Sacrococcygeal teratoma

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- Teratoma
  - Embryo and pathology
  - Genetics
  - Associated anomalies

- Sacrococcygeal teratoma (SCTs)
  - Diagnostic
  - Differential diagnosis
  - Investigation
  - Type
  - Management : Thai POG
  - Surgical management
  - Follow up

Teratoma

- Teratos = “ of the monster”
  onkoma = “ swelling ”

- Teratoma compose of **multiple tissues foreign to the organ or site which they arise**
- **Recent classification include monoderm type**
- **SCTs is the most common**

Teratoma embryo & pathology

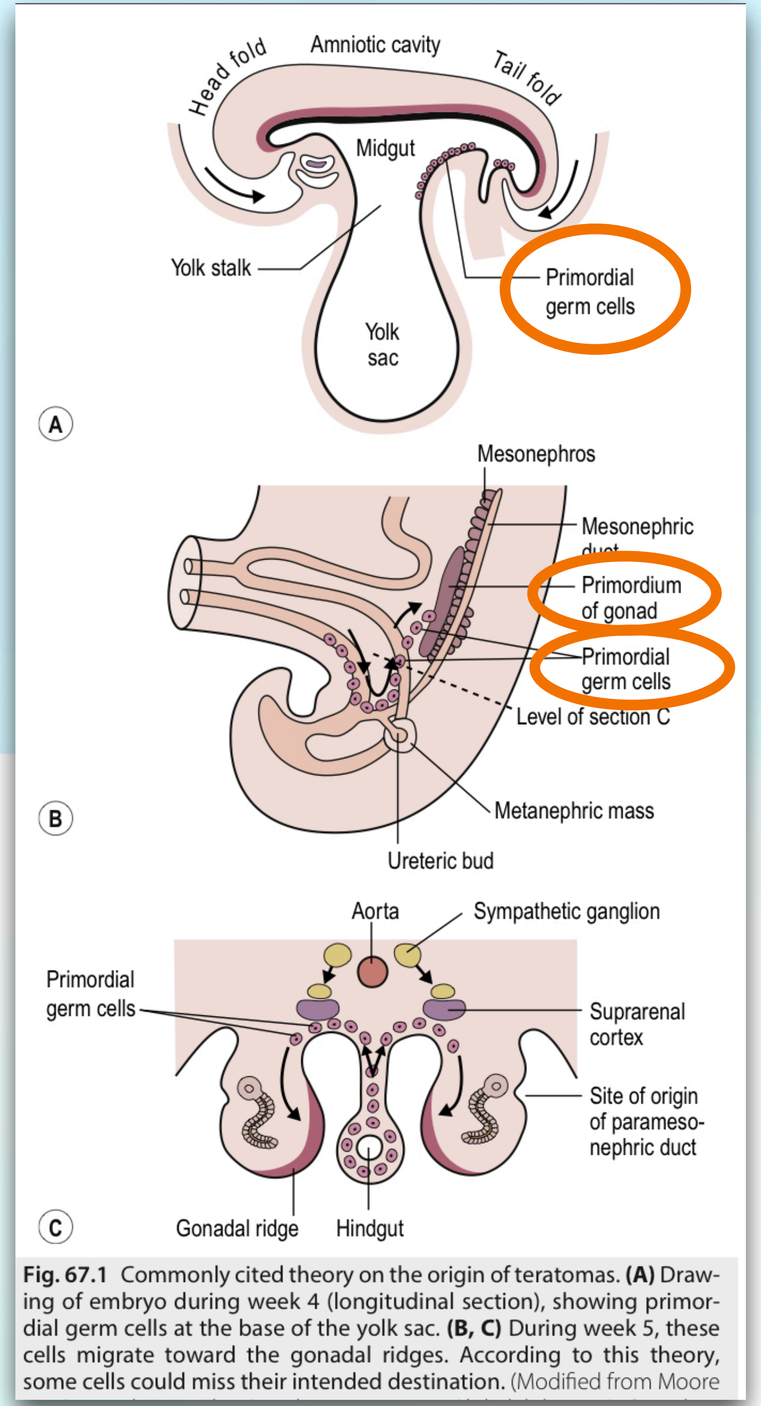


Fig. 67.1 Commonly cited theory on the origin of teratomas. **(A)** Drawing of embryo during week 4 (longitudinal section), showing primordial germ cells at the base of the yolk sac. **(B, C)** During week 5, these cells migrate toward the gonadal ridges. According to this theory, some cells could miss their intended destination. (Modified from Moore

1st Theory

- Arise from **totipotent primodial germ cell**
- GA 4-5 wk :
  - Migrate to gonadal ridge
  - Some cells miss their destination > teratoma in midline

Teratoma embryo & pathology

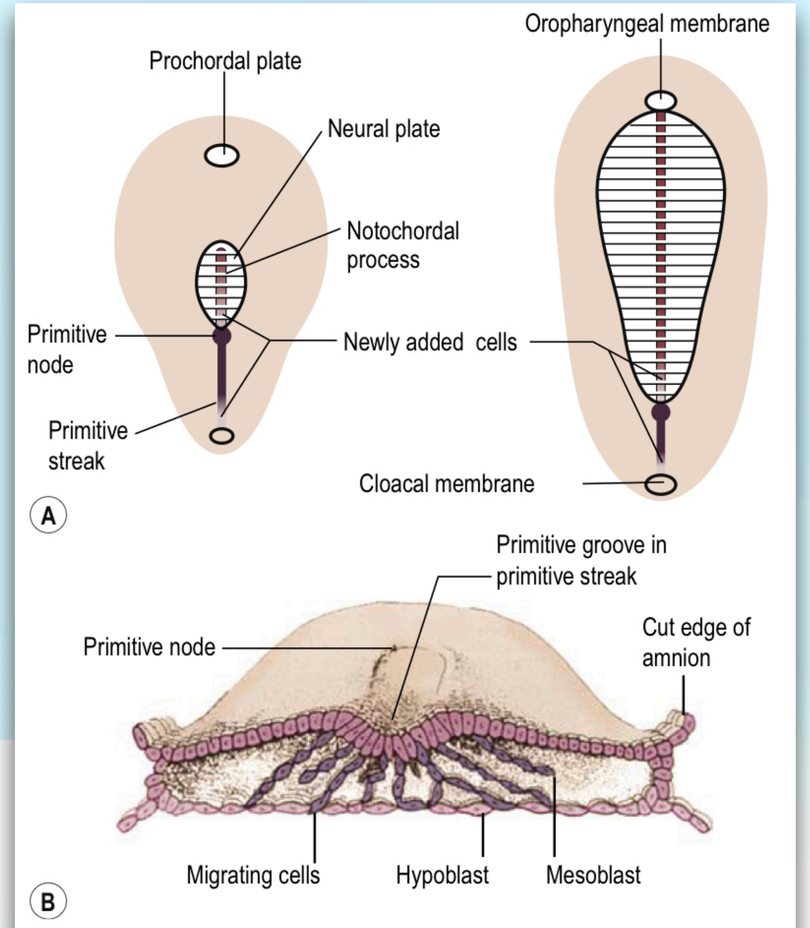


Fig. 67.2 Alternative theory on embryogenesis of teratomas. **(A)** Sketches of dorsal views of the embryonic disk on days 17 and 18, showing the primitive streak and primitive node. **(B)** Drawing of a transverse cut of the embryonic disk during week 3. This shows that cells from the primitive streak migrate to form the mesoblast (the origin of all mesenchymal tissues) and also displace the hypoblast to form the endoderm. Hence, remnants of these pluripotent primitive streak cells could give rise to teratomas and could account for the more frequent sacrococcygeal location. (From Moore KL, Persaud TVN. The Developing Human. Philadelphia: WB Saunders; 1993. pp. 55–56.)

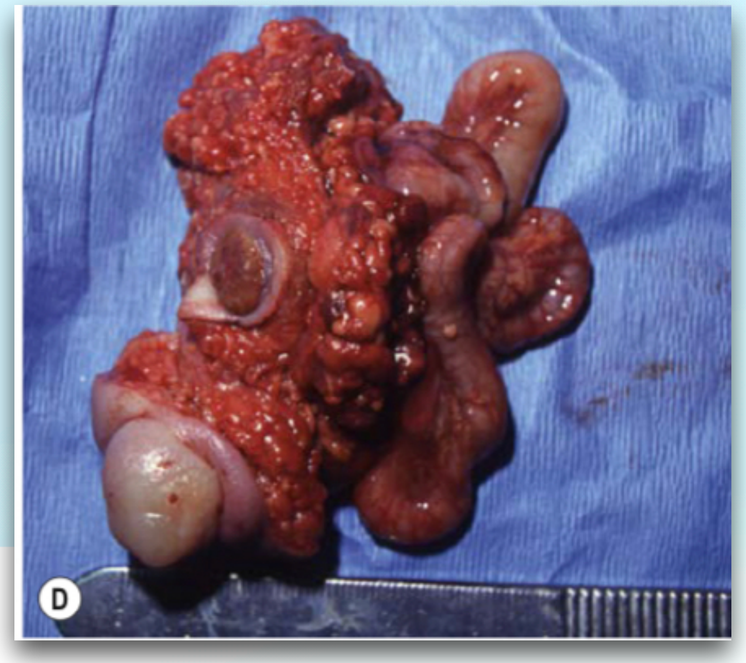
2nd Theory

Arise from **remnant of primitive streak/ primitive node**

- GA 3 wk , midline cell at caudal divide rapidly
  - **gastrulation**, give raise to 3 germ layers of embryo
  - primitive streak **shorten and disappears**
- **Explain more common in location at sacrococcyx**

3rd Theory

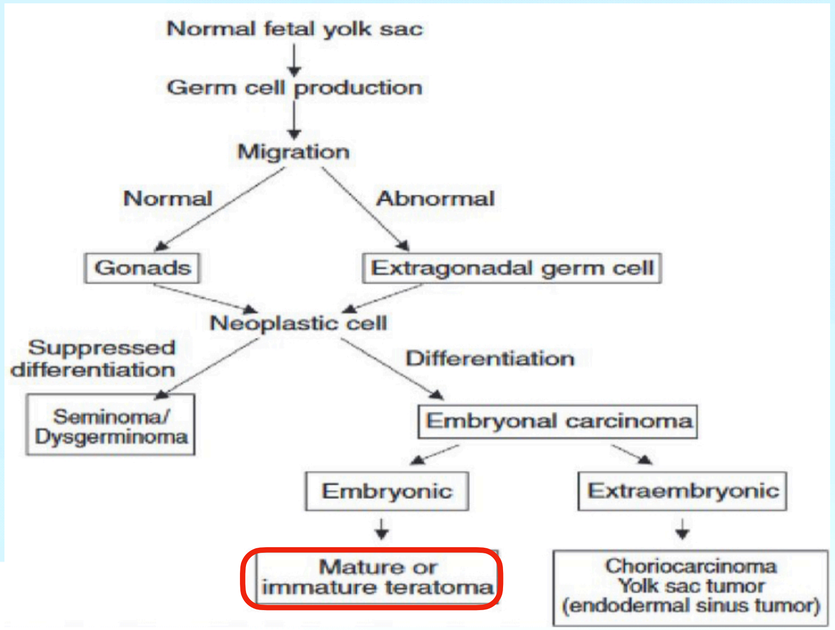
Form of incomplete twin



Teratoma embryo & pathology

- **tissue** : skin, teeth, neural tissue, fat, cartilage, intestinal mucosa with normal ganglion cell

- ***Fetiform teratomas*** : Small bowel, limbs, beating heart
- ***Fetus-in-fetu*** : vertebrae/notochord and high organized organ



Teratoma embryo & pathology

- 25% of germ cell tumor are **mixed tumor**

- **Mature** teratoma : well differentiated tissue
- **Immature** teratoma : neuroectoderm

  Graded 1-3

  base on number of low-power fields of primitive neuroepithelium

Teratoma embryo & pathology

Malignancy

- May **contain or develop foci of malignancy**
- Most common malignant component = **YST** (formerly called endodermal sinus tumor)
- Other : neuroblastoma, squamous cell carcinoma, carcinoid
- **Malignant at birth is uncommon, but increase with age & incomplete resection**

Genetics

- Not yet understood
- Most germ cell tumor have **amplification, isochromosome 12p**
- **MYCN gene amplification**
  present in immature teratoma,
  absent in mature teratoma in one study
- **BAX mutation and overexpression**
  correlated with survival in one study

Associated anomalies

Currarino triad

- 1. ARM : anal/anaorectal stenosis is the most common
  2. sacral anomaly
  3. presacral mass : teratoma, anterior meningocele
     Maybe combination with harmatoma, duplication cyst, dermoid cyst

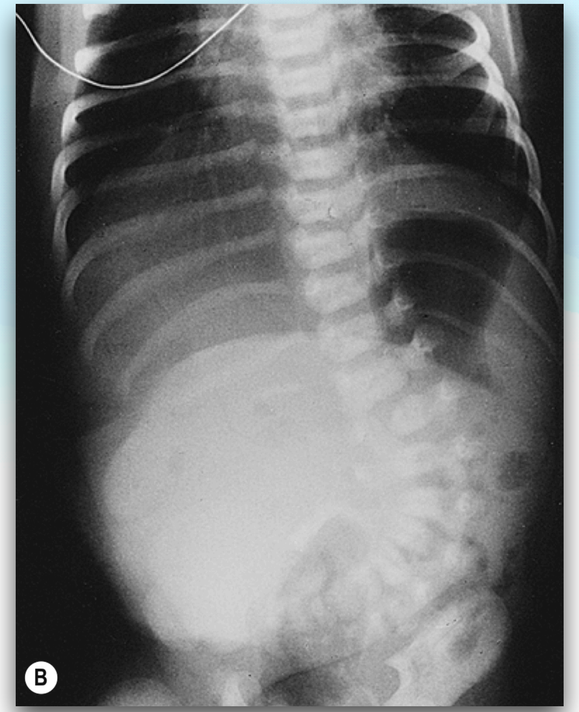
- Female : male
  1.5 : 1
  Present with constipation
  20% of patient's age > 12 years

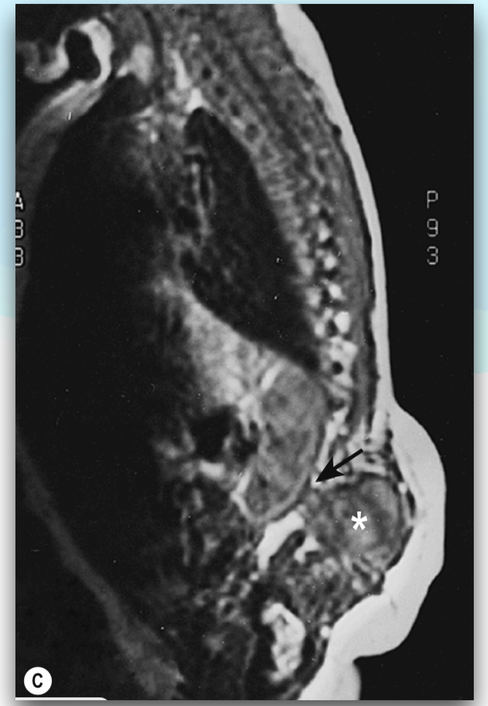
- Malignant transformation 1%

- 57% has autosomal dominant inherritence pattern
- **MNX1 gene** in familial form

Associated anomalies

- **Hypospadias**, **VUR**
- **Vagina or uterine duplication** : usg pelvis
- Congenital **hip dislocation** : 7%
- Vetebral anomalies
- **Anencephaly, trigonocephaly, Dandy-walker, spinabifida, myelomenongocele**





Sacrococcygeal teratoma

Sacrococcygeal teratoma (SCTs)

- **Rarely malignancy**

- **Risk factor malignancy** depend on
  1. **Site**
  2. **Extent**
  3. **Age**

     >= 2 months high rate malignancy

- **Hidden pelvic tumor : higher rate malignancy**

- Risk malignancy
  - <10% at birth
  - 40-75% after age 1 years

Incidence

Table 67.1 Relative Frequency of Teratomas by Site*

Site	Number of Cases (%)
Sacrococcygeal	290 (45)
Gonadal	
Ovary	176 (27)
Testis	31 (5)
Mediastinal	41 (6)
Central nervous system	30 (5)
Retroperitoneal	28 (4)
Cervical	20 (3)
Head	20 (3)
Gastric	3 (<1)
Hepatic	2 (<1)
Pericardial	1 (<1)
Umbilical cord	1 (<1)
Total	**643 (100)**

- Most common : extragonadal
- 35-60% of teratoma
- Incidence 1 per 35,000-40,000 live births

- Female : Male
  3 : 1

Diagnosis

- **Prenatal diagnosis**

- Visible mass at birth protruding from coccygeal region
  Pushing anus and vagina anteriorly
- High output heart failure
- DIC
- Tumor rupture, ulcer
- Tumor bleeding
- Tumor necrosis : hyperkalemia

- Constipation
- urinary obstruction
- PR : intact sacrum above mass = complete resection in prone position

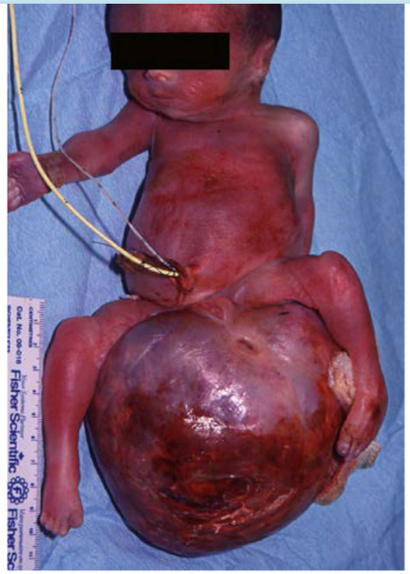
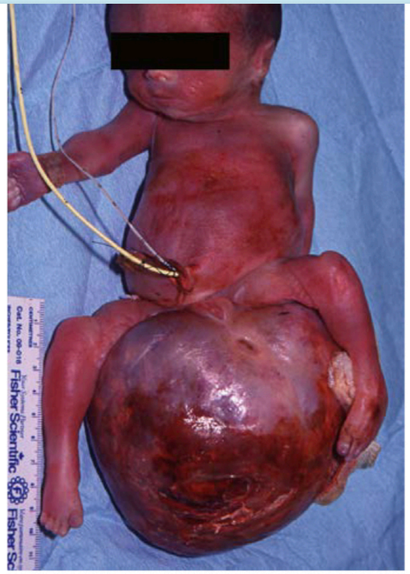


Fig. 67.5 This infant was diagnosed with a large sacrococcygeal teratoma in utero. Within days, premature labor occurred, prompting cesarean delivery at 25 weeks of gestation. The baby died despite resuscitation attempts.

Prenatal diagnosis

- **USG**
  - site
  - intrapelvic extension ?
  - urinary obstruction?

- **Significant mortality rate**
  - large solid vascular tumor
  - prematurity
  - rupture with exsanguination
- **Cesaren section : avoid ruptured & dystocia**
  - size > 5 cm
  - size > BPD
- **Urgent cesarean section : placentomegaly & hydrop**
- **Emergency cesarean section : maternal mirror syndrome**



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Prenatal diagnosis

- **Poor prognosis**
  - greater than BPD at diagnosis
  - grow faster than 150 mL/week

- **Vascular shunting within tumor**
  High output heart failure
  Placentomegaly, Hydrops : impending fetal death

- **Fetal anemia** from intratumoral bleeding

Prenatal diagnosis

- **Open fetal surgical excision/ debulking**
  too preterm to deliver

- **Other therapeutic**
  - intrauterine endoscope laser ablation of large feeding artery
  - alcohol injection
  - RFA
  - percutaneous aspiration
    Pure cystic teratomas (10-15%)

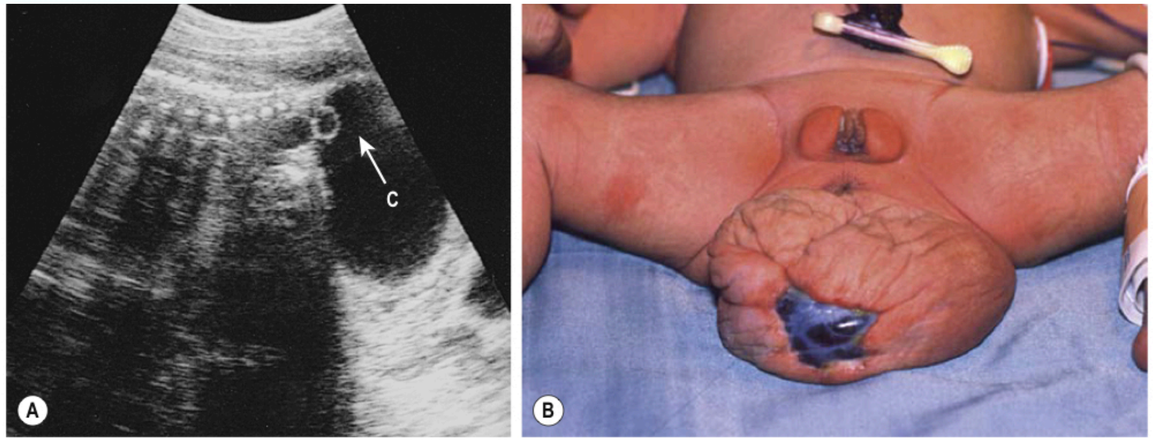


Fig. 67.7 **(A)** Ultrasound image of a female fetus at 38 weeks of gestation, showing a large cystic mass (C) attached to the coccyx, with tiny cysts anterior to the sacrum (arrow). An ultrasound evaluation at 18 weeks was normal. The cyst was gradually enlarging from an initial diameter of 9.5 cm at 31 weeks of gestation. The cyst was aspirated for 650 mL of fluid, permitting external rotation from breech to the vertex position. Two days later, when labor was induced, another 200 mL of fluid was removed to permit an uncomplicated vaginal delivery. **(B)** Twenty-four hours postnatally, the lesion remained floppy with an area of skin ulceration, likely a consequence of excessive in utero distention. A mature cystic teratoma was confirmed histologically.

Differential diagnosis

- **Meningocele**
  - cystic
  - cephalad to sacrum, maybe anterior sacral defect
  - covered by dura, skin
  - **bulging fontanelle with gentle pressure on sacral meningoce**
  - USG, MRI confirm

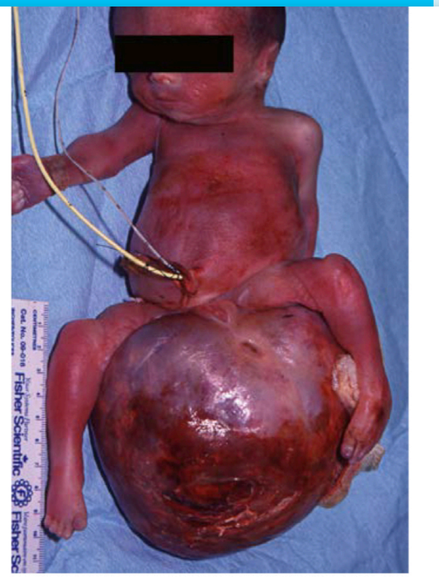
Familial form teratoma

coexistence **meningocele with teratoma**

Teratoma

usually presacral

- **Lymphangioma**
- **Lipomas**
- **Tail-like remnant**



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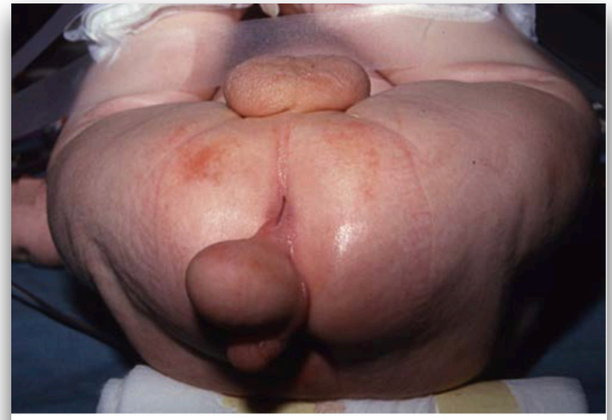


Fig. 67.6 This patient had a scrotum-like perianal mass with anal stenosis at birth. An anoplasty was done with removal of the mass, which was not attached to the coccyx. Pathologic examination showed only fibroadipose tissue with smooth muscle, vascular structures, and cartilage, consistent with a hamartomatous process or caudal vestige (also called a tail remnant).

Investigation

- **Elevate AFP**
  turn normal at 9 months
  assessing presence of residual or recurrence
  post-op half life 6 days
- **Elevate Beta-hCG**
  produce by choriocarcinomas
  cause precociuos puberty
- **CA 125**
  used for follow up
- **Plain film AP ,lateral spine & pelvis**
  calcification
  spine defect
- **USG spine & pelvis**
- **CT, MRI :** vascular supply

Stage

Extragonadal germ cell tumors:

Stage	Extent of disease
I	Complete resection at any site, coccygectomy for sacrococcygeal site, negative tumor margins.
II	Microscopic residual: lymph nodes negative.
III	Lymph node involvement with metastatic disease. Gross residual or biopsy only; retroperitoneal nodes negative or positive.
IV	Distant metastases, including liver.

Type : Altman’s study

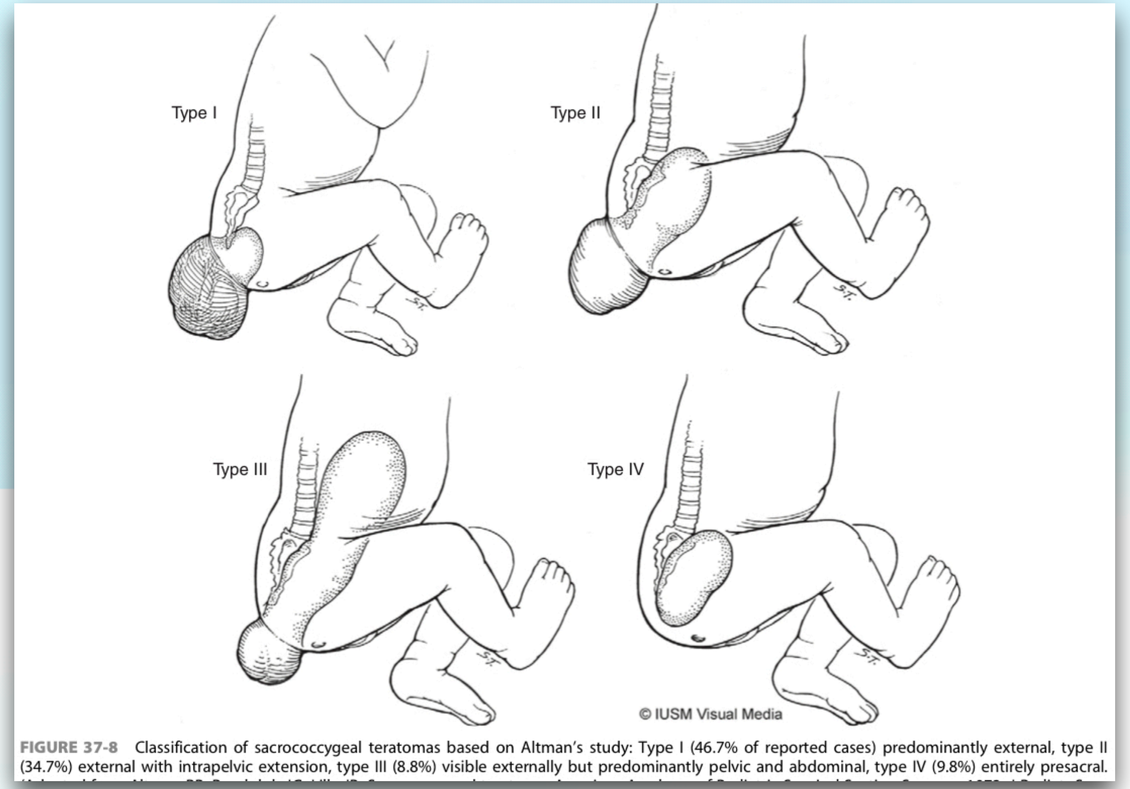
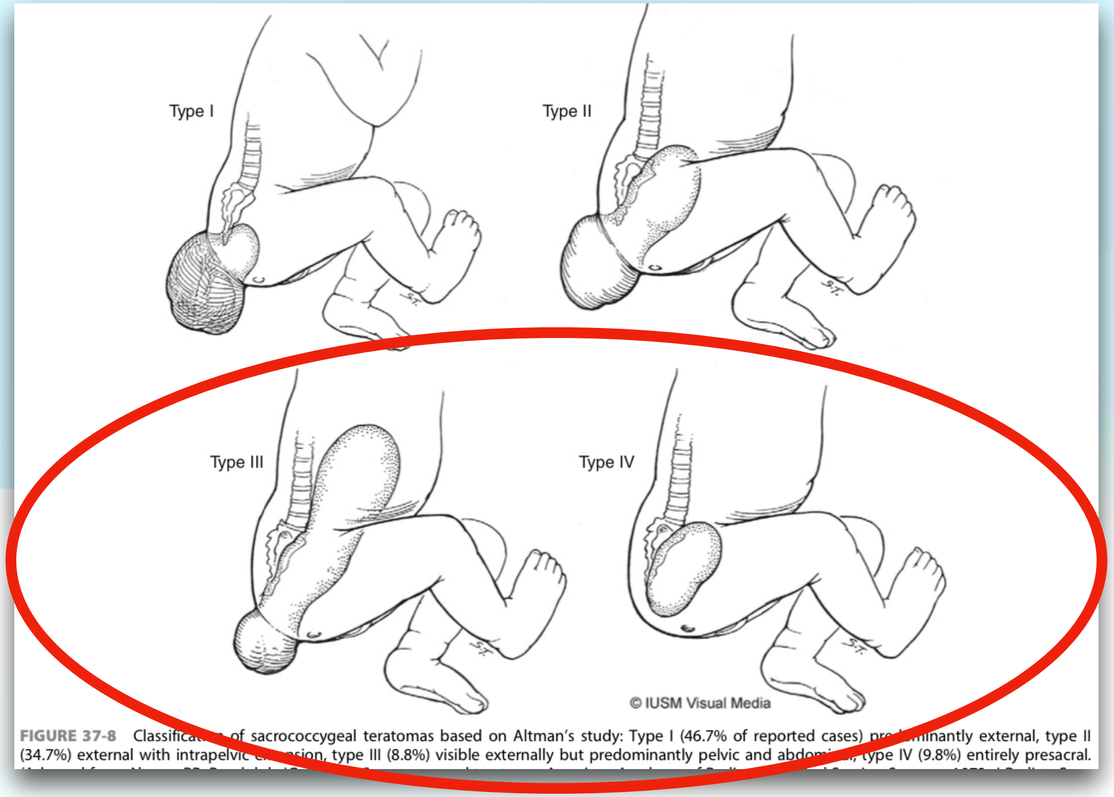


FIGURE 37-8 Classification of sacrococcygeal teratomas based on Altman’s study: Type I (46.7% of reported cases) predominantly external, type II (34.7%) external with intrapelvic extension, type III (8.8%) visible externally but predominantly pelvic and abdominal, type IV (9.8%) entirely presacral.

	% Malignancy
• Type I : almost exclusively exterior, minimal pelvic component	0%
• Type II : significant pelvic component	6%
Type III : Intra-abdominal bigger than external component	20%
Type IV : exclusively presacral	8%

Type



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- **More hidden lesion, more malignancy**
  (Type III, IV)

Management : Thai POG

สรุปแนวทางการรักษาผู้ป่วย **extracranial germ cell tumors**ตามตำแหน่งของก้อน, **histology** และ staging

Histology	Primary site	Stage	Treatment
Mature teratoma	All sites	Localized	Surgery +observation
Immature teratoma*	All sites	Localized	Surgery +observation
Germinoma and malignant germ cell tumors	Testicular	Stage 1	Surgery +observation
		Stage 2-4	Surgery+ standard PEB
	Ovary	Stage 1**	Surgery +observation
		Stage 2-4	Surgery+ standard PEB
	Extragonadal	Stage 1-2	Surgery+ standard PEB
		Stage 3-4	Surgery+ standard PEB

ขนาดของยาเคมีบำบัด PEB และ JEB

Regimen	Bleomycin	Etoposide	Cisplatin	Carboplatin
Standard-PEB (every 21days)	15 units/m^2, day 1	100 mg/m^2, day 1-5	20 mg/m^2, day 1-5	
JEB (every 21-28 days)***	15 units/m^2, day 1	120 mg/m^2, day 1-3		600 mg/m^2, day 2

* Immature teratoma ถ้า intraoperative tupture หรือ incomplete removal พิจาณาให้ยาเคมีบำบัด PEB
Immature teratoma grade III ที่ตำแหน่ง sacrococcygeal พิจารณาให้ยาเคมีบำบัด PEB หลังผ่าตัด

EXTRAGONADAL GERM CELL TUMORS:

Stage	Extent of Disease
I	Complete resection at any site, coccygectomy for sacrococcygeal site, negative tumor margins.
II	Microscopic residual; lymph nodes negative.
III	Lymph node involvement with metastatic disease. Gross residual or biopsy only; retroperitoneal nodes negative or positive.
IV	Distant metastases, including liver.

Management : Thai POG

❑ **PEB regimen**

Given dose	Drug	Dosage	Day
_____mg	Cisplatin	20 mg/m^2 IV drip in 6 hr	1-5
_____mg	Etoposide	100 mg/m^2 IV drip in 1-2 hr	1-5
_____U	Bleomycin	15 unit/m^2 IV push	1

❑ **JEB regimen**

Given dose	Drug	Dosage	Day
_____mg	Carboplatin	600 mg/m^2 IV drip in 1 hr	2
_____mg	Etoposide	120 mg/m^2 IV drip in 1-2 hr	1-3
_____U	Bleomycin	15 unit/m^2 IV push	1

- ❑ Repeat chemotherapy every 3-4 weeks
- ❑ ANC >1,000 /μL and platelet count >100,000 /μL before start chemotherapy
- ❑ Blood for LFTs, tumor markers before each course of chemotherapy
- ❑ If BW <12 kg or age <12 months, calculate chemotherapeutic agent dose per kg

Treatment course	Date	AFP	β-hCG	Hearing test	Remarks
I					
II					
III					
IV					
surgery					
V					
VI					

พิจารณาให้ G-CSF 5 µg/ kg SC OD, Start หลังให้ยาเคมีบำบัดครบ 24 ชม.ในกรณีที่ผู้ป่วยเคยมี febrile neutropenia มาก่อนเท่านั้น

Management : Thai POG

แนวทางติดตามการรักษาหลังหยุดยาเคมีบำบัดหรือหลังผ่าตัดแล้วไม่ได้ให้ยาเคมีบำบัด

- Tumor marker: AFP and/or β–hCG ทุก 1-2 เดือน ใน 6 เดือนแรก หลังจากนั้น ทุก 3 เดือน
- CT or MRI ที่ primarytumor site ทุก 4 เดือนในปีแรก หลังจากนั้น ทุก 6 เดือน
- ในกรณีที่ได้ cisplatin พิจารณาตรวจการได้ยิน ก่อนให้ยา และหลังให้ยาครบ 4-6 ครั้ง

Response criteria

Complete Response (CR)

No evidence of disease by imaging studies and normal tumor markers. β-HCG must be normal. Patients with AFP ≤40,000 ng/mL at diagnosis must have a normal AFP. For patients with an AFP >40,000 ng/mL at the beginning of chemotherapy, an AFP above normal, but consistent with a half-life fall off of 7 days will be considered CR.

Partial Response (PR)

Radiographic reduction of at least 50% in the size of all measurable tumors and reduction of tumor markers more than 90% or normalization of markers.

Non-Response

Non-responders will include patients with <50% decrease and no more than 25% increase in tumor size. Patients with markers declining slower than defined for partial Response

Surgical management

Preoperatively

- Time

  If infant is stable : no need for immediate resection
- Preoperative ATB and continue for 24-48 hrs
- G/M blood
- AFP level for baseline
- NG
- Foley’s cath
- Rectum maybe prep for digital manipulation

Ruptured tumor

- **emergency surgery due to blood loss**
- pressure bandage
- or suture with pledgets

Surgical management

Position

- **Most** resection can be completely in **prone jack-knife position**
- In doubt : prep skin lower chest - toes
- Intra-abdominal , intrapelvic, highly-vascular and bleeding within tumor
- Laparotomy Vs. laparoscope

- **Vaseline packing in rectum**
  - identify rectum
  - pack for reduce content
- **En bloc resection, including cocyx is preferable**
  - fail remove cocyx : high recurrence rate (37%)
- **Reconstruct gluteal crease and perineum**
  - cosmetic
  - use plastic surgery principles

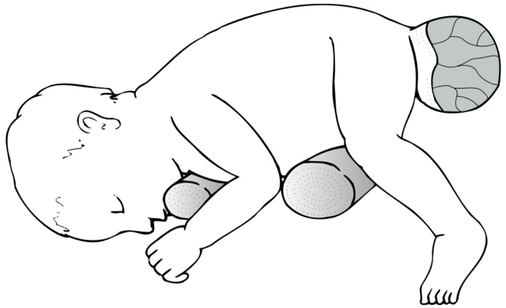
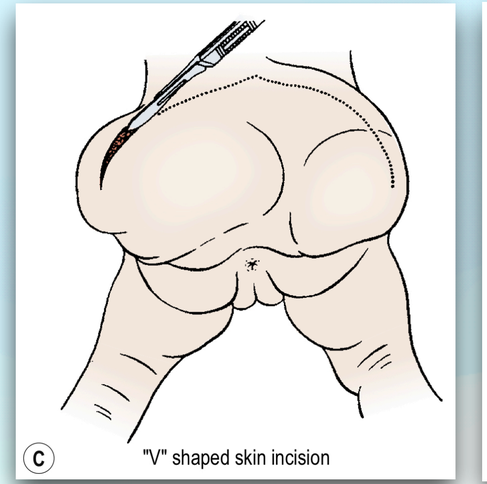


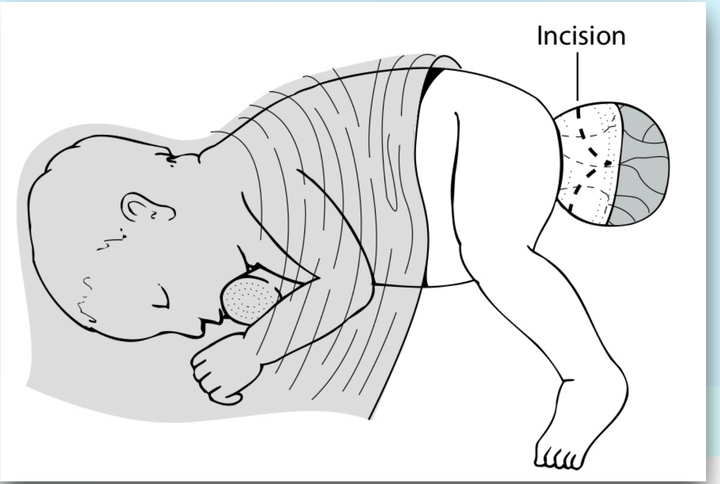
Figure 89.4 Infant with a sacrococcygeal teratoma positioned for surgical resection of the tumor. Note the large transverse roll under the pelvis and the smaller roll under the upper chest.

Surgical management

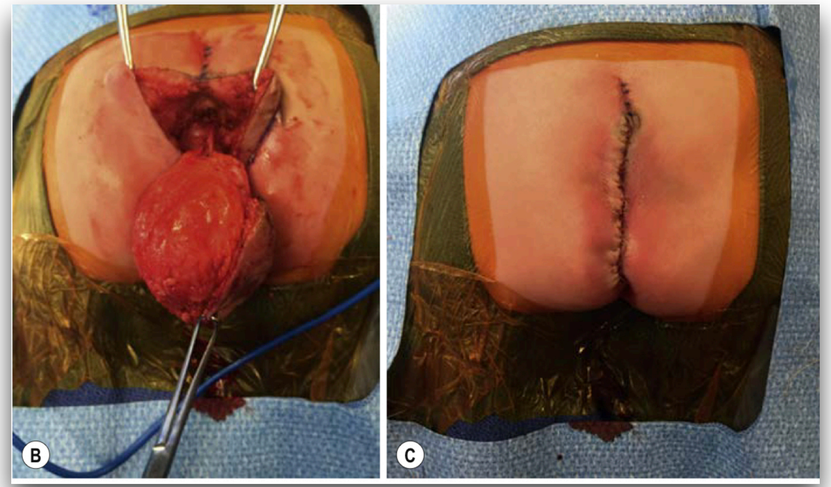
Incision

- **Most** : **chevron**
  - apex of incision should cover lower sacrum
  - preserve skin as much as possible,
    it can be trim later

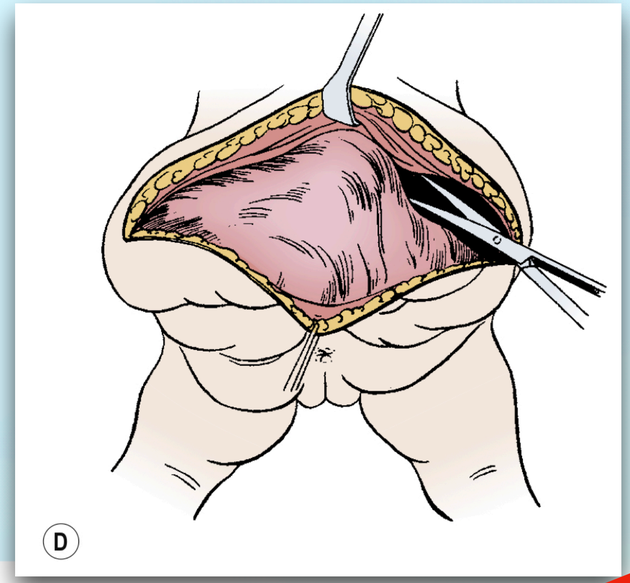




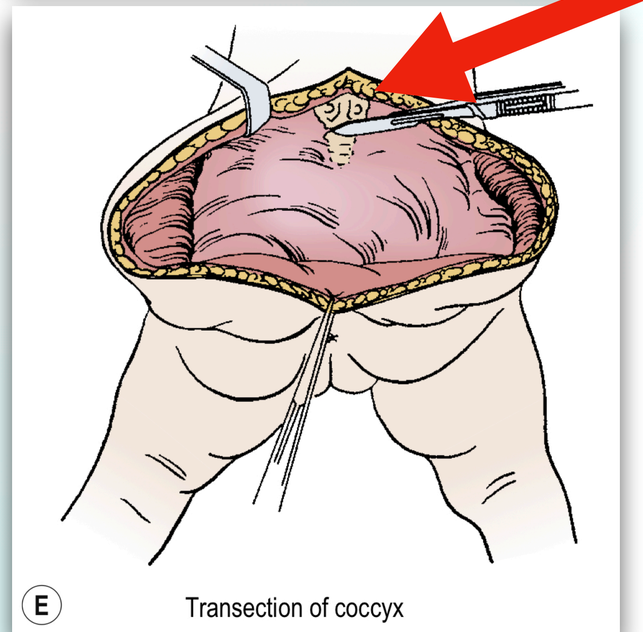
- **vertical** : for smaller tumor



Surgical management

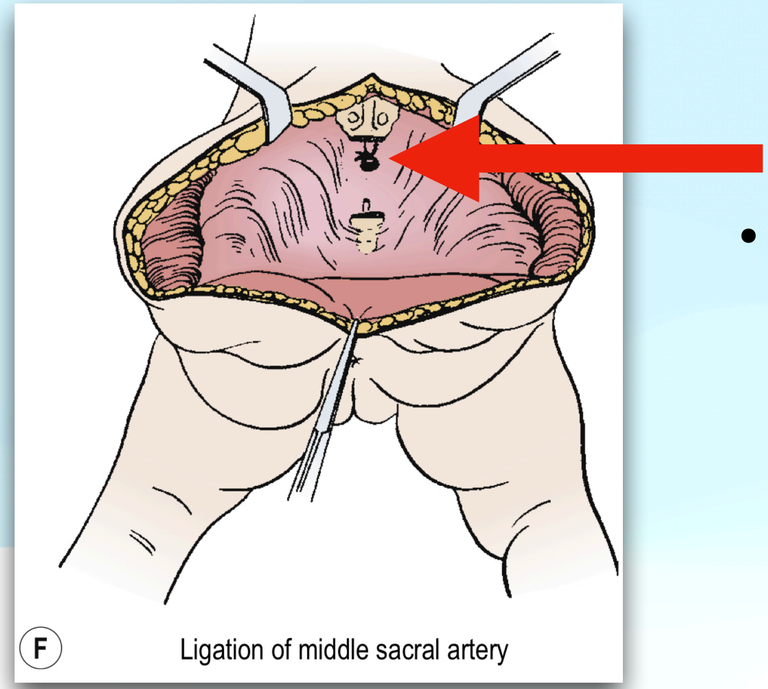


- **Dissected** tumor from inferior, medial aspect of gluteus maximus



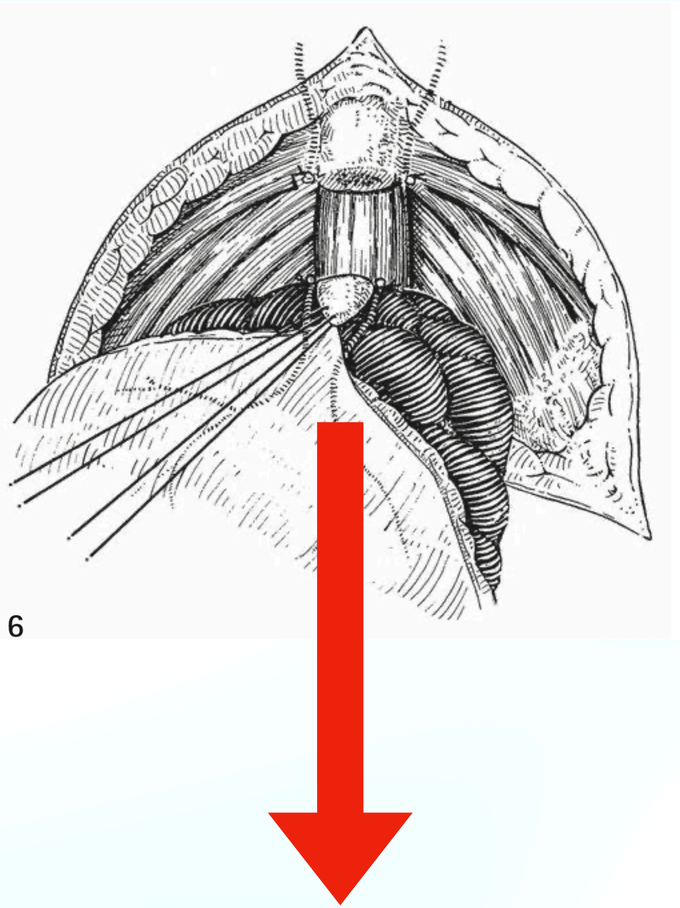
- **Identified sacrum & coccyx**
- **Transect coccyx**
  - at sacrococcygeal joint
  - cautery
  - En-bloc coccyx with tumor

Surgical management



- Identify **Median & lateral sacral vessel ligate** or coagulated

Surgical management



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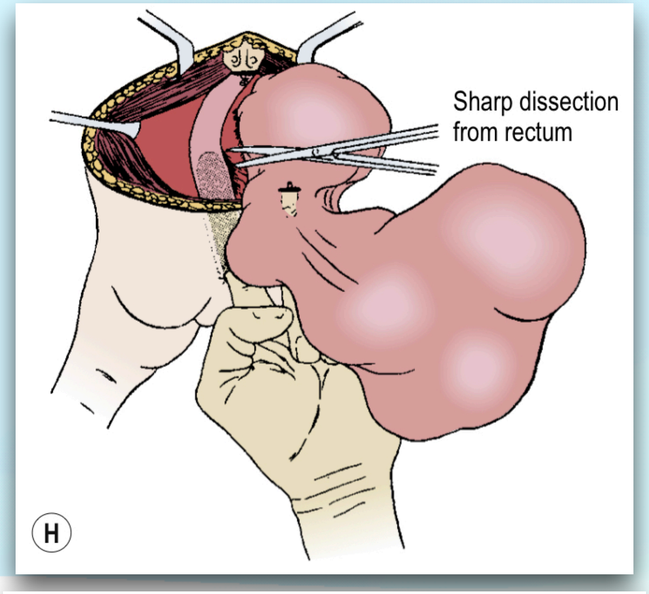
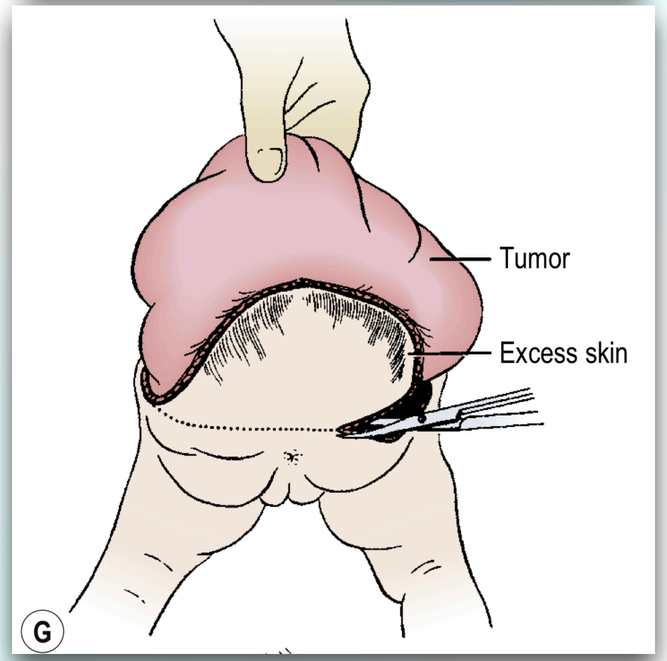
- **Traction**
- **Coccyx and tumor are retracted and dissected from gluteus maximus** and surrounding tissue
  - down to pelvic floor
  - preserve pelvic floor muscle
- **Identified rectum**
  - dissected free from rectum and sphincter complex

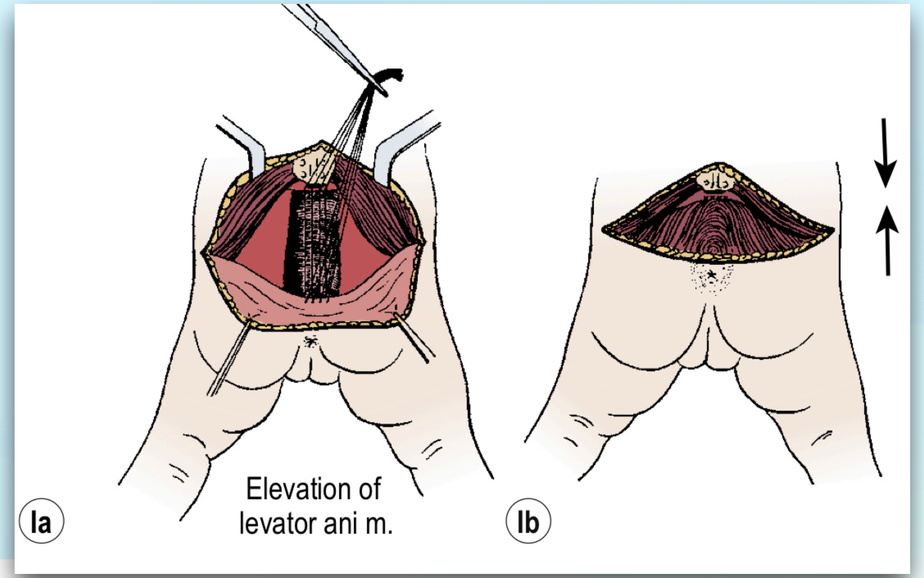
Surgical management



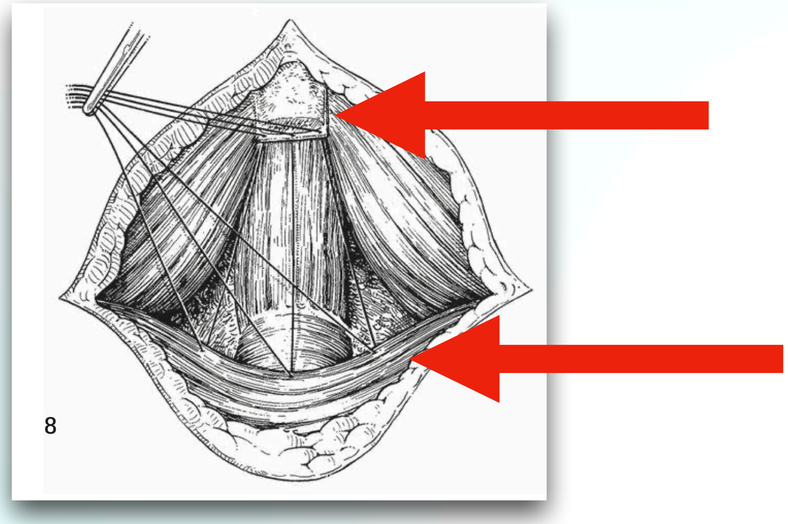


- If necessary place finger in rectum

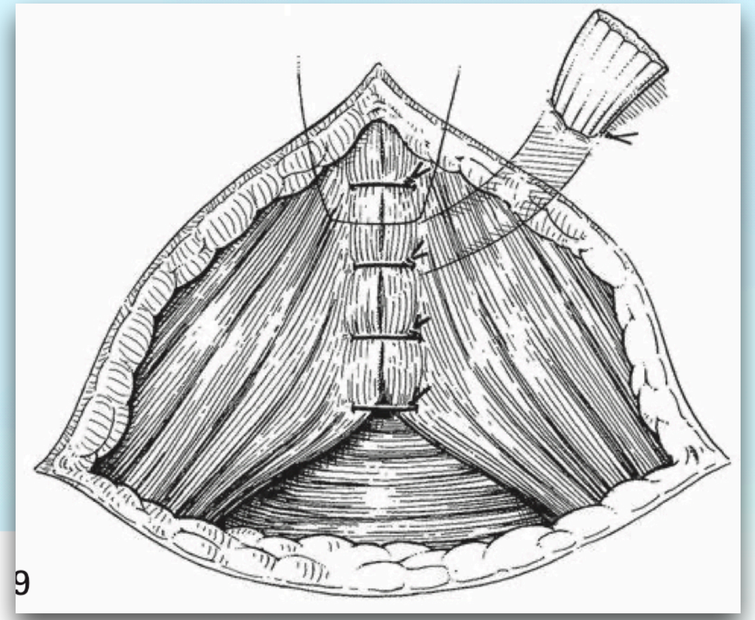
Surgical management



- Pelvic floor reconstruction
  - **suture superior & posterior portion levator m.**
  - **to presacral fascia**

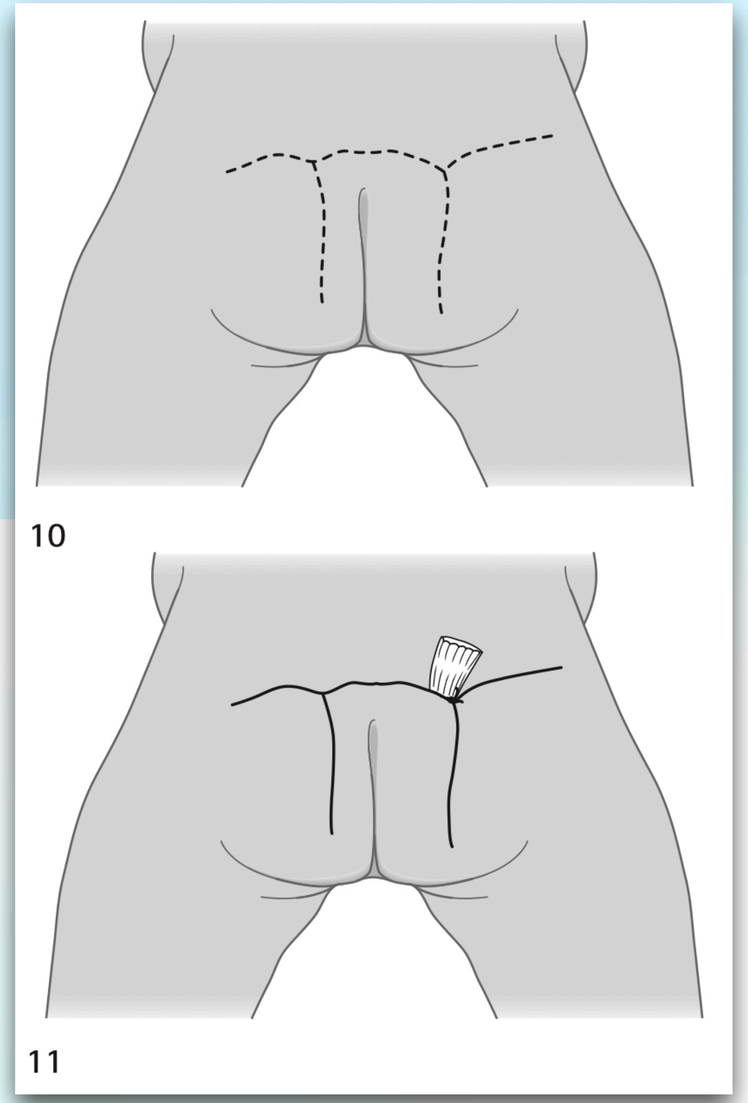


Surgical management

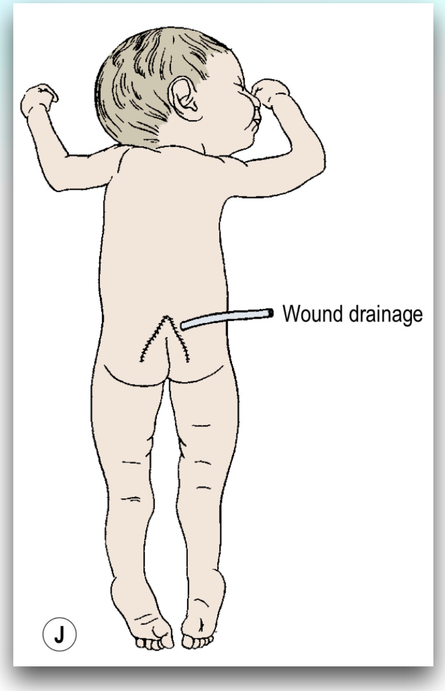


- <u>Pelvic floor reconstruction</u>
  - appose **gluteus maximus**
  - interrupted suture

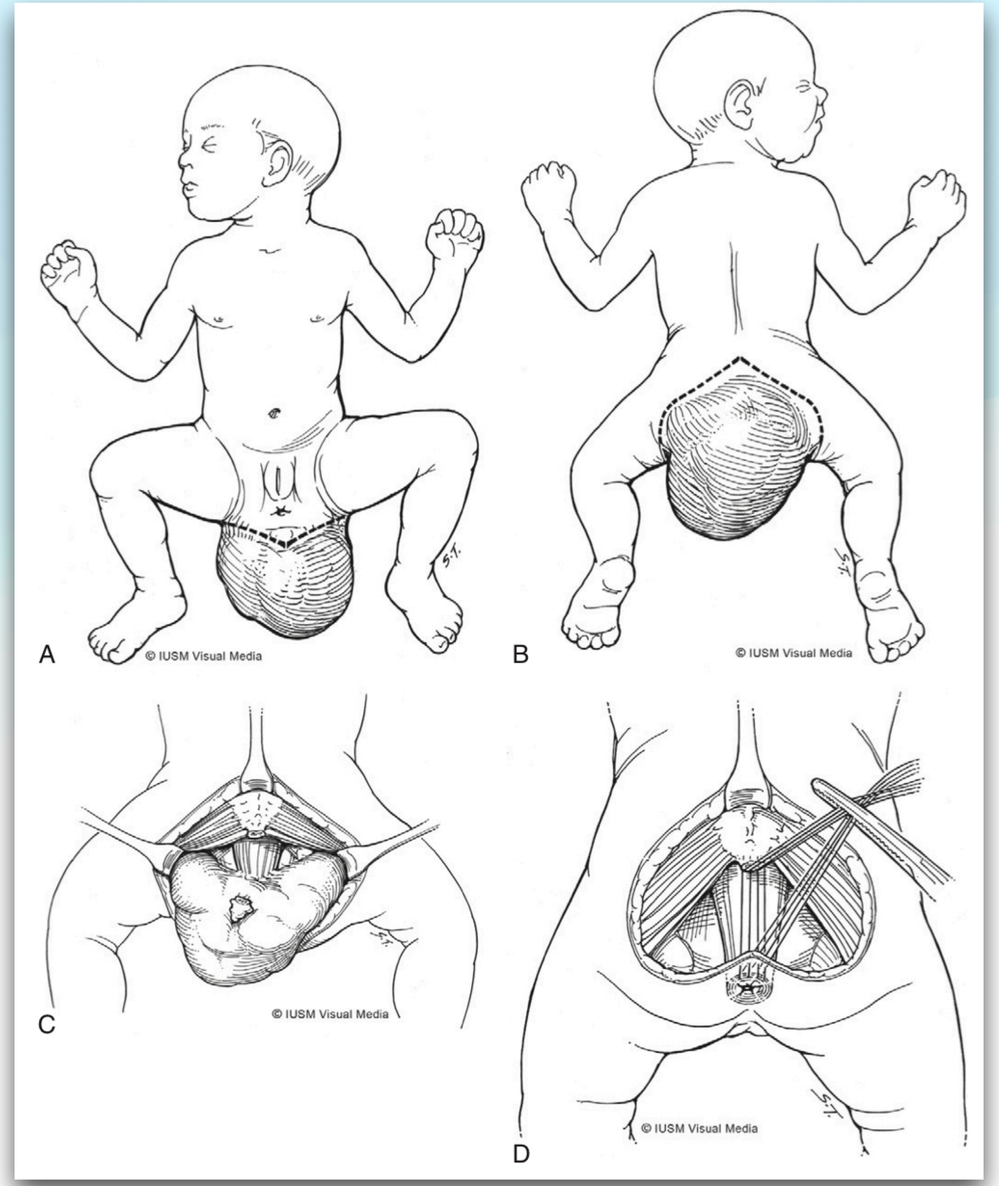
Surgical management



- <u>Closure</u>
  - drain maybe left in perirectal space

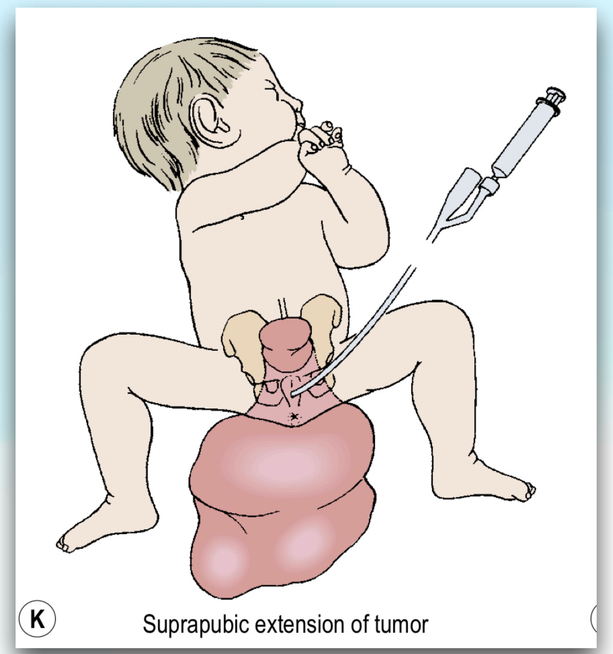


Surgical management



Surgical management

Suprapubic extension



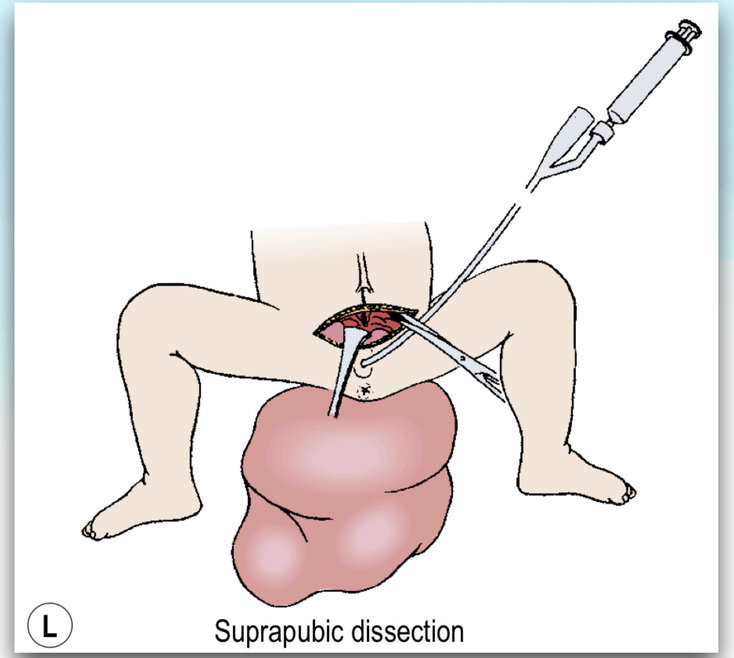


Fig. 67.8 cont'd **(G)** Excess skin is excised to facilitate closure. However, often it is desirable to save all viable skin flaps until the resection is complete and a decision can be made as to the best closure method (transverse, vertical or a combination). Rather than leaving "dog ears", excess skin can be de-epidermized and buried to improve buttock contour. **(H)** Because the tumor is adherent to the rectum, sharp dissection can be directed by placing a finger or a Hegar dilator in the rectum (the latter can be inserted during draping and covered with a sterile clear plastic drape, allowing manipulation during dissection). **(I)** Placement of sutures between the anal sphincter and the presacral fascia (*a*). When the sutures are tied, the anal sphincter is pulled upward to the sacrum to form a gluteal crease (*b*). **(J)** A drain is left in the surgical site for drainage of postoperative serosanguineous fluid. ***Inset,*** Alternate technique for closure after excision of large teratomas. Using plastic surgery principles, this avoids "dog ears" and places the scars along natural skin lines for an improved long-term cosmetic result. **(K)** If the tumor extends through the bony pelvis into the retroperitoneum, a urinary bladder catheter is inserted to facilitate suprapubic dissection. **(L)** Lower abdominal transverse incision allows interruption of the middle sacral artery and dissection of the tumor from the sacrum and pelvis, which is eventually removed from the perineum. (Inset redrawn from Fishman SJ, Jennings RW, Johnson

Surgical management

Giant SCTs, technique that help in management

- intraoperative snaring aorta
- laparoscopic division of median sacral artery
- ECMO and hypothermic perfusion
- devascularization and stage resection
- Preop embolization +- RFA
- Autologous cord blood transfusion

Surgical management

Curarino syndrome

- **presacral mass** :
  - resected through posterior sagittal approach
  - teratoma : often **densely adhere to rectum**
  - should not aggressive in absence of malignancy
- from experience
  - present with anal anomaly before recognized mass
  - anal anomaly may did not require surgery

Surgical management

Post operative

- AFP level immediate
- Prone position for 3 days to prevent soiling the wound with urine & feces

Prognosis

Survival rate >90%

Intrautero diagnosed

Mortality rate near 100%

Hydrop or placentomegaly :

Mortality rate 50%

>= 10 cm that highly vascular or fast growing

Worst prognosis

SCTs **growth > 150 ml/week and cardiac outpu > 650 mL/kg min**

Poor prognosis

(Tumor volume / fetal weight) > 0.12 at GA <24 WK

Solid tumor volume / head volume

<1 No died

>1 died 71%

Prognosis

- **Prognosis of malignant tumors**
  - tumor type
  - stage
  - location
  -age

Recurrence

- **Recurrence** risk factor
  - immature histology
  - malignancy
  - incomplete resection
- **Malignancy recurrence** risk
  - resect after newborn period
  - elevated AFP

Follow up

- Rectal exam, AFP & CA 125 every 2-3 months
- At least 3 years

Follow up : Thai POG

แนวทางติดตามการรักษาหลังหยุดยาเคมีบำบัดหรือหลังผ่าตัดแล้วไม่ได้ให้ยาเคมีบำบัด

- Tumor marker: AFP and/or β–hCG ทุก 1-2 เดือน ใน 6 เดือนแรก หลังจากนั้น ทุก 3 เดือน
- CT or MRI ที่ primarytumor site ทุก 4 เดือนในปีแรก หลังจากนั้น ทุก 6 เดือน
- ในกรณีที่ได้ cisplatin พิจารณาตรวจการได้ยิน ก่อนให้ยา และหลังให้ยาครบ 4-6 ครั้ง

Follow up

Functional

- Neuropathic bladder & bowel (35-40%)
  - soiling (13 %)
  - constipation (16 %)
  - urinary incontinence (30 %)
- Leg weakness
- Normal fertility, vaginal delivery

Recurrence tumor

- **Recurrence tumor**
  - initial benign tumor : recurrence 10-20%
    May be due to **sampling error, incomplete excision malignant foci, transformation**
  - most with in 3 years
  - local
    Metas : lymph node, lung, liver, brain, peritoneum (pseudomyxoma peritonii)
  - CMT : platinum based , Prognosis 80-90%

Thank you

Q & A