [1, 10, 12, 20], certainly due to our very short intervention times. Neither the duration of postoperative hospital stay, nor the maternal haematocrit levels differed from the usual range at our facility. No blood transfusion was necessary. The incidence of wound infection is reportedly increased after EXIT procedures compared to conventional CS (15% vs. 2%) [13]. Reported long-term outcomes of mothers after foetal surgery are good overall [12] and no maternal deaths resulting from EXIT procedures are known. Pregnant women undergoing the EXIT procedure should however, be counselled about the risks associated with CS, such as the increased risk of abnormal placentation for subsequent pregnancies [32] as well as those associated with anaesthesia. Trial of labour for subsequent pregnancies may be compromised if an unusual hysterotomy is required for the procedure [5].

The foetal and neonatal risks depend on vital organ compromise by the primary pathology, on developmental issues potentially arising from perturbed organ growth as well as risks related to premature delivery. Vital organ compromise often results in hydrops as mentioned earlier and is clearly associated with a bad prognosis with mortality rated around 50% or more [14–17]. When foetal thoracocentesis is feasible, hydrops may reverse with some evidence for subsequent improved prognosis [15, 17] and should therefore be attempted. Prematurity-related risks are well recognized and should be avoided if possible but are beyond the scope of this review.

In all our cases with intra-thoracic expansion, normal lung development was quite uncertain, particularly when the diagnosis was made before 27 weeks gestation. When diagnosed in midtrimester, hydrothorax requires a detailed foetal investigation including morphology scans for associated cardiac and extra-cardiac anomalies [33], caryotyping and maternal serological assessment. Only the last three of our five cases had foetal MRI to estimate lung volume but from our limited experience we strongly caution against using such volume estimate as a prognostic factor for lung hypoplasia, probably one of the most important outcome factors. In fact, despite very small volumes on MRI in the two last cases, neonatal outcome was good. Serial foetal ultrasonography however is mandatory to confirm persistence and/or growth of intra-thoracic expansions.

Until now, foetal hydrothorax has classically been managed either *in utero* by thoracocentesis or thoraco-amniotic shunt with a double pigtail catheter or approached immediately postnatal by immediate intubation and thoracocentesis. The first option may not always be feasible due to an unacceptable risk as a result of foetal and placental position and the second exposes the neonate to permanent hypoxemic brain damage if drainage and ventilation fail to establish sufficiently rapid lung expansion and alveolar gas exchange. Although normal vaginal delivery may theoretically benefit pulmonary adaptation of the newborn, the duration of utero-placental bypass by late cord clamping is uncontrollable and a coordinated multidisciplinary neonatal resuscitation virtually impossible on call. Advances in foetal diagnostics now allow consideration of a third option, the EXIT procedure.

In cases where the foetal intervention carries an increased risk and gestation permitted until reasonably close to term to reduce the risk of prematurity, a short *ex utero* intra-partum treatment with thoracocentesis may present the lowest risk scenario and needs to be considered as a possible option. With increasing experience, teams at our facility felt more confident in the use of the technique even in more immature babies. Perinatal evacuation of large pleural effusions during preserved placental-foetal circulation present a valid and safe treatment option in perinatal teams with good pluridisciplinary coordination. Its advantage over intrauterine intervention is the ease and precision of the access by thoracocentesis and it does not have the disadvantage of postnatal hypoxia until adequate ventilation is established. In addition, placental-foetal transfusion secondary to late cord clamping during the EXIT procedure may support neonatal circulatory adaptation after large volume withdrawals.

Conclusion

Originally developed to reverse tracheal occlusion for treatment of CDH, the EXIT procedure has been shown to be useful in the management of some other upper airway and also intrathoracic diseases of the foetus by overcoming the obstruction or reducing compression of the normal lung with an invasive procedure while gaining time through extracorporeal oxygenation by the placenta. Our experience shows that the EXIT procedure is a feasible approach for some compromised foetuses with intra-thoracic lesions with minimal maternal and neonatal morbidity. A suc-

cessful EXIT procedure requires a multi-disciplinary perinatal team familiar with maternal CS, foetal or neonatal surgery, neonatal resuscitation, and foetal and maternal anaesthesia. In addition to the availability of such a large team, coordination and organisation of procedures and equipment is essential. This begins with the prenatal diagnosis continues in a crowded operating theatre with two simultaneous patients and ends with an efficient neonatal intensive care unit. Anaesthetic considerations for the EXIT procedure specifically differ from the routine CS in that placental perfusion and tocolysis is aimed for, requiring a surgical approach with careful haemostasis from the obstetrician. In conclusion, with strong collaboration, this technique allows extension of neonatal resuscitation techniques into foetal life in order to gain time through natural placental oxygenation.

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