

### Chest Radiology in Pregnant Women with TB

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EXCELLENCE

EXPERTISE

### Objectives

- Describe the timely diagnosis of MTB disease in pregnant women using radiology as a tool.
- Describe the radiographic manifestations of pulmonary MTB disease in pregnant women.



## TB Disease in Pregnancy is Bad for Both Mother and Baby



## TB in Pregnancy

- Active TB disease in pregnant women is associated with increases in:
  - ×Maternal morbidity
  - ×Pre-term birth
  - ×Low birth weight
  - ×Perinatal death
- ➢Outcomes are worse when anti-TB treatment is started late.
  - ×Neonatal mortality and extreme prematurity were significantly higher in pregnant women with TB who started treatment later ( > 25 weeks)

Sobhy S. BJOG. 2017; 124: 727-733 Tripathy SN. Int J Gynaecol Obstet. 2003.



#### Study ID

Subtotal  $(I^2 = .\%, P = .)$ 

NOTE: weights are from random effects analysis

0,00444

Study		%				
ID		OR (95% CI) weight	TB affecte	ed TB tota	al Control affe	acted Control total
Maternal death						
A.Ali, 2011		5.25 (0.24, 112.66)35.60	2	42	0	42
Tripathy, 2003	•	1,40 (0,06, 34,91) 32,34		111	0	51
Ricardo Figueroa- Damian- 1998		8,88 (0.35, 224, 98)82,06	1	26	0	75
Asuquo,2012		(Excluded) 0.00	0	24	0	72
N, Jana, 1994		(Excluded) 0,00	0	79	0	316
Subtotal $(I^2 = 0.0\%, P = 0.714)$		4.05 (0.65, 25.24) 100.0	0			
Maternal Morbidity						
Ricardo Figueroa- Damian- 2001		7.48 (2.09, 26.72) 10.75		35	4	105
N. Jana, 1999		2,05 (0,86, 4,88) 17,41		32	24	132
Ricardo Figueroa- Damian- 1998		4.57 (1.45, 14.37) 12.45		25	7	75
T.Bjerkedal, 1975	1 <del>*</del> _	1.74 (1.34, 2.27) 34.02		542	8653	125 423
P.A. Kavganko, 2004		3.31 (1.89, 5.80) 25.37		96	39	120
Subtotal (I-squared = 60.3%, P = 0.039)	$\sim$	2.78 (1.70, 4.56) 100.0	0			
Antenatal admission						
N. Jana, 1999		9.56 (2.25, 40.60) 100.0	0.6	33	3	132
	-	9,56 (2,25, 40,60) 100,0			2	102
Subtotal $(I^2 = \%, P = .)$		3,30 (£,£3, 40,00) 100,8	0			
Anaemia						
A.Ali, 2011		3,08 (1,11, 8,56) 23,28	35	42	26	42
Adolfas Pranevièius,2003		6.70 (3.00, 14.97) 33.33	40	77	10	72
P.A. Kavganko, 2004		2,83 (1,47, 5,46) 43,38	32	96	18	120
Subtotal $(I^2 = 29.8\%, P = 0.241)$	$\sim$	3.85 (2.21, 6.71) 100.0	0			
Subtotal (1 = 2010/0,1 = 012+1)						
C-section Delivery						
N. Jana, 1994 —	•	0.90 (0.45, 1.83) 22.80	11	79	48	316
N. Jana, 1999		3.44 (1.10, 10.74) 14.96	6	33	8	132
P.A. Kavganko, 2004		4,80 (1.95, 11,80) 18,93	22	96	7	120
T.Bjerkedal, 1975		2.38 (1.40, 4.06) 26.57	14	542	1238	112 530
Adolfas Pranevièius,2003 —	•	1,39 (0.50, 3,86) 16,73		77	7	72
Subtotal (I <sup>2</sup> = 61.1%, P = 0.036)	$\diamond$	2.10 (1.17, 3.79) 100.0	0			
Miscarriage					0.57	
T.Bjerkedal, 1975		9.06 (4.93, 16.67) 100.0		546	257	113 511

Maternal Morbidity OR 2.8, CI 1.7-4.6

Anemia OR 3.9, CI 2.2-6.7

**C-section** OR 2.1 CI 1.2-3.8

Figure 3. Maternal outcomes in women with tuberculosis (TB) compared with those without TB.

\*

 $\stackrel{\cdot}{\diamond}$ 

Active TB better outcome Active TB poorer outcomes

9,06 (4,93, 16,67) 100,00

225

Sobhy S. BJOG. 2017; 124: 727-733

#### Study ID

% OR (95% CI) weight TB affected TB total Control affected Control total

Perinatal death OR 4.2 Cl 1.5-11.8

Low birth weight OR 1.7 Cl 1.2-2.4

Pre-term birth OR 1.7 Cl 1.2-2.4

Perinatal death Ricardo Figueroa- Damian- 2001 N. Jana, 1999 Ricardo Figueroa- Damian- 1998 P.A. Kavganko, 2003 T.Bjerkedal, 1975 Subtotal ( $l^2 = 57.2\%$ , $P = 0.029$ ) Low birth weight Lin, 2009 Tripathy, 2003 A.Ali, 2011 N. Jana, 1999 N. Jana, 1994 P.A. Kavganko, 2003 T.Bjerkedal, 1975 Subtotal ( $l^2 = 53.7\%$ , $P = 0.044$ ) Pre-term birth Asuguo- 2012 Addiga 2012 Addiga 2012 Addiga 2012 Addiga 2003 Tripathy, 2003 C. Subtotal ( $l^2 = 53.7\%$ , $P = 0.044$ ) Pre-term birth Asuguo- 2012 Addiga 2012 Addiga 2012 Addiga 2013 C. Subtotal ( $l^2 = 53.7\%$ , $P = 0.044$ )	d Control tota
Lin, 2009 Tripathy, 2003 A,Ali, 2011 N, Jana, 1999 N, Jana, 1994 P.A. Kavganko, 2003 T.Bjerkedal, 1975 Subtotal $(l^2 = 53.7\%, P = 0.044)$ Pre-term birth	105 133 316 75 121 113 511 72
	3805 51 42 132 316 121 112 000
Lin, 2009 Ricardo Figueroa- Damian- 2001 A.Ali, 2011 N. Jana, 1999 N. Jana, 1994 A.Marynowski, 1971 P.A. Kavganko, 2004 T.Bjerkedal, 1975 Ricardo Figueroa- Damian- 1998 Subtotal ( $l^2 = 66,5\%, P = 0,001$ )	72 3805 105 42 132 316 2007 120 108 622 74
Acute fetal distress         2.65 (1.24, 5.69)         72.14         12         79         20           N. Jana, 1994         1.68 (0.49, 5.75)         27.86         4         33         10           Subtotal (l <sup>2</sup> = 0.0%, P = 0.538)         2.34 (1.22, 4.47)         100,00         33         10	316 132
Asphyxia Adolfas Pranevièius,2003 P.A. Kavganko, 2004 P.A. Kavganko, 2003 Subtotal ( <i>I</i> <sup>2</sup> = 46.3%, <i>P</i> = 0.155) NOTE: weights are from random effects analysis	72 120 121
0.00212 1 472	

Active TB better outcomes Active TB poorer outcomes

Figure 4. Perinatal outcomes in women with tuberculosis (TB) compared with those without TB.

#### Sobhy S. BJOG. 2017; 124: 727-733



## TB Disease in Pregnancy can be Challenging to Identify



## TB in Pregnancy

- Significant overlap between symptoms of pregnancy and symptoms of TB disease.
  - ×Fatigue and malaise
  - ×Poor appetite
  - × Breathlessness
- A significant number of pregnant women may be asymptomatic and found only through screening.

E. Jane Carter. Susan Mates. CHEST. 1994; 106: 1466-70 JM Gould. AC Aronoff. Clinical Microbiology. Vol. 4. Issue 6. 2016.



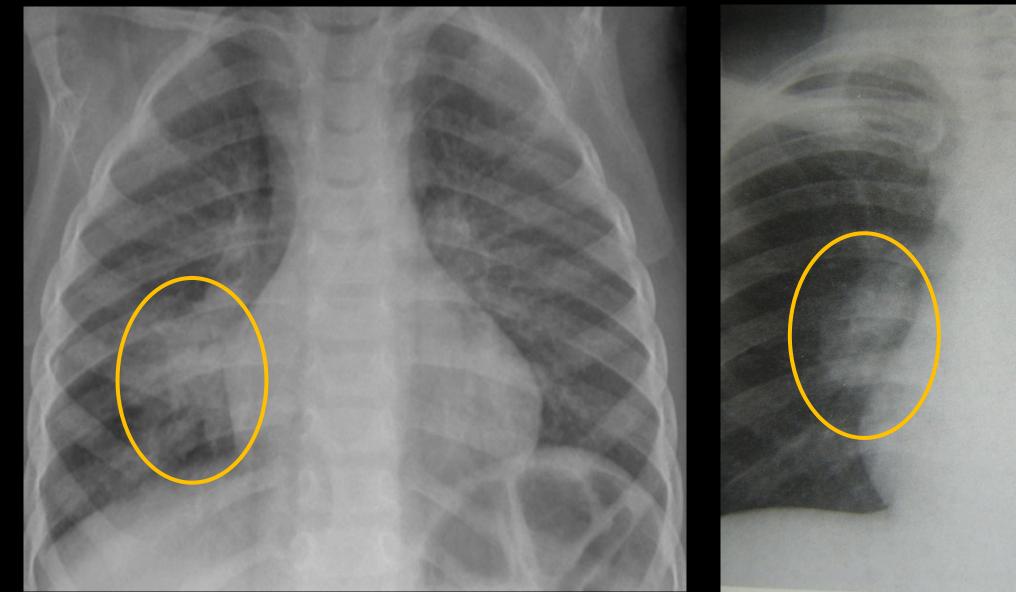
## TB in Pregnancy

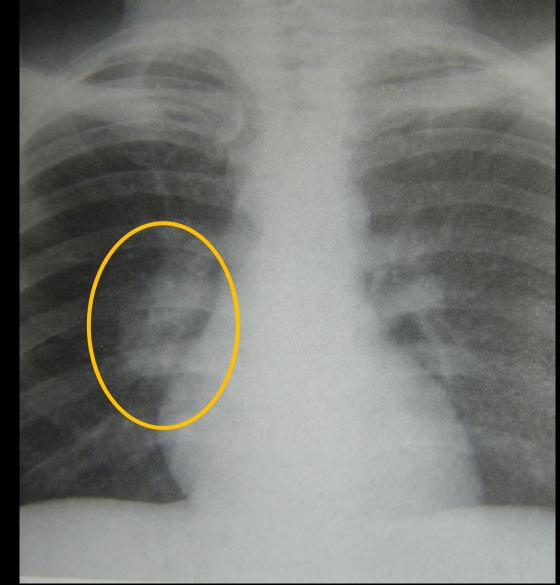
In several series, all women with pulmonary TB disease had some abnormality on CXR

- ✓ Unilateral, non-cavitary disease
- ✓ Small and/or indistinct infiltrates
- ✓ Small effusions
- Pregnant women may be more likely to have negative sputum smears and negative cultures

E. Jane Carter. Susan Mates. CHEST. 1994; 106: 1466-70 H Bishara et al. IMAJ. VOL 17. June 2015.





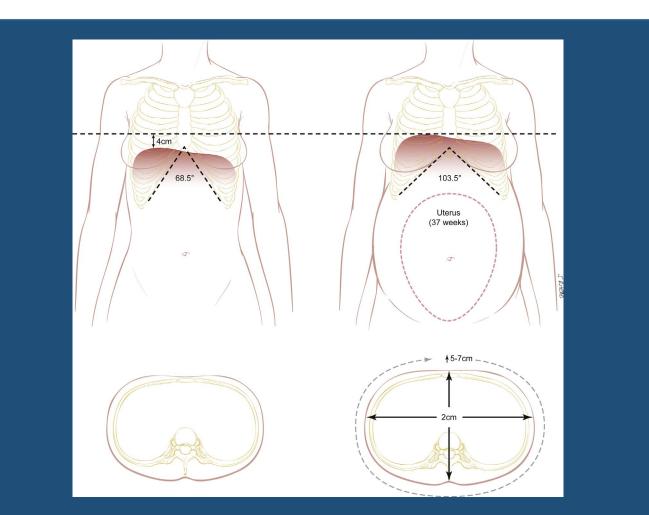


## Chest Xray in Pregnant Women



### Chest Anatomy Changes in Pregnancy

- 50% increase in the average costal angle
- Increase in lower chest wall circumference
- Diaphragmatic
   position moves
   up 4-5cm



\*

- Maternal
   blood volume
   increases ~ 2
   liters
- Increased LV compliance
- Decreased SVR
- CVP and wedge pressure do not change

### Chest Xrays in pregnancy are considered safe!

- No-adverse-effect-level (NOAEL) = the threshold level under which the incidence of congenital malformations will not be increased
- > NOAEL = 0.2 Gy at the most sensitive stage of development
- > HPS.org Health Physic's Society website
- Shield the abdomen/pelvis

"The use of shielded chest radiography in pregnant women poses no significant risk" - WHO

> Brent, Robert. AJOG. January 2009. WHO recommendations on antenatal care for a positive pregnancy experience. World Health Organization; 2016.



Table 2. Effects of Gestational Age and Radiation Dose on Radiation-Induced Teratogenesis 🗢

Gestational Period	Effects	Estimated Threshold Dose*
Before implantation (0–2 weeks after <mark>fertilization</mark> )	Death of embryo or no consequence (all or none)	50–100 mGy
Organogenesis (2–8 weeks after <mark>fertilization</mark> )	Congenital anomalies (skeleton, eyes, genitals)	200 mGy
	Growth restriction	200–250 mGy
Fetal period	Effects	Estimated Threshold Dose*
8–15 weeks	Severe intellectual disability (high risk) <sup>†</sup>	60–310 mGy
	The second se	05.10 1.11 4.000 0
	Intellectual deficit	25 IQ-point loss per 1,000 mGy
	Intellectual deficit Microcephaly	25 IQ-point loss per 1,000 mGy 200 mGy

\*Data based on results of animal studies, epidemiologic studies of survivors of the atomic bombings in Japan, and studies of groups exposed to radiation for medical reasons (eg, radiation therapy for carcinoma of the uterus).

<sup>†</sup>Because this is a period of rapid neuronal development and migration.

Modified from Patel SJ, Reede DL, Katz DS, Subramaniam R, Amorosa JK. Imaging the pregnant patient for nonobstetric conditions: algorithms and radiation dose considerations. Radiographics 2007;27:1705–22.

#### Table 3. Fetal Radiation Doses Associated With Common Radiologic Examinations 🗢

Very low-dose examinations (<0.1 mGy) Cervical spine radiography (anteroposterior and lateral views)	
Cervical spine radiography (anteroposterior and lateral views)	
	<0.001
Head or neck CT	0.001-0.01
Radiography of any extremity	<0.001
Mammography (two views)	0.001-0.01
Chest radiography (two views)	0.0005-0.01

Guidelines for Diagnostic Imaging During Pregnancy and Lactation. ACOG. VOL. 130 NO. 4 October 2017.



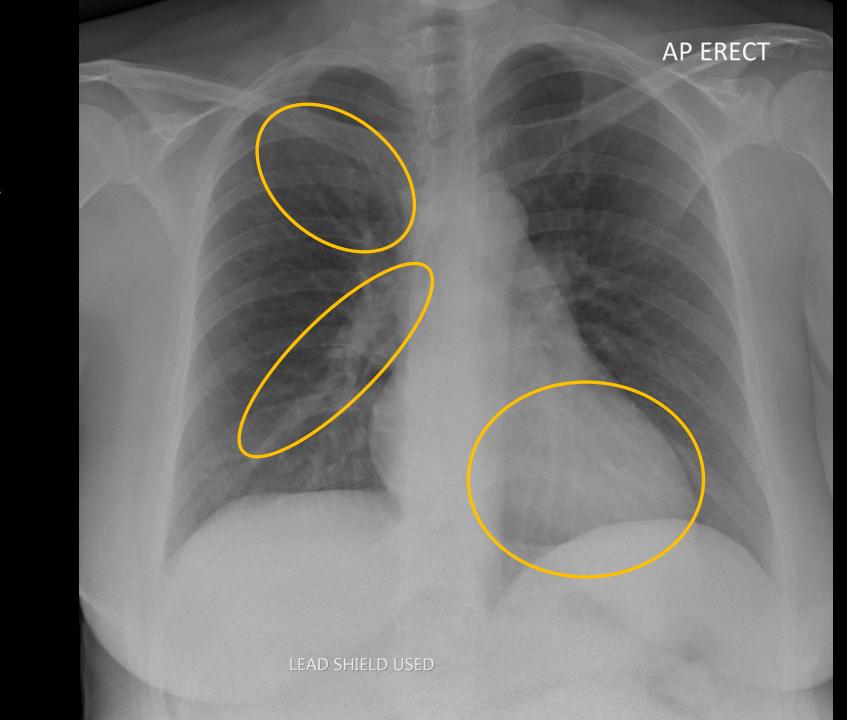
- ➤Chest Xrays of pregnant women look like the chest xrays of non-pregnant women.
  - ✓ May have increased vascularity, enlarged PA shadows or mildly enlarged cardiac border
  - ✓ May have elevated diaphragms, smaller lung volumes
- ➤Chest xrays of pregnant women with TB disease may have more subtle findings.
  - $\checkmark$  May have less fibrotic and less cavitary change.
  - ✓ May be more likely to have subtle infiltrates, adenopathy, small effusions.
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E. Jane Carter. Susan Mates. CHEST. 1994; 106: 1466-70 H Bishara et al. IMAJ. VOL 17. June 2015.



Nonpregnant woman





Pregnant woman, 27weeks gestation

"If routine screening is not performed prenatally, with radiographic follow-up of infected individuals, most pregnant women [with TB] will not have their conditions diagnosed and, therefore they will not be treated in time to prevent risk to the fetus, the newborn and the obstetric ward."



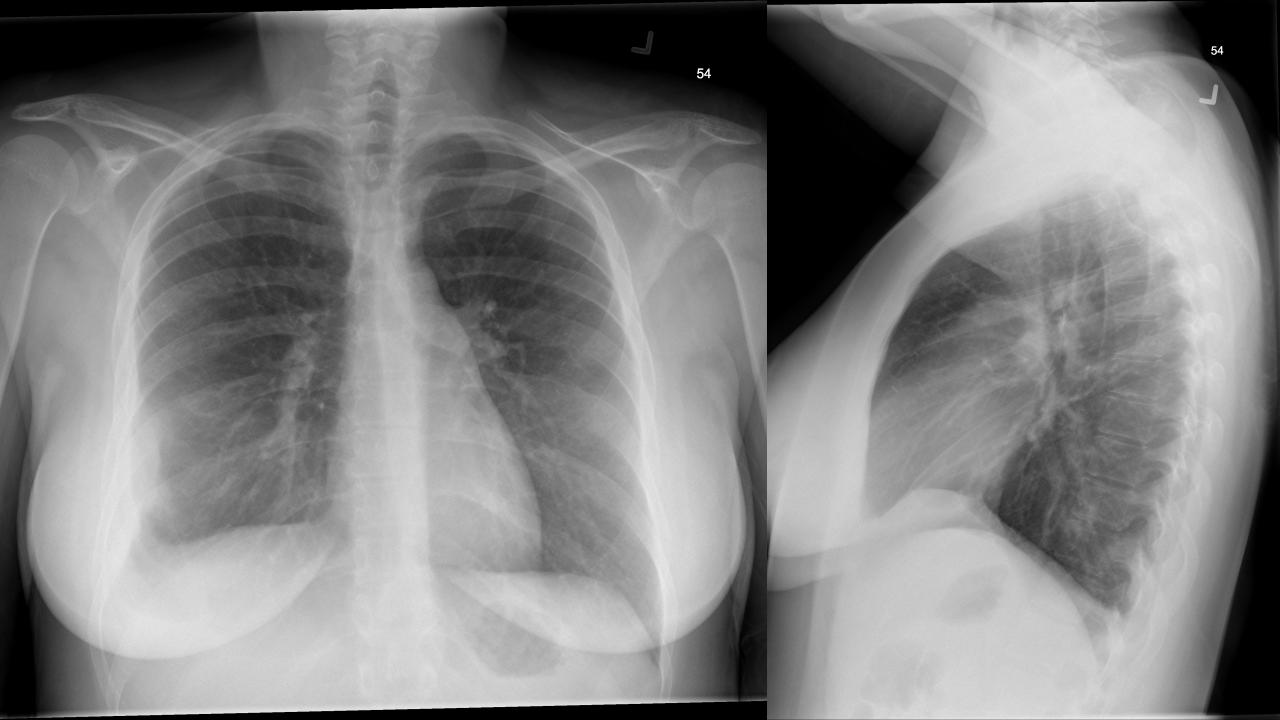
## **Cases and Discussion**



# A Young Woman Identified Post-Partum

When her infant became ill.





## A Woman Identified Post-Partum

When she became ill.





## Missed Opportunities



A pregnant woman in her first-trimester comes to attention due to a + TST, 35mm, obtained while incarcerated.

Asymptomatic and negative CXR

Planned to treat as LTBI post-partum

Additional information:

HIV status – negative No known TB exposures BUT prior incarceration No previously reported + TST



In her third trimester, she is out of incarceration and working in a pawn shop

Fatigue

Tachycardia

Worsening anemia despite iron supplementation

No weight gain (15 wks, 65kg, 34 wks, 64kg)

HA 2 wks prior to delivery

Could we consider this normal in a third trimester pregnancy?



At 36 weeks, she has premature rupture of membranes and delivers a healthy baby girl weighing 5lbs, 5 ounces She is afebrile, Hgb 7.8, platelets 653,000

At 3 weeks postpartum, she is again incarcerated and now her TST is 0mm (previous TST 35mm).

She has multiple visits to medical services. Fatigue, night sweats, shortness of breath. Tachycardia, low albumin, low hemoglobin.

At 7 weeks post-partum, she goes to the ER with fever to 103F, cough and continued constitutional symptoms.





At 13 weeks post-partum, she is admitted to the hospital with fever, hypoxia, tachycardia, and intermittent incontinence. Multiple serologic abnormalities + QFT Sputum and urine AFB +

RIPE started 4 days after admission. She expires the next day.

What can we learn from this woman's tragic course?



## Additional Questions or Comments



## Thank you

