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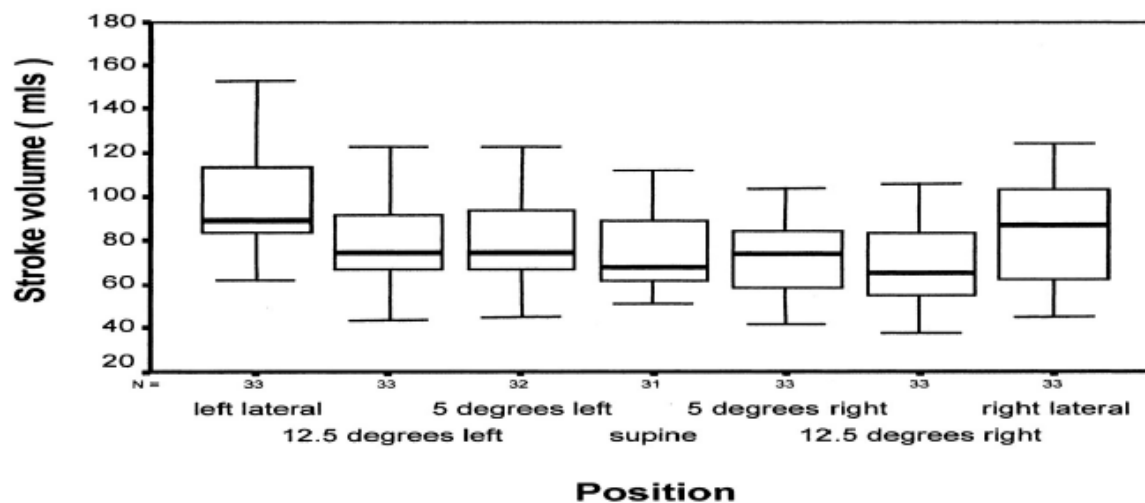
Speaker: Sanda-Maria Copotoiu

# Anestezia gravidelor pentru afecțiuni non-obstetricale

- I. Modificări fiziologice datorate sarcinei
- II. Fătul și anestezia
- III. Principii de management al anesteziilor gravidei
- IV. Particularități legate de tipul intervenției

- Hemodinamica și coagularea gravidei
- Modificările respiratorii
- Modificările digestive
- Modificările renale
- Modificările imunologice
- Modificările de interes pentru anestezist

# Modificări HD – VE în funcție de poziția mamei



**Figure 1:** Box plot of maternal stroke volume related to position (from Bamber J H, Dresner M Anesth Analg 2003;97:256-58)

## Modificările hemodinamice și hematologice

- ⑩ ↑↑ volumul plasmatic → → 50%
- Anemie fiziologică
- ⑩ ↑ perfuzia uterului ⊖ autoreglare
- hTA de la debut → decubit lateral stg
- ⑩ ↓ RVS
- Preeclampsie: hipovolemie semnificativă, hTA max săpt 28

## Aortocaval Compression and Uterine Displacement

KARL-LUDWIG ECKSTEIN, M.D.,\* AND GERTIE F. MARX, M.D.†

When the pregnant woman near term is supine, the enlarged uterus compresses the inferior vena cava<sup>1</sup> and partially obstructs the

lower aorta.<sup>2</sup> As a result, venous return to the heart and arterial blood flow to the pelvic organs and lower extremities are decreased. Pressure recordings obtained from women in labor show that, in the supine position, the uterus may divide the maternal circulation into two zones: distal to the point of obstruction, arterial pressure may be decreased, venous pressure increased, and blood flow decreased; proximal to the obstruction, aortic pressure may be increased.<sup>2</sup>

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**Figure 4.** Patient in a 30° left-lateral tilt using a firm wedge to support pelvis and thorax.



Figure 4. Patient in a 30° left-lateral tilt using a firm wedge to support pelvis and thorax.



Source: Tintinalli JE, Stapczynski JS, Ma OJ, Cline DR, Cyszkowski RK, Meckler OD: Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th edition; <http://www.emcrit.com>; Copyright © The McGraw-Hill Companies, Inc. All rights reserved.



## *BLS Modification: Relief of Aortocaval Compression*

Priorities for the pregnant woman in cardiac arrest are provision of **high-quality CPR** and **relief of aortocaval compression** (Class I, LOE C-LD).

If the fundus height is at or above the level of the umbilicus, **manual LUD** can be beneficial in relieving aortocaval compression during chest compressions (Class IIa, LOE C-LD).

High-quality CPR

Relief of aortocaval  
compression



**Lateral Uterine Displacement (LUD)**

Parametrul	Variațiile
DC	+ 50%
VE	+ 25%
FC	+ 25%
Vtelediastolic VS	↑
Vtelesisitolic al VS	→
FE	↑
Indexul lucrului mecanic al VS	→
PCWP	→
PdAP	→
PVC	→
RVS	De la 20 la 30%

- ⑩ ↑ Producția de factori ai coagulării
  - Rol protector – hemoragii
  - ↑ Risc complicațiilor tromboembolice
  
- ⑩ ↓ Albumina serică → 60% → ↓ capacității de legare a medicamentelor
  - ↓ globulinele serice
  - ↓ pres oncotice

Săptămâna	26-30	31-35	36-40	postpartum
Trombocite 10G/l	227 (124-331)	209 (101-317)	199 (91-308)	222 (91-352)
Fibrinogen	3,78 (2,67-5,35)	4,17 (2,90-6,00)	4,23 (2,90-6,15)	4,61 (2,98-7,14)
VII (%)	158 (75-332)	162 (84-312)	171 (87-336)	134 (70-255)
X (%)	126 (78-203)	123 (78-194)	127 (72-208)	117 (72-191)
V (%)	82	82	85	91
II (%)	124	115	115	112
VIIIc (%)	188	185	212	206
VIII R Ag (%)	203	292	376	421
AT (%)	94	87	86	87
Test von Kauulla(h)	18,25	22,25	17,80	6,25
PDF (µg/ml)	1,13	1,28	1,32	1,66

# Modificările respiratorii

- Progesteronul  $\rightarrow$   $\uparrow$  răspunsului la  $O_2 \rightarrow \uparrow V_T$

## Inducție rapidă

- ⑩  $\downarrow pCO_2$  3,7-4,2 kPa = 30-32 mmHg = alcaloză respiratorie
- ⑩  $\uparrow$  Consumul de  $O_2 \rightarrow 20\% \rightarrow \uparrow$  necesarul metabolic al fătului, uterului, placentei

## Preoxigenare scrupuloasă

# Modificările respiratorii cont

⑩ ↑Diafragmului → ↓ CRF → V/Q dezechilibru

⑩ ↑ ⊘ toracic → respirație diafragmatică

- Nu Trendelenburg → hipoxemie
- Nu decubit dorsal
- Edemul mucoaselor = CAD

# Modificări digestive

- Golirea lentă a stomacului  
Fără profilaxie antiacidă → → săpt 18 de sarcină
- ⑩ ↓ DS hepatic → 35%
- ⑩ ↑ Vol de distribuție → ↓ CI medicamentelor dependente de fluxul sanguin hepatic
- ⑩ ↑ Fluxul splanhnic, ↑ portal, ↑ peretelui venos esofagian  
varice esofagiene reversibile postpartum

⑩ ↑RFG cu 50% → ↓ creatininei serice < 0,8mg%

→ → → redefinirea IRA în sarcină – cr ser  
>1,0mg% (0,8)

→ → → ↓ dozajului medicamentelor

Glicozurie

Proteinurie – microalbuminurie val critică 300mg/24h



# Modificări imunologice

- Adaptarea răspunsului celular → toleranța imună a fătului
- Celulele T helper → cel de tip 2 = infecție

# Alte modificări de interes pentru anestezist

- Vene epidurale angorjate
- ⑩ ↓↓ Vol spațiului epidural → ↑ difuziei anestezicelor peridurale
- ⑩ ↑ Sensibilității la opioide și sedative
- Ventilația în PP → ↓ volemia mamei
- → ↓ fluxul sanguin uterin
- Hipertonia uterului + ↑ rezistenței vasculare uterine → ↓ debitul sanguin uterin

Ventilația trebuie să mențină  $paCO_2 = 30\text{mmHg}$

Denitrogenare cu  $FiO_2 = 1,0$

IOT secvență rapidă

# Alte modificări de interes pentru anestezist cont

- ⑩ ↑ Viteza de inducție cu volatile
- ⑩ ↑ Debitului ventilator, ↓ CRF
- Rata creșterii vaporilor anest >>> rata creșterii p a gazelor respiratorii

Recomandarea de ↓ concentrației anestezicelor în  
armonie cu ↓ MAC de 15-40%

Edemul mucoaselor

→ ↓ nr canulei traheale

CI IOT

# HELP Head Elevating Laryngoscopy Pillow



## Alte modificări de interes pentru anestezist cont

- Succinilcolina – dozaj nemodificat
- ⑩ ↑ Sensibilitatea musculorelaxantelor aminosteroides → ↓  
rocuroniu, vecuroniu
- Mortalitatea
- Mec:
  - depresie respiratorie
  - Colaps CV sever
- Cauze: aspirația, CICV, Int esofagiană, obstr CR, ascensiunea spinalelor, OCC insuf respiratorie, epidurala masivă, rr medic, sedative, hTA, HTA + cauze neidentificate!!!!

# Alte modificări de interes pentru anestezist cont

- Hiperlaxitate ligamentară
- Ramolirea țesuturilor moi

Relaxină = progesteron

- Accentuarea lordozei fiziologice
- Ramolirea ligg supra și interspinoase – reperarea spațiilor dificilă

## II. Fătul și anestezia

### Siguranța fătului!

–Perfuzia

–Oxigenarea

- Hiperoxigenarea mamei – inocuă
- Hipoxia mamei → vasoconstricție utero-placentară hipoxiema fatului acidoză → exit
- Hipocapnia → mamei vasoconstricției uterină

**Anticiparea și reversarea factorilor predispozanți pentru asfixia fetală!**

Majoritatea anestezicelor – transfer placentar...

## Efectele anesteziei loco-reagonale asupra fluxului sanguin uterin

### ↑ fluxului sanguin uterin

- ↓ durerilor travaliului
- ↓ activității simpatice
- ↓ hiperventilației materne

### ↓ fluxului sanguin uterin

- ↓ TA
- Injectarea iv accidentală AL ± adrenalină
- Resorbția sistemică a AL (efecte reduse)



# Principii de management al anesteziei gravidei

- Orice pacientă de vârstă fertilă (12 – 50 ani) poate fi însărcinată.
- Documentarea UM
- Test de sarcină retard 3 săpt
- ACOG – nu se vor amâna intervențiile chirurgicale cu indicație, chirurgia elective numai postpartum.
- ACOG – chirurgia care nu e urgentă – amânare pînă în trim II
- Planificare interv nonobstetricală – se anunță ginecologul + centru adecvat + neonatolog + calificare în interpretarea BCF!
- Discutarea preoperatorie a riscului teratogen!!!

## Efectele anestezicelor asupra debitului sanguin utero-placentar

Anestezicul /factori	Efecte asupra DSUP
Thiopental	↓de la 20-35% prin catecolaminele din timpul laringoscopiei și IOT
Etomidatul	Ca mai sus, nu previne răspunsul simpatic al IOT
Ketamina	Inocua pentru 1mg/kgc
Propofolul	Inocuu la 2mg/kgc
Volatile halogenate	Pt MAC 0,5-1,5 efecte minime
Ventilația mamei	Hiperventilația mamei cu hipocapnie →↓

**Table 2. Commonly used vasoactive drugs and pregnancy**

Drug	Teratogenicity	Side-effects	Recommendations
<b>Epinephrine</b>	Not observed	Reduction of uteroplacental perfusion (UPP)	For vital indications only As adjuvant drug in regional anaesthesia without concern
<b>Norepinephrine</b>	Not observed	As above	Strict indications only
<b>Dobutamine</b>	Not observed	No reduction of UPP	Prefer
<b>Cafedrine / Theodrenaline</b>	Not observed	Dose-dependent reduction of UPP	Avoid during 1 <sup>st</sup> trimester As above As above
<b>Etilefrine</b>	So far, not observed With high doses, embryotoxic effects cannot be excluded	Dose-dependent reduction of UPP	
<b>Ephedrine</b>			
<b>Phenylephrine</b>			
<b>β-Blockers</b>	Some reports of increased rates of deformity after atenolol	Reduced foetal weight gain, bradycardia and hypoglycemia if used until delivery	Prefer well proved drugs such as metoprolol
<b>α-Methyldopa</b>	Probably no teratogenicity	Some reports of hepatotoxic effects	1 <sup>st</sup> Choice drug
<b>Dihydralazine</b>	Not observed	As above	2 <sup>nd</sup> Choice drug
<b>Calcium channel blockers</b>	Not observed	Tocolytic effects; Verapamil: hyperprolactinaemia and galactorrhoea possible	2 <sup>nd</sup> Choice drugs, prefer well proved agents such as nifedipine or verapamil
<b>ACE-Inhibitors, AT-II-Receptor-Antagonists</b>	Unclear	Deficits in placental perfusion	Contraindicated
<b>Clonidine</b>			Not observed
<b>Digoxin</b>	Not observed		1 <sup>st</sup> Choice drug for foetal tachycardia
<b>Nitroglycerine</b>	Not observed	Tocolytic	Limited data on use during 1 <sup>st</sup> trimester

UPP = uteroplacental perfusion, ACE = angiotensin converting enzyme; AT = angiotensin (modified from Neindorff [13])

# Alegerea tipului de anestezie

Nu există tehnică anestezică optimă!

Anestezia regională pentru limitarea expunerii fătului și evitarea riscului CAD.

12 000 anestezii, mortalitate maternă 1/10 000

Riscul pierderii fătului: peritonită, apendicită

Necesarul de anestezice ↓↓

MAC ↓ cu 30%

Trezirea intraoperatorie ↑

MgSO<sub>4</sub>

Tocoliză perioperatorie

# Monitorizarea perioperatorie

## Standardele minime de siguranță – WFSA

- Normocarie *arterele spirale*
- Oxigenare
- Normotensiune
- Euglicemie
- BCF periop săpt 18-22; săpt 25-> variabilitatea BCF

## Chirurgia cardiacă

- Proteze valvulare –tromboză, tromboliză
- CEC
  - fluxuri de pompă de 2,5l/mp/min
  - PP >70mmHg
  - Ht >29%
  - Normotermie în interes fetal
  - Optimizarea val gazometriei – alfa-stat
  - Valvotomia pe balon > săpt 20 SM, SAo

## Left tilt position for easy extracorporeal membrane oxygenation cannula insertion in late pregnancy patients

William Ngatchou\*, Ahmed S.E. Ramadan, Guido Van Nooten and Martine Antoine

Department of Cardiac Surgery, Erasme Hospital, Université Libre de Bruxelles (ULB), Brussels, Belgium

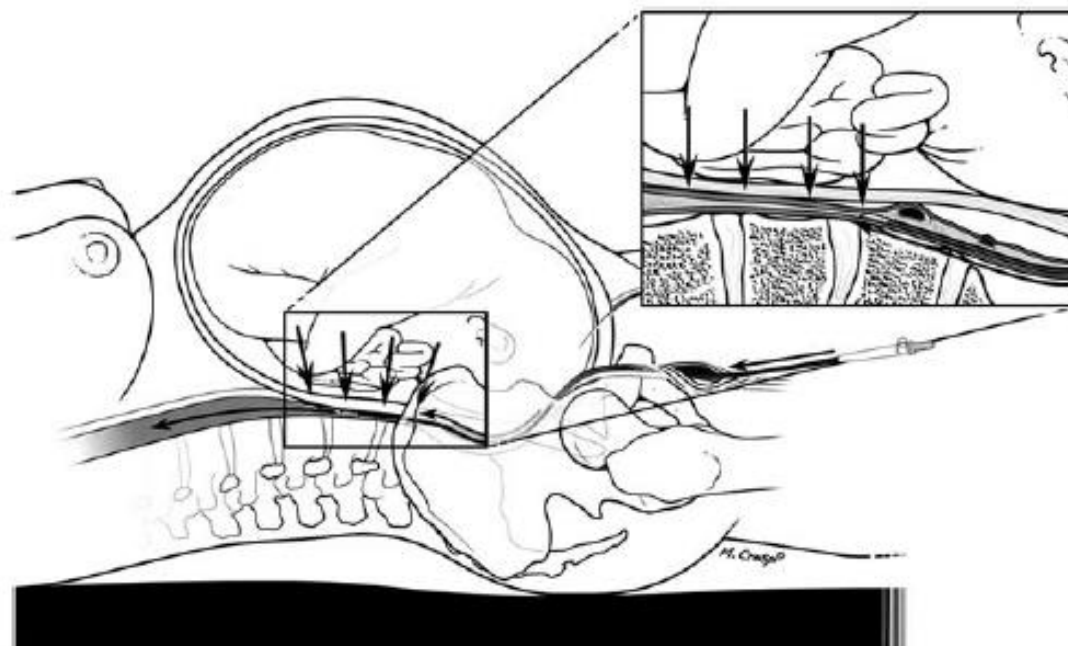


Figure 1: Vena cava compression avoiding the femoral cannula advancement.



# ECMO for ARDS

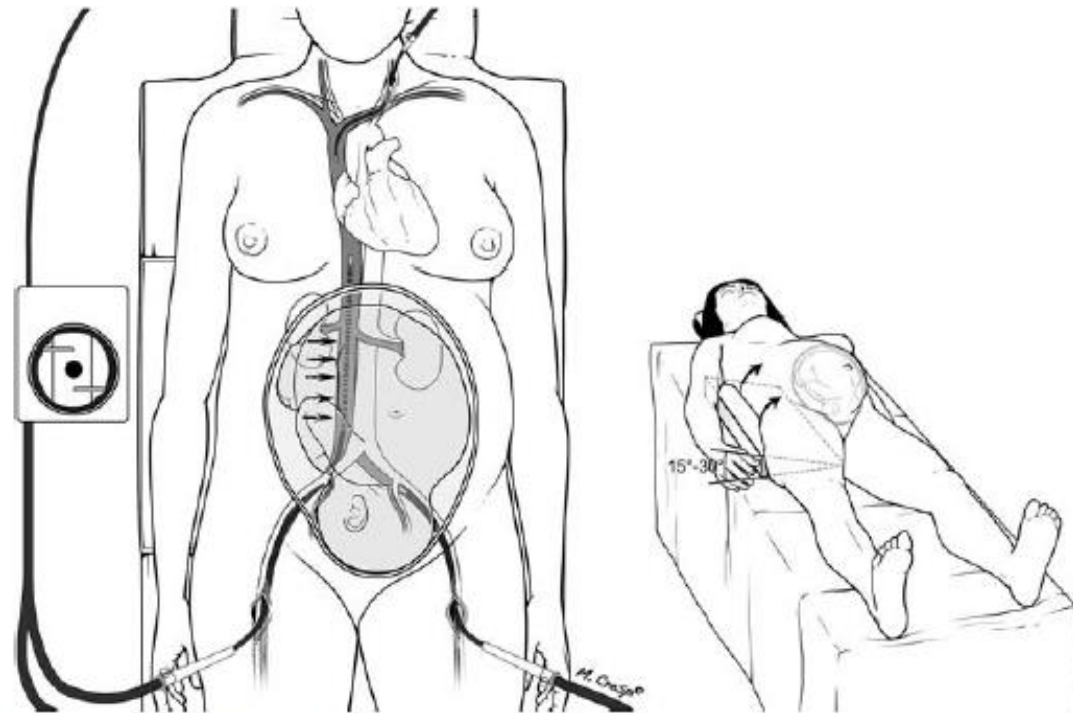


Figure 2: Left lateral tilt by a wedge-shaped cushion and the cannula in place.

## Embolizările malformațiilor pulmonare

- Malformații pulmonare arterio-venoase manif în timpul sarcinii

## NCH

- Hemoragii cerebrale
- + hTA controlată
- + hipotermie
- + stimularea diurezei
- +hiperventilație

# NCH riscuri suplimentare

## hTA controlată

- ✓ Acumularea cianaților – NPS
- ✓ NTG – ferestrele de NPS, nitriți metHb
- ✓ Clipuri vasculare proximal de leziune- evitarea inducerii hTA materne

hT – 30°C

Hventilația <  $paO_2$  3,3kPa

Diureza excesivă

**NEUROANAESTHESIA BACKGROUND for PLANNING / MANAGEMENT**

Pregnancy-Related Physiologic Changes

Uteroplacental Perfusion

Anaesthetic Drugs-Associated Effects on Foetus

**APPROACH: PROVIDE BALANCE BETWEEN THERAPY for MOTHER and RISKS for FOETUS**

**RISKS for FOETUS**

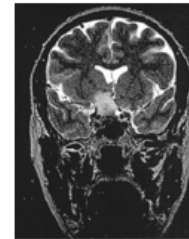
- HYPOXEMIA, ASPHYXIA
- TERATOGENICITY
- NEUROTOXICITY
- PRE-TERM LABOUR
- REDUCED UTERO-PLACENTAL PERFUSION



- HYPEROSMOLARITY / DEHYDRATION
- UTERINE ARTERY VASOCONSTRICTION
- HYPOTHERMIA

**NEUROANAESTHESIA**

- VENTILATORY / AIRWAY MANAGEMENT
- ANAESTHESIA
- HAEMODYNAMIC MANAGEMENT



**NEUROPROTECTIVE MEASURES**

- HYPEROSMOLAR SOLUTIONS
- HYPERVENTILATION
- HYPOTHERMIA

**NEUROANAESTHETIC GOAL**

**OPTIMAL CARE for MOTHER and MINIMIZATION of HARM for FOETUS**

# Chirurgia laparoscopică

SAGES 1/500-650 gravide necesită intervenții nonobstetricale

## Urgențele cele mai frecvente



Apendicita

Colecistita

Ocluzia int

Chiste ovariene

Tu, torsiuni

Colelitiaza simptomatică

Tu suprarenale

Patologia splinei

Hernii simptomatice

Complicațiile bolii inflamatorii intestinale

Dureera abd de etiol necunoscută

- Echografiile
- Doza radiantă cumulativă max 5-10rad pe durata sarcinii
  - CT pelvian - făt 2rad, 5 rad ex complet abd
- RMN - oricând fără gadoliniu, surditate
- Med nucleară – Th99 expunere fetală max 0,5rad
- Colangiografie introp – risc mic, protecție sorț Pb
- Laparoscopia dg – sigură
- Poz decubit lat stg
- Profil trombembolism – compresii, mobilizare
- ERCP preoperator + sfincterotomie + colecitectomie
- !! Nu tocolitice profilactc preoperator, avute în vedere în cazul travaliului prematur.

## Radiation Exposures from Interventional Procedures for Complications of Pregnancy

Procedure	Radiation Dose (mSv)
US-guided chemical ablation of ectopic pregnancy	0
Bilateral UAE	22–32*
US-guided ovarian cyst aspiration	0
US-guided abdominopelvic abscess drainage	0
CT-guided abdominopelvic abscess drainage	9.5–14†
Percutaneous nephrostomy	6.9‡
Suprapubic cystostomy with trocar technique	0.1–0.76§
Suprapubic cystostomy with Seldinger technique	9.1§

### Interventional Radiology in Pregnancy Complications: Indications, Technique, and Methods for Minimizing Radiation Exposure<sup>1</sup>

TEACHING POINTS  
See last page

ONLINE-ONLY CME

Ashraf Thabet, MD • Sanjeeva P. Kalva, MD • Bob Liu, PhD • Peter R. Mueller, MD • Susanna I. Lee, MD, PhD



## STANDARDS OF PRACTICE

# **Radiation Management for Interventions Using Fluoroscopic or Computed Tomographic Guidance during Pregnancy: A Joint Guideline of the Society of Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe with Endorsement by the Canadian Interventional Radiology Association**

Lawrence T. Dauer, PhD, CHP, Raymond H. Thornton, MD, Donald L. Miller, MD,  
John Damilakis, PhD, Robert G. Dixon, MD, M. Victoria Marx, MD, Beth A. Schueler, PhD,  
Eliseo Vañó, PhD, Aradhana Venkatesan, MD, Gabriel Bartal, MD, Dimitrios Tsetis, MD, PhD,  
and John F. Cardella, MD, for the Society of Interventional Radiology Safety and Health  
Committee and the Cardiovascular and Interventional Radiology Society of Europe Standards  
of Practice Committee



**Table 1. Deterministic Radiation Effects at Different Stages of Gestation (9,14,15,22,25,26,28–32)**

Stage of Gestation (wk)	Possible Radiation Effect	Dose Characteristic	Estimated Threshold Dose (mGy)
3–4	Most sensitive period for the induction of embryonic death	Minimum lethal dose (from animal studies)	100–200
4–8	Embryo is also predisposed to the induction of major malformations and growth retardation	Minimum lethal dose (from animal studies)	250 (at 18 d), >500 (at >50 d)
8–15	Most sensitive period for irreversible whole-body growth retardation, microcephaly, and severe mental disability	Minimum dose for growth retardation	200–500
		Minimum dose for growth retardation	250–500
		Threshold for severe mental disability	60–500
16-Term	Higher exposures can produce growth retardation and decreased brain size and intellect, although the effects are not as severe as occurs from similar exposures during midgestation	Decrease in IQ can occur at lower doses	~100
		Microcephaly	≥20,000
		Minimum lethal dose (from animal studies)	>1,500
		Minimum dose for severe mental disability	>1,500
		Decrease in IQ can occur at lower doses	>100

Note.—IQ = intelligence quotient.

**Table 5. Estimated Conceptus Absorbed Dose from Common Abdominal and Pelvic Radiologic Procedures (9,15,20,62,68,70,88,89,92,94–103)**

Examination	Nominal Fetal Dose "Typical Estimate" (mGy)	Reported Range (mGy)	References
Lumbar/lumbosacral spine	4	0.20–40.0	9, 20, 70, 88, 89, 92
Abdomen (KUB)	4	0.21–19.0	9, 20, 70, 88, 89, 92, 96
Abdomen	1.4	1.4–4.2	15
Abdomen (21-cm-thick patient)	1	–	20
Abdomen (33-cm-thick patient)	3	–	9, 20
Pelvis	2	0.16–22.0	9, 70, 89, 92
Film pelvimetry	10	0.35–55.0	70, 97, 98
Digital pelvimetry	0.5	0.05–0.35	70, 97
Hips and femur	3	0.73–14.0	70, 92
Hip fracture fluoroscopy, first trimester	–	0.09–0.125	95
Hip fracture fluoroscopy, second trimester	0.127	–	95
Hip fracture fluoroscopy, third trimester	0.155	–	95
Bone density: spinal and hip dual x-ray	–	0.002–0.005	99
Urography, IV or retrograde pyelogram	6	0.70–55.0	70, 89, 92
Urethrocytography	–	2.70–41.0	70
Urinary bladder (anterior–posterior)	3.9	0.56–11.0	89
CT, abdomen (routine)	10	4–60	15, 20, 70, 92, 94, 96, 103
CT, abdomen (renal stone protocol)	10	4–10	20, 94
CT, appendicitis	16	4–45	62, 94, 100
CT, abdomen, second trimester	–	30–44	101
CT, abdomen, third trimester	–	29–42	101
CT, pelvimetry (single slice)	2.5	1.6–5	70, 98
CT, trauma (chest/abdomen/pelvis) first trimester	–	9.25–37.7	102
CT, pelvis	25	6.7–114.0	9, 15, 68, 89
CT, lumbar spine	2.5	2–8.6	9, 15, 89
CT, liver	3.6	2.0–4.4	89

Note.—KUB = kidneys, ureters, and bladder.

# Mielomeningocel intrauterin

1/1 500 nașteri

La termen, trat chir imediat postnatal

Intrauterin: risc materno-fetal

Major pentru mamă și făt!

Complicații semnific acute postoperatorii!

MOMS trial 2002 Management of Myelomeningocele  
Study

## Includere în chirurgia fetală

- Mielomeningocel T1-S1
- Malformații Chiari II
- Kariotip normal – amniocenteză
- Vârsta gestațională 19-26 săpt

## Ghid de excludere

- Sarcină multifetală
- CI materne pt chirurgie, anestezie
- BMI > 35
- Izoimunizare materno-fetală
- Anomalii uterine
- Lipsa complianței la recomandări

Published in final edited form as:

*N Engl J Med*. 2011 March 17; 364(11): 993–1004. doi:10.1056/NEJMoa1014379.

## A Randomized Trial of Prenatal versus Postnatal Repair of Myelomeningocele

N. Scott Adzick, M.D., Elizabeth A. Thom, Ph.D., Catherine Y. Spong, M.D., John W. Brock III, M.D., Pamela K. Burrows, M.S., Mark P. Johnson, M.D., Lori J. Howell, R.N., M.S., Jody A. Farrell, R.N., M.S.N., Mary E. Dabrowiak, R.N., M.S.N., Leslie N. Sutton, M.D., Nalin Gupta, M.D., Ph.D., Noel B. Tulipan, M.D., Mary E. D'Alton, M.D., and Diana L. Farmer, M.D. for the MOMS Investigators\*

**Results**—The trial was stopped for efficacy of prenatal surgery after the recruitment of 183 of a planned 200 patients. This report is based on results in 158 patients whose children were evaluated at 12 months. The first primary outcome occurred in 68% of the infants in the prenatal-surgery group and in 98% of those in the postnatal-surgery group (relative risk, 0.70; 97.7% confidence interval [CI], 0.58 to 0.84;  $P < 0.001$ ). Actual rates of shunt placement were 40% in the prenatal-surgery group and 82% in the postnatal-surgery group (relative risk, 0.48; 97.7% CI, 0.36 to 0.64;  $P < 0.001$ ). Prenatal surgery also resulted in improvement in the composite score for mental development and motor function at 30 months ( $P = 0.007$ ) and in improvement in several secondary outcomes, including hindbrain herniation by 12 months and ambulation by 30 months. However, prenatal surgery was associated with an increased risk of preterm delivery and uterine dehiscence at delivery.

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**Conclusions**—Prenatal surgery for myelomeningocele reduced the need for shunting and improved motor outcomes at 30 months but was associated with maternal and fetal risks. (Funded by the National Institutes of Health; [ClinicalTrials.gov](http://ClinicalTrials.gov) number, NCT00060606.)

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# Cik Damadian

