Curso de Radiologia - Módulo 12:

ACHADOS RADIOLÓGICOS NA TUBERCULOSE

Ana Luiza Nunes Martins
Residência de Pneumologia Pediátrica e Alergia infantil
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Introdução

AGENTE ETIOLÓGICO

- Micobactérias do complexo M. tuberculosis (espécie mais comum: M. tuberculosis – bacilo de Koch)
- Bacilo álcool-ácido resistente (BAAR), aeróbio, intracelular
- Parede lipídica → resistência a antibióticos e persistência nos macrófagos

BRASIL. Ministério da Saúde. Manual de recomendações para o controle da tuberculose no Brasil. Brasília: MS, 2019

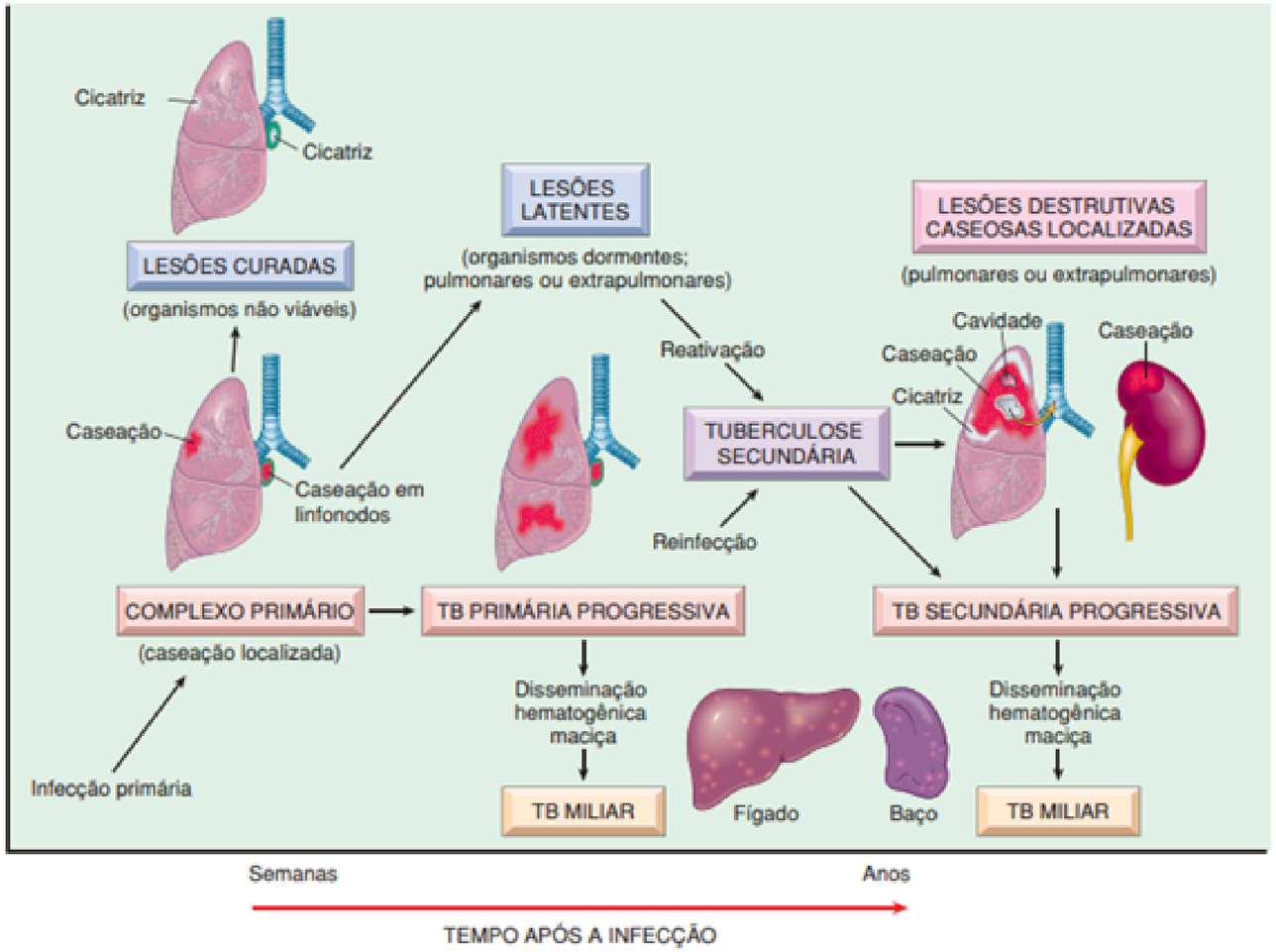
Introdução

TRANSMISSÃO

- Aérea (tosse, fala, espirro) de casos pulmonares/laríngeos
- Bacilos <5 µm permanecem em suspensão por horas (núcleos de Wells)
- Fatores que influenciam a transmissão:
  - Baciloscopia positiva
  - Tempo e intensidade do contato
  - Ambiente fechado e mal ventilado

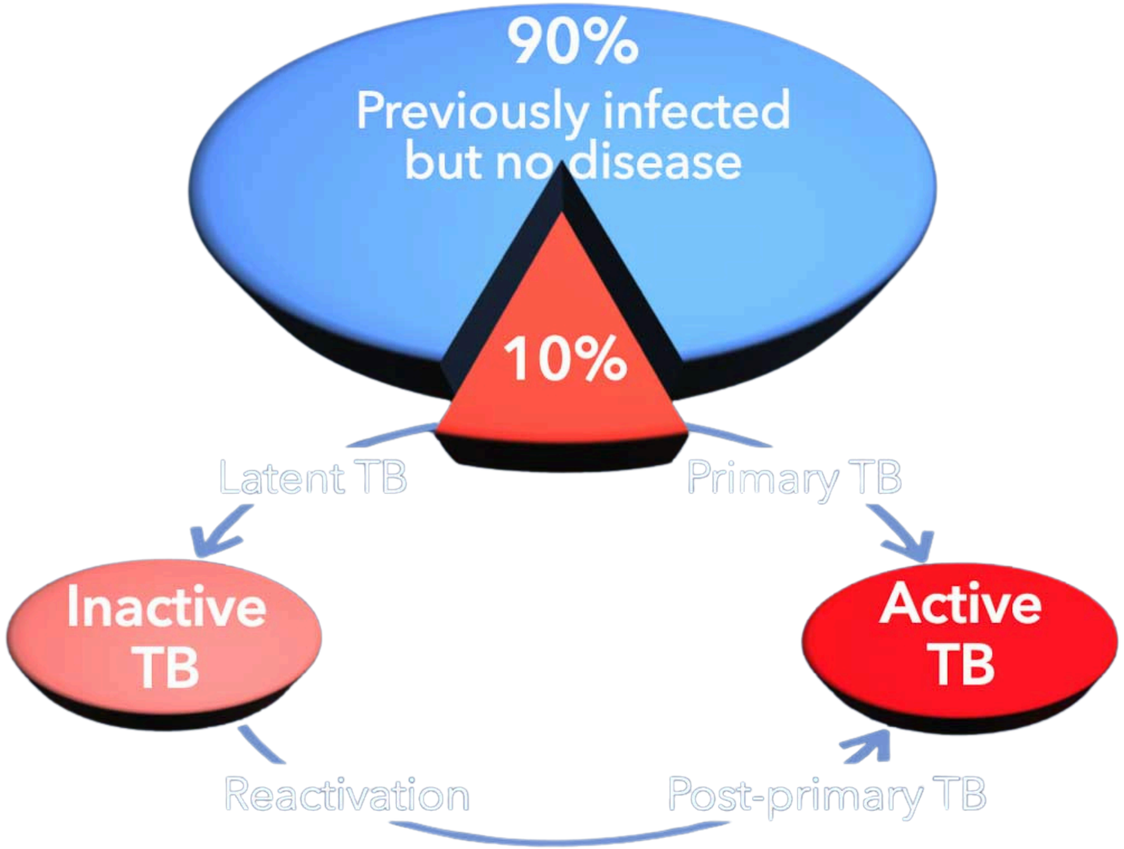
BRASIL. Ministério da Saúde. Manual de recomendações para o controle da tuberculose no Brasil. Brasília: MS, 2019

História natural da doença



História Natural e Espectro da tuberculose - Retirado de KUMAR, V.; ABBAS, A.; FAUSTO, N. Robbins e Cotran - Patologia - Bases Patológicas das Doenças. 8. ed. Rio de Janeiro: Elsevier, 2010

História natural da doença



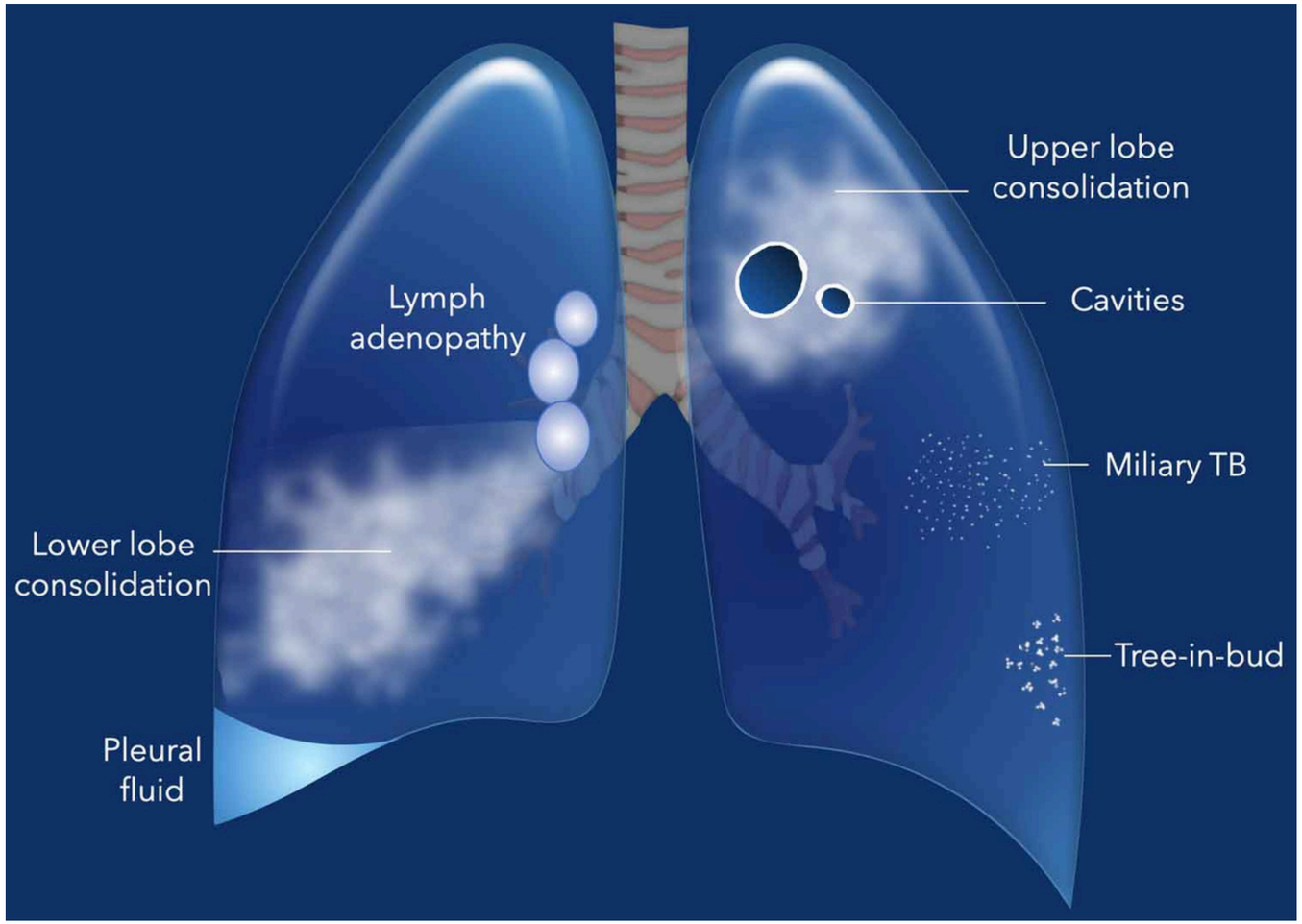
Disponível em: https://radiologyassistant.nl/chest/tb/tuberculosis

Diagnóstico

EXAMES DE IMAGEM

- Radiografia de tórax: primeira escolha na TB pulmonar, útil para monitoramento.
- Tomografia computadorizada: avalia lesões complexas ou em formas extrapulmonares (realizar com contraste).
- Outros exames de imagem: USG, RNM e cintilografia auxiliam no diagnóstico de TB extrapulmonar (meníngea, pleural, óssea etc.).

BRASIL. Ministério da Saúde. Manual de recomendações para o controle da tuberculose no Brasil. Brasília: MS, 2019



Disponível em: https://radiologyassistant.nl/chest/tb/tuberculosis

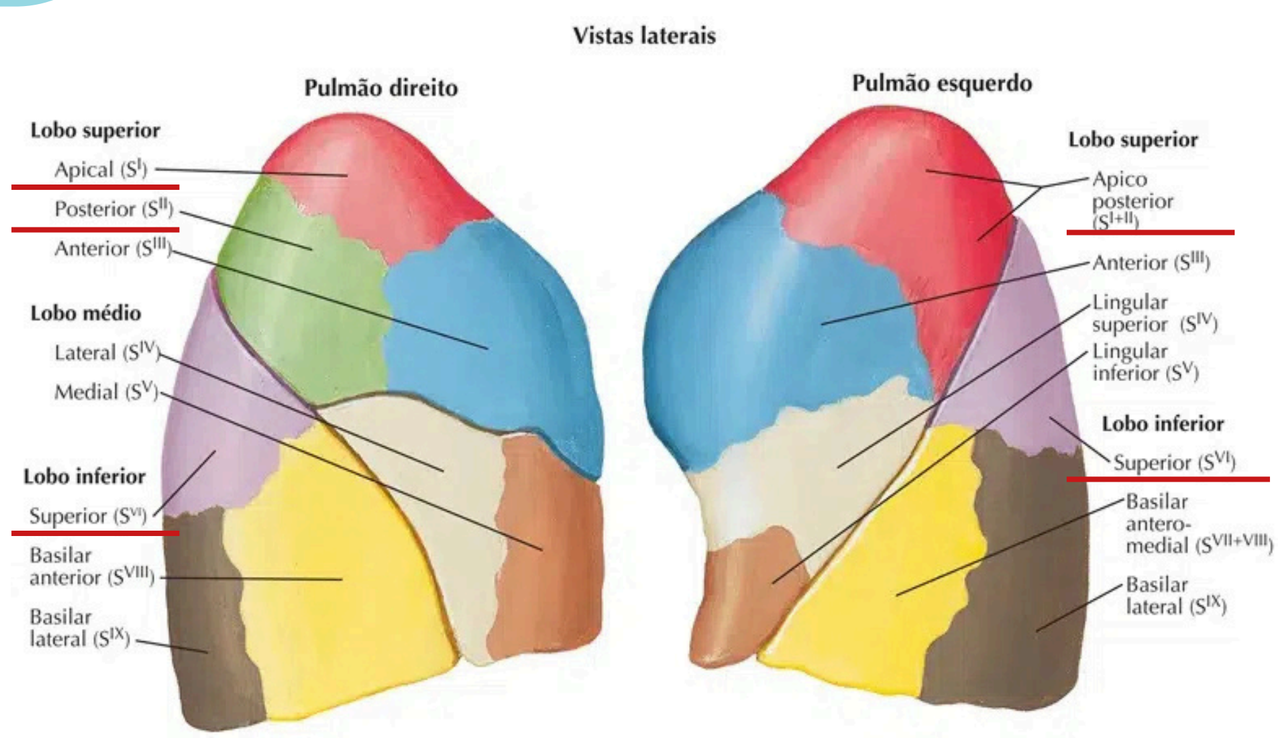
QUADRO 10 – Alterações sugestivas de tuberculose ativa ou sequela de tuberculose em tomografia computadorizada de tórax.

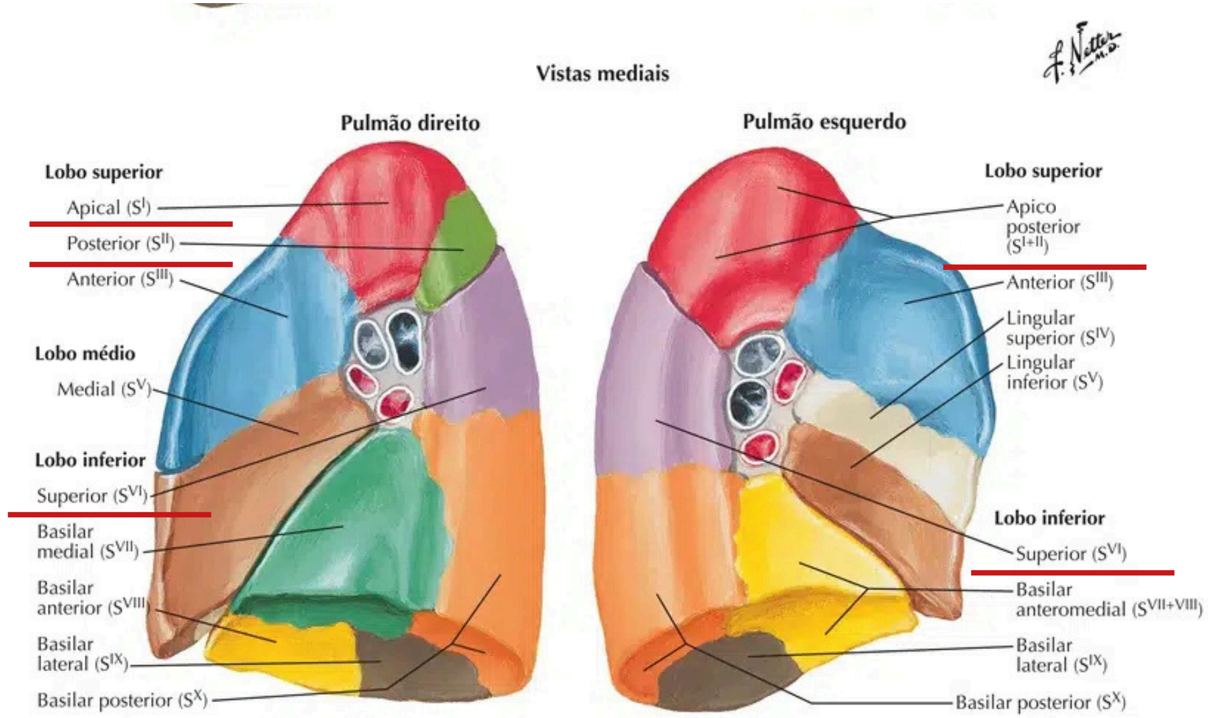
SINAIS SUGESTIVOS DE TUBERCULOSE ATIVA	SINAIS SUGESTIVOS DE SEQUELA DE TUBERCULOSE
▪ Cavidades de paredes espessas ▪ Nódulos ▪ Nódulos centrolobulares de distribuição segmentar ▪ Nódulos centrolobulares confluentes ▪ Consolidações ▪ Espessamento de paredes brônquicas ▪ Aspecto de “árvore em brotamento” ▪ Massas ▪ Bronquiectasias	▪ Bandas ▪ Nódulos calcificados ▪ Cavidades de paredes finas ▪ Bronquiectasias de tração ▪ Espessamento pleural

Fonte: Adaptado de BOMBARDA, S. et al, 2003.

BRASIL. Ministério da Saúde. Manual de recomendações para o controle da tuberculose no Brasil. Brasília: MS, 2019

ACHADOS RADIOLÓGICOS





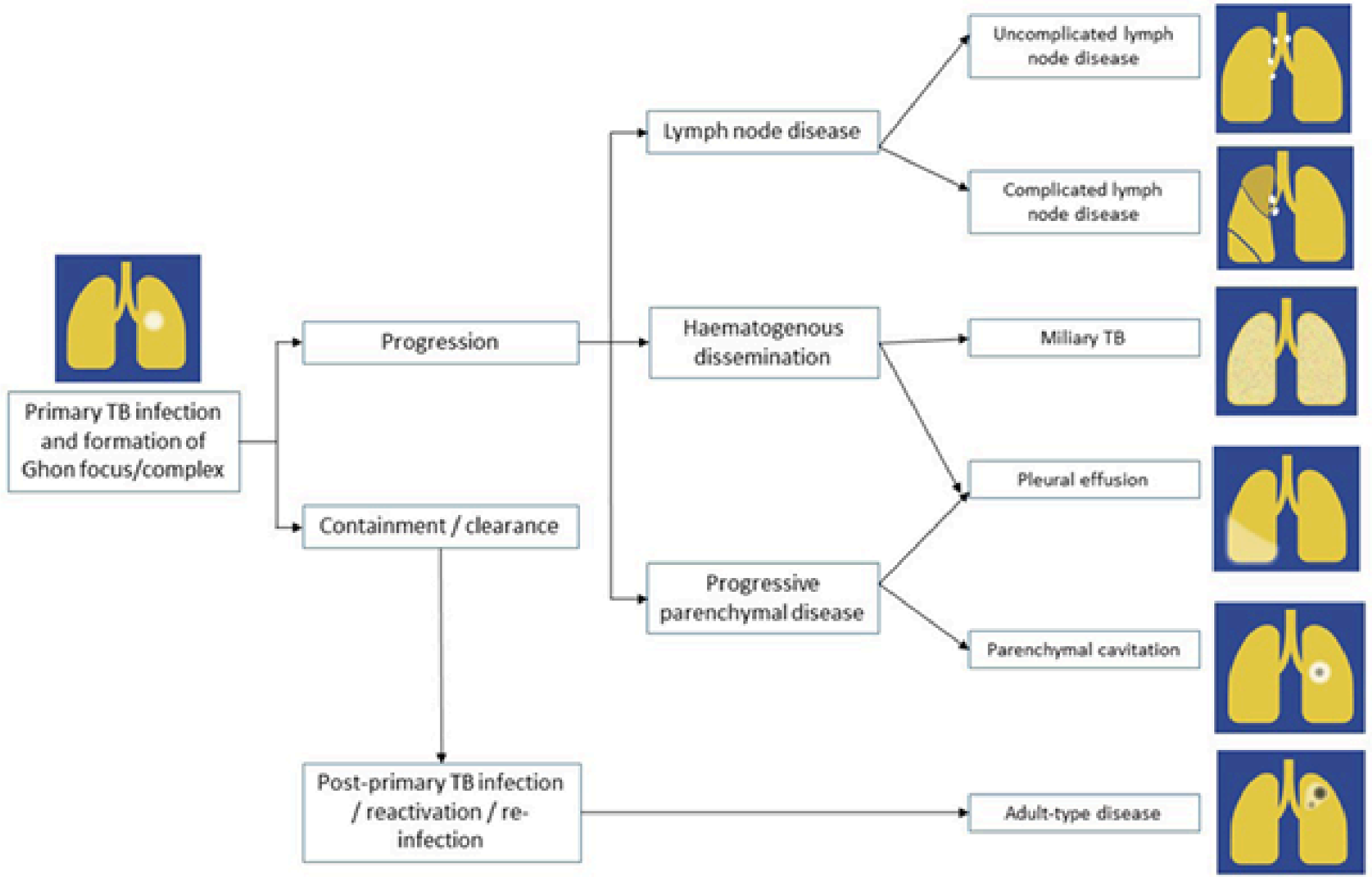


Figure 5.1: Well-recognised typical CXR features for paediatric pulmonary TB that have high specificity for pulmonary TB

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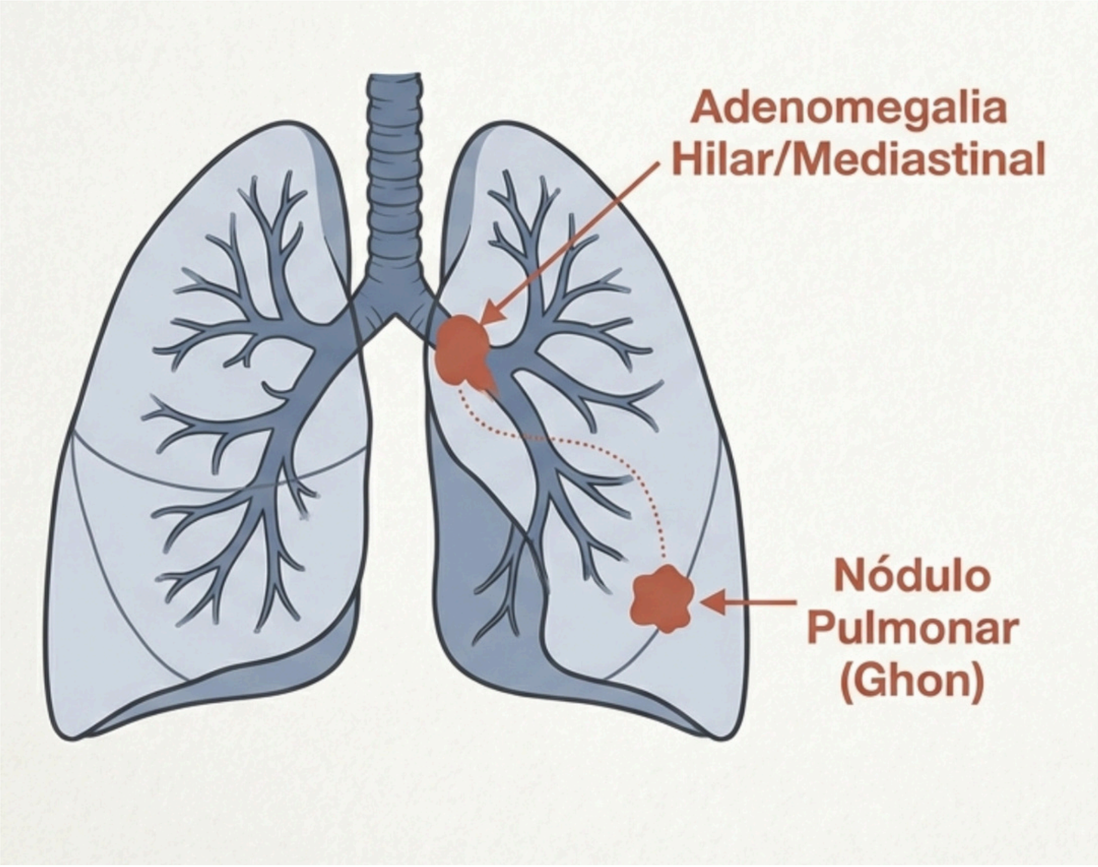
Complexo primário



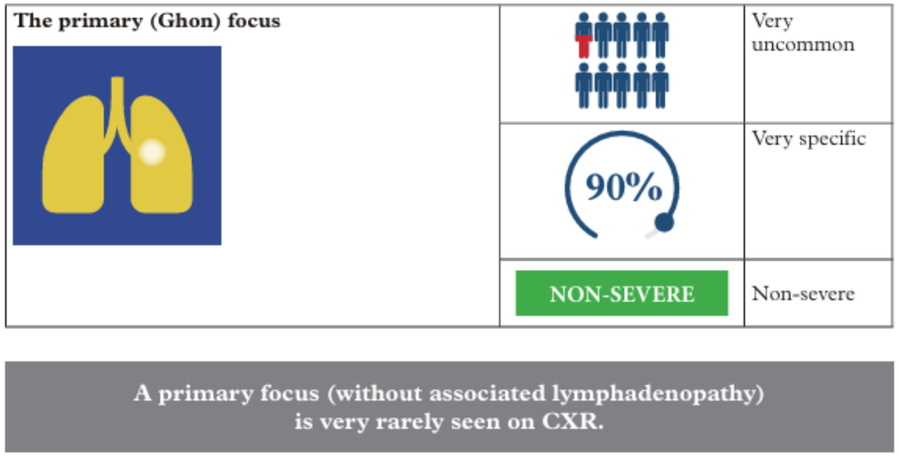
- Marca da primoinfecção;
  - componente pulmonar (nódulo periférico) e componente linfático (adenomegalia satélite).
- Geralmente, unilateral.
- O bacilo é inalado, instala-se no alvéolo e é drenado para os linfonodos regionais.

Complexo primário

Disponível em: https://anatpat.unicamp.br/pecasinfl18.html

NÓDULO DE GHON

- Nódulo unico e periférico de coloração esbranquiçada;



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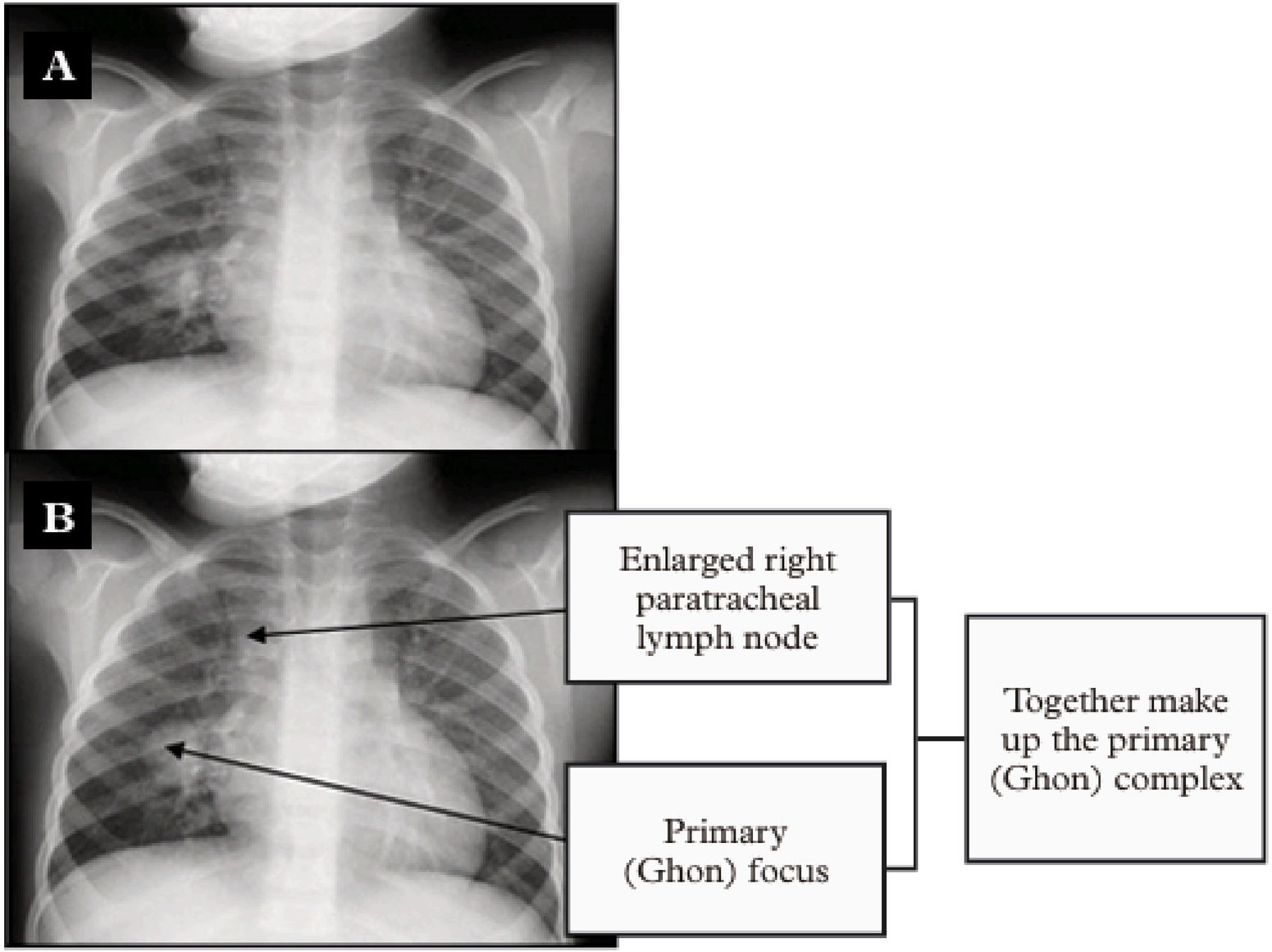

Figure 5.6: CXR B is an annotated version of CXR A. This CXR shows a primary (Ghon) complex

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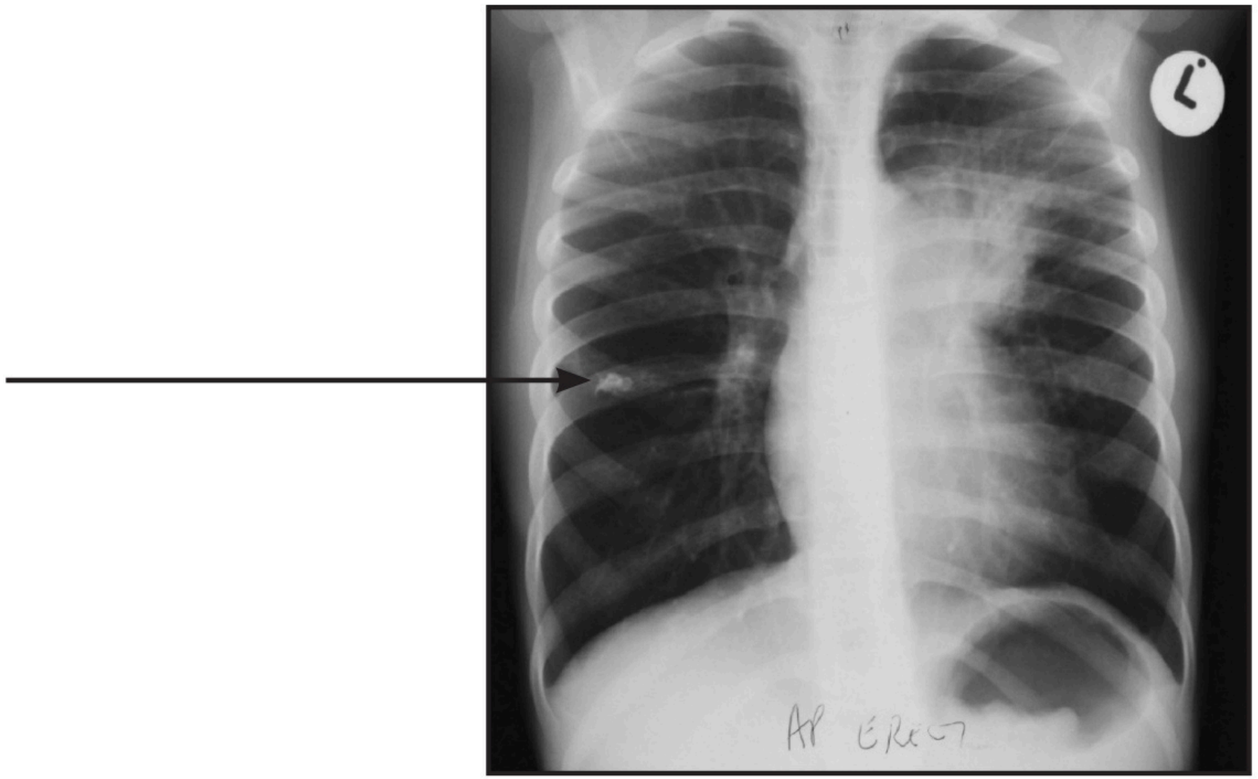

Figure 5.5: Note the presence a calcified primary (Ghon) focus (see arrow) and left hilar lymph node enlargement. There is infiltration of the lung parenchyma in the left upper lobe.

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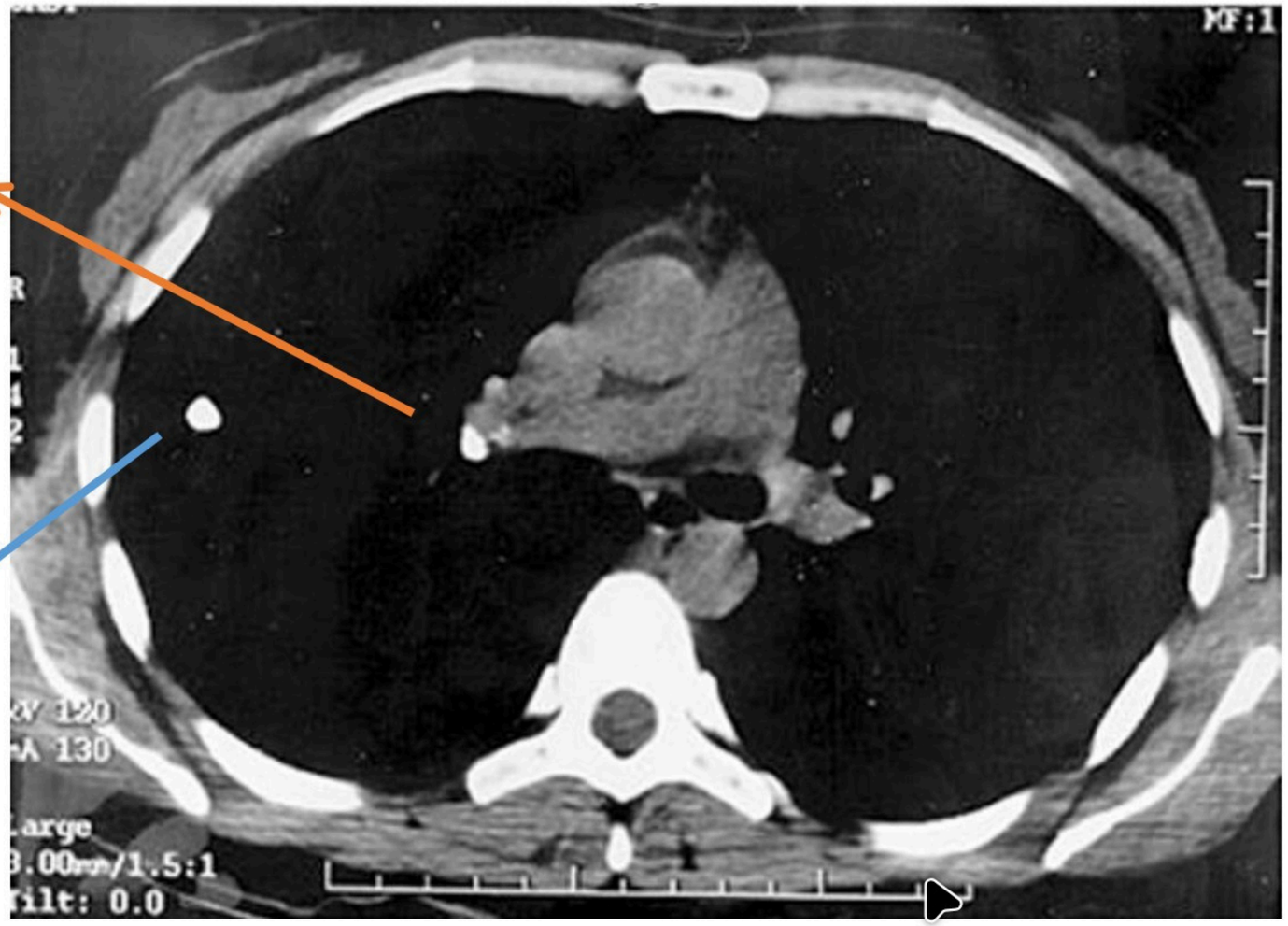
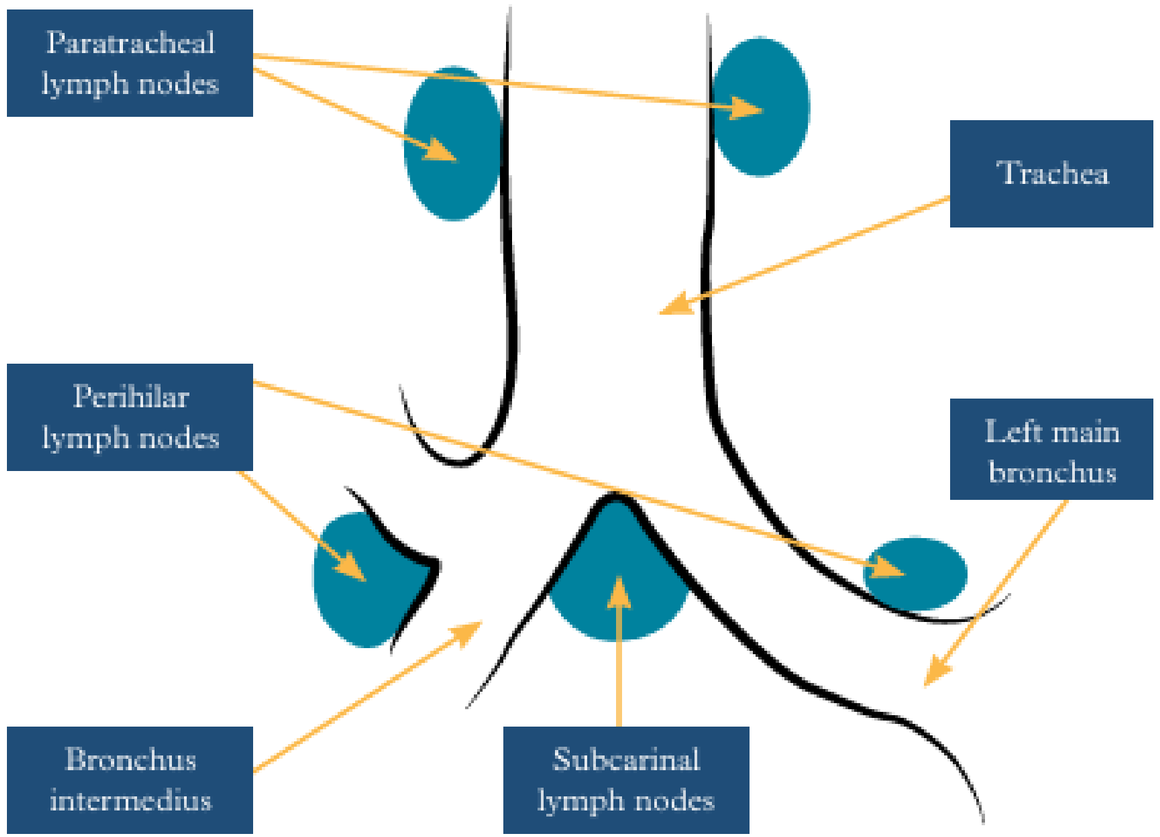
Adenomegalia hilar calcificada

Nódulo de Ghon calcificado



BOMBARDA, SIDNEY et al. Imagem em tuberculose pulmonar. J. Pneumologia [online]. 2001, vol.27, n.6 [cited 2019-11-24], pp.329-340. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-

Adenomegalia



- Principal manifestação radiográfica da tuberculose primária
- Quase totalidade dos casos na infância
- Até 40% nos adultos
- Habitualmente unilateral, podendo ser bilateral em até 30% dos casos.
- As regiões mais comprometidas são hilar, paratraqueal direita e subcarinal

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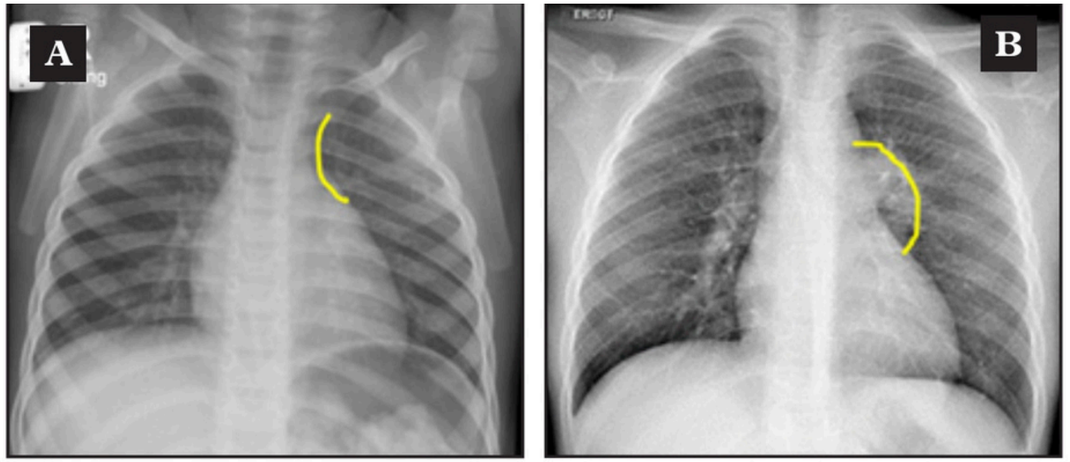

Figure 5.8: CXR A is normal - note how the hilar region has an inward convex shape. CXR B is abnormal and shows an enlarged left perihilar lymph node - note how the shape of the hilar region curves inwards.

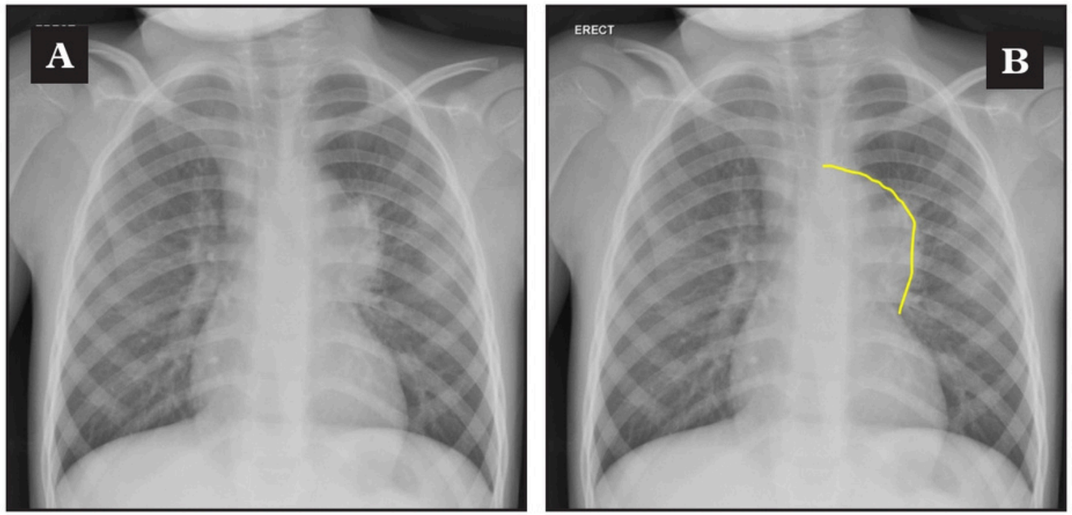

Figure 5.9: Another example of an enlarged left perihilar lymph node - CXR B is an annotated version of CXR A and shows the typical outline of an enlarged perihilar lymph node.

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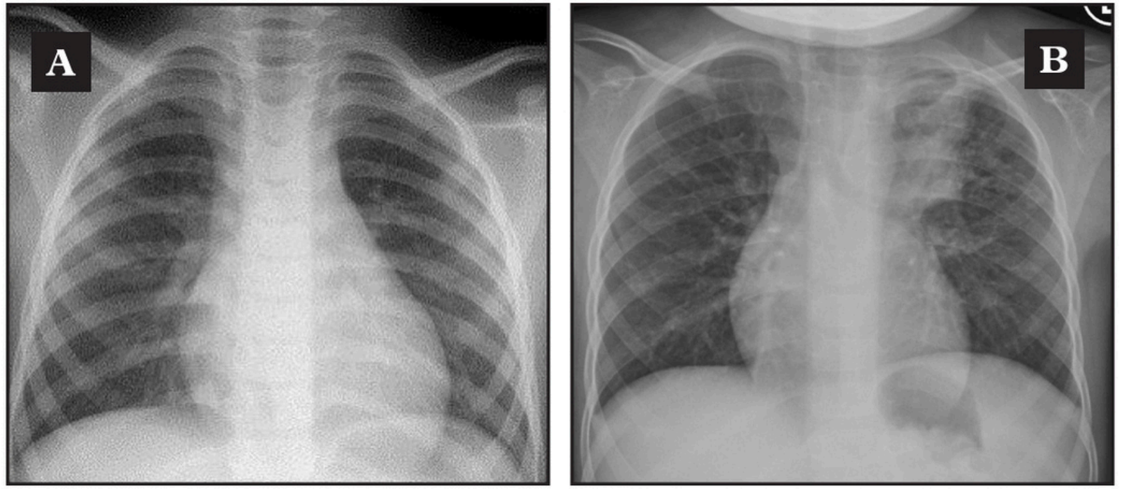

Figure 5.10: CXR A is normal, while CXR B shows the characteristic shape of an enlarged paratracheal lymph node - note the widening of the upper mediastinum on the left and the radio-opaque structure bulging outwards.

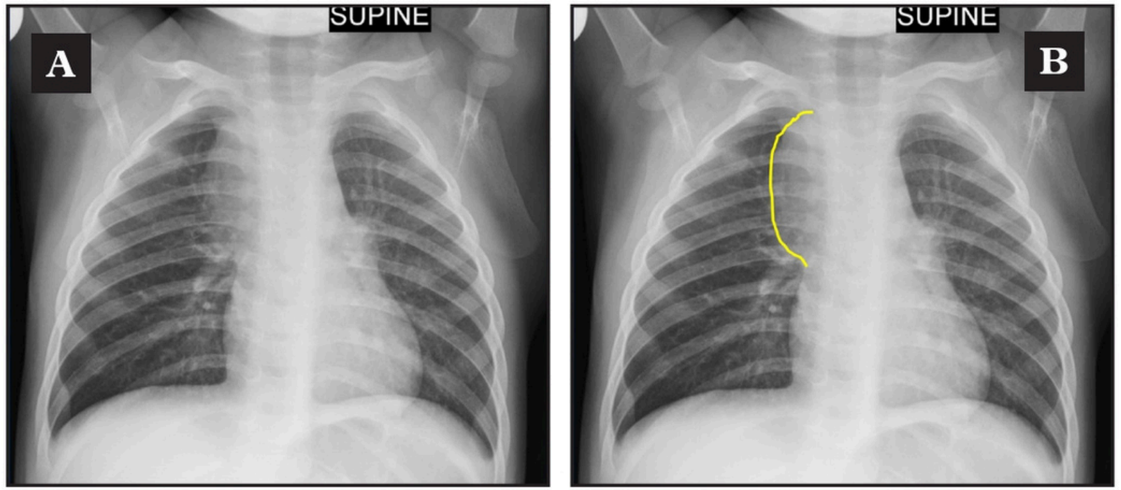

Figure 5.11: Another example of an enlarged paratracheal lymph node – this time on the right. CXR B is an annotated version of CXR A.

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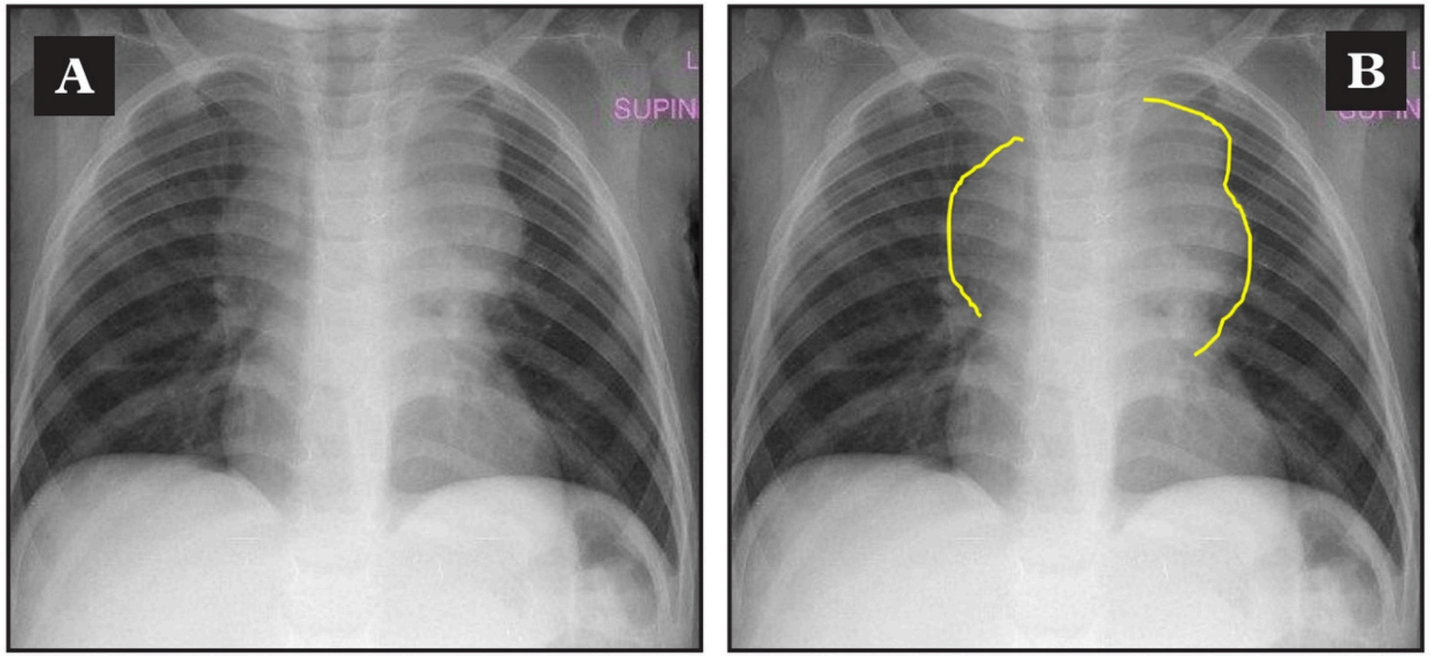

Figure 5.12: CXR B is an annotated version of CXR A - note that the mediastinum is wide and there are bilateral lobulated opacities in the mediastinum – these are enlarged paratracheal and hilar lymph nodes.

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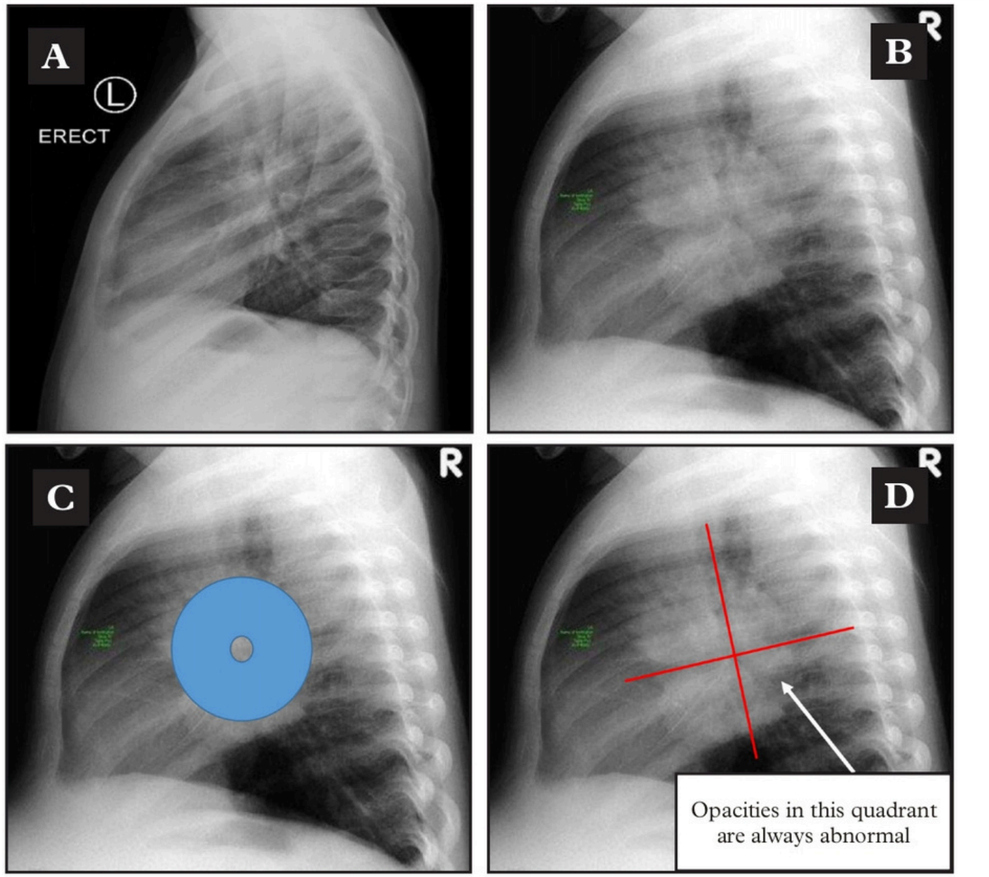

Figure 5.13: CXR A is a normal lateral film while CXR B is an abnormal lateral film with enlargement of the perihilar lymph nodes. CXRs C and D are annotated versions of CXR B. CXR C shows the "doughnut" or "hamburger" sign - the enlarged lymph nodes, posteriorly and inferiorly, make up the bottom half of the doughnut and the normal vascular structures make up the top half. CXR D demonstrates another useful trick that can be used to identify enlarged lymph nodes on the lateral CXR - draw a straight line downwards following the trachea and then draw a line perpendicular to this where the trachea ends (bifurcates) so that you have made a cross with 4 quadrants. Opacities in 3 of these 4 quadrants may represent normal anatomy but an opacity in the inferior posterior quadrant is always abnormal and likely represents enlarged sub-carinal lymph nodes.

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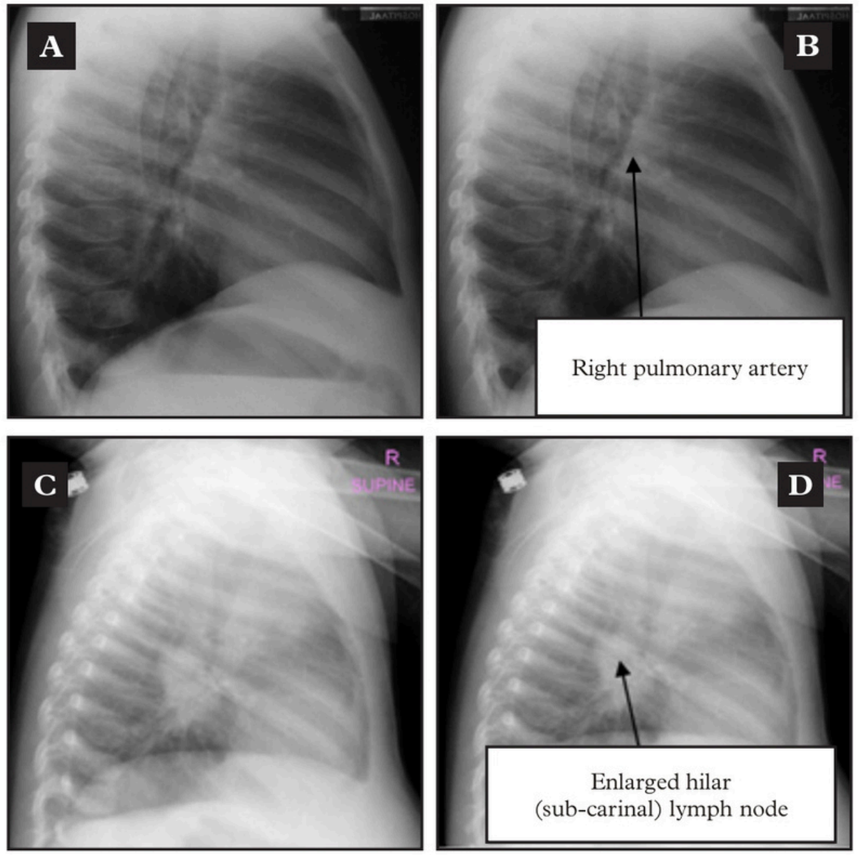

Figure 5.14: CXR B is an annotated version of CXR A. This is a normal lateral film - note the the opacity in front of the trachea which is the normal right pulmonary artery. CXR D is an annotated version of CXR C and shows an opacity that is located inferiorly and posteriorly – this is abnormal and represents an enlarged hilar (sub-carinal) lymph node. These lateral films are the other way around to the ones above so the inferior posterior quadrant is on the other side - don't be confused!

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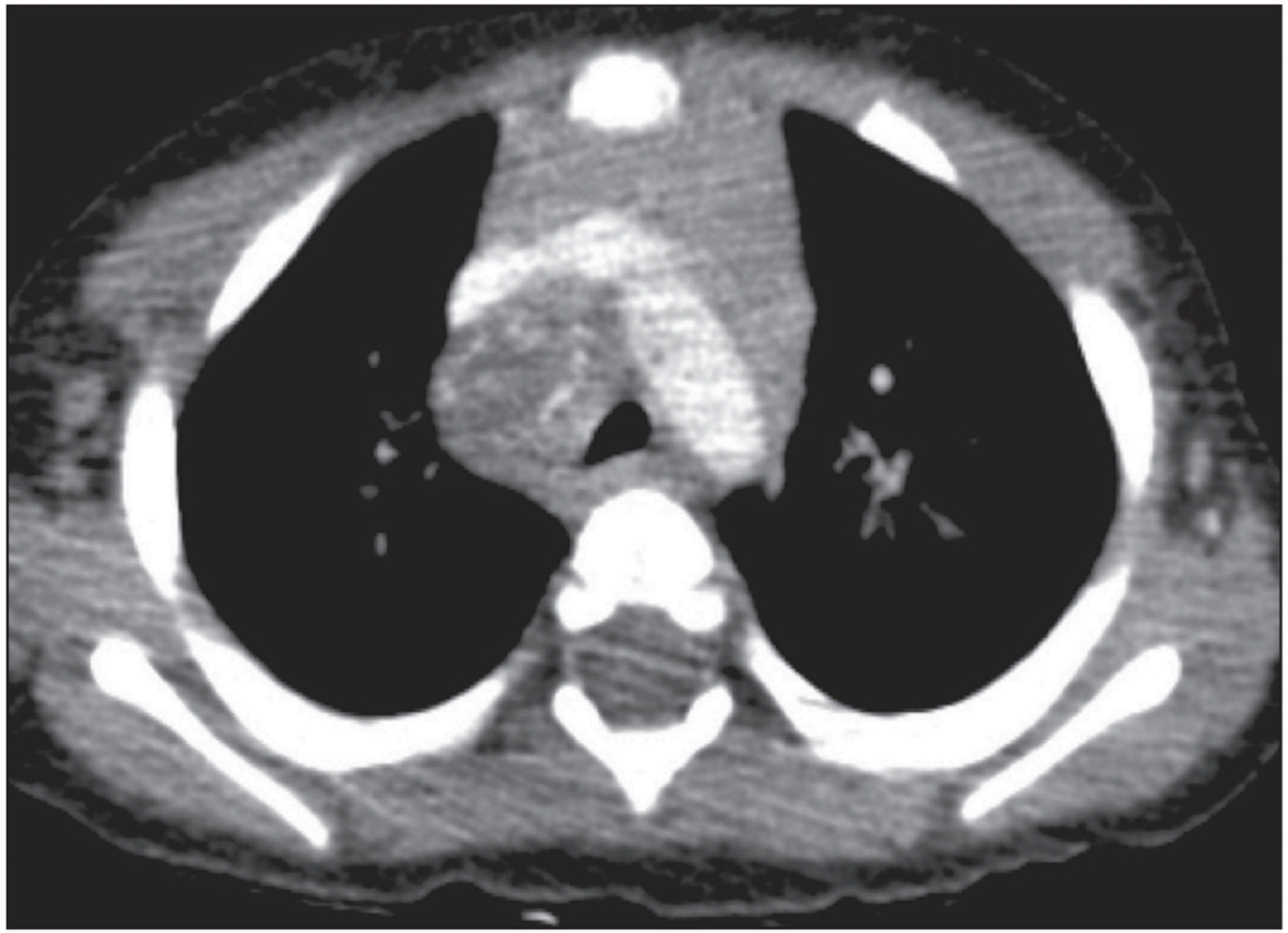
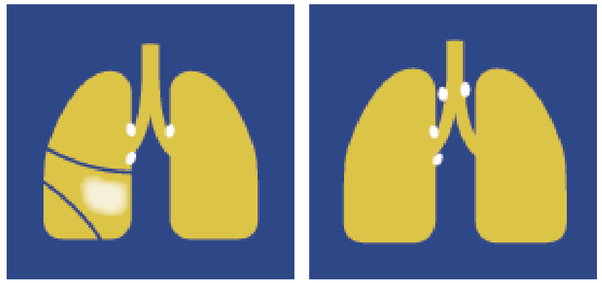
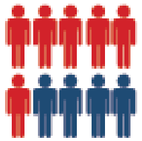


Figura 1. Lactente, oito meses. TC com contraste (janela para partes moles) demonstrando linfonodomegalia retrocaval paratraqueal direita, com centro hipodenso e realce periférico pelo meio de contraste, inferindo centro necrótico.

Santos TCS et al. Aspectos radiológicos na tomografia computadorizada em lactentes, 2019

Adenomegalia não-complicada

Uncomplicated lymph node disease

Uncomplicated lymph node disease 		Very common
		Very specific
	NON-SEVERE	Non-severe

- Sem compressão significativa da via aérea
- Acometimento de apenas um lobo ou sem envolvimento de parênquima

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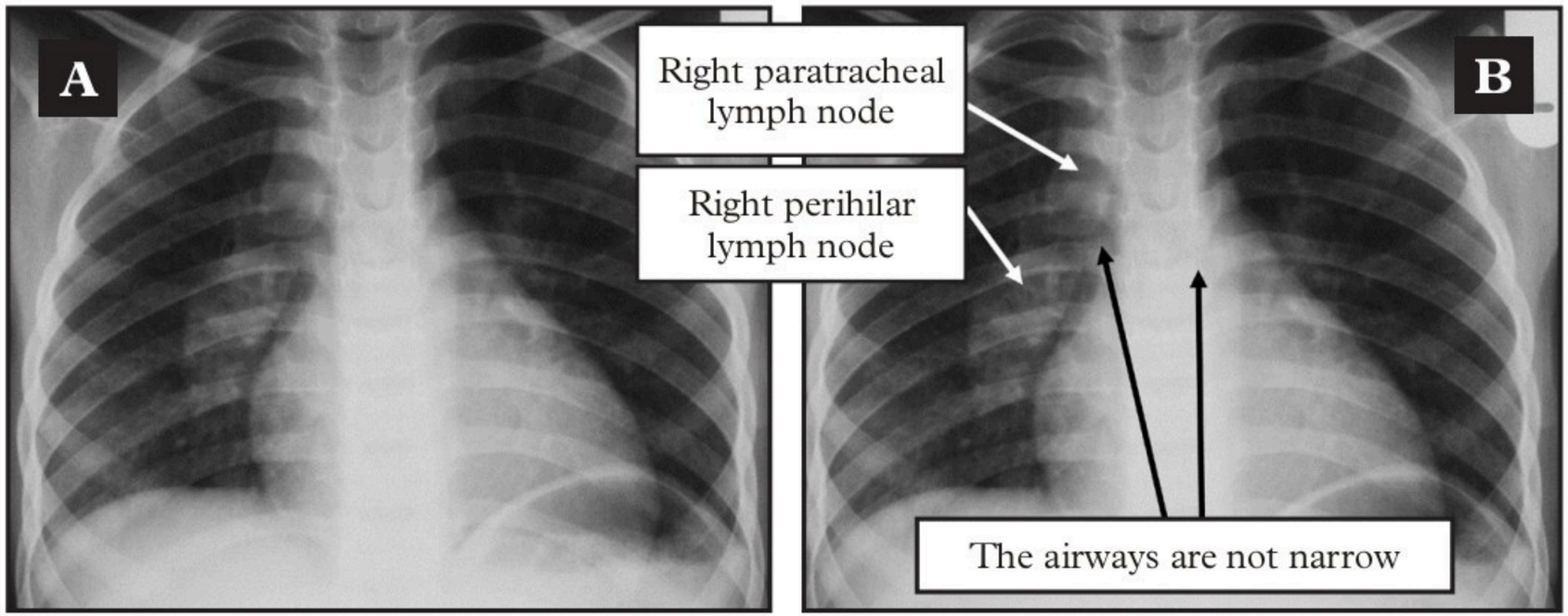

Figure 5.15: CXR B is an annotated version of CXR A which was taken from a 3-year-old child. This CXR shows an enlarged paratracheal and perihilar lymph nodes on the right, with no airway or parenchymal involvement. This is radiologically non-severe disease.

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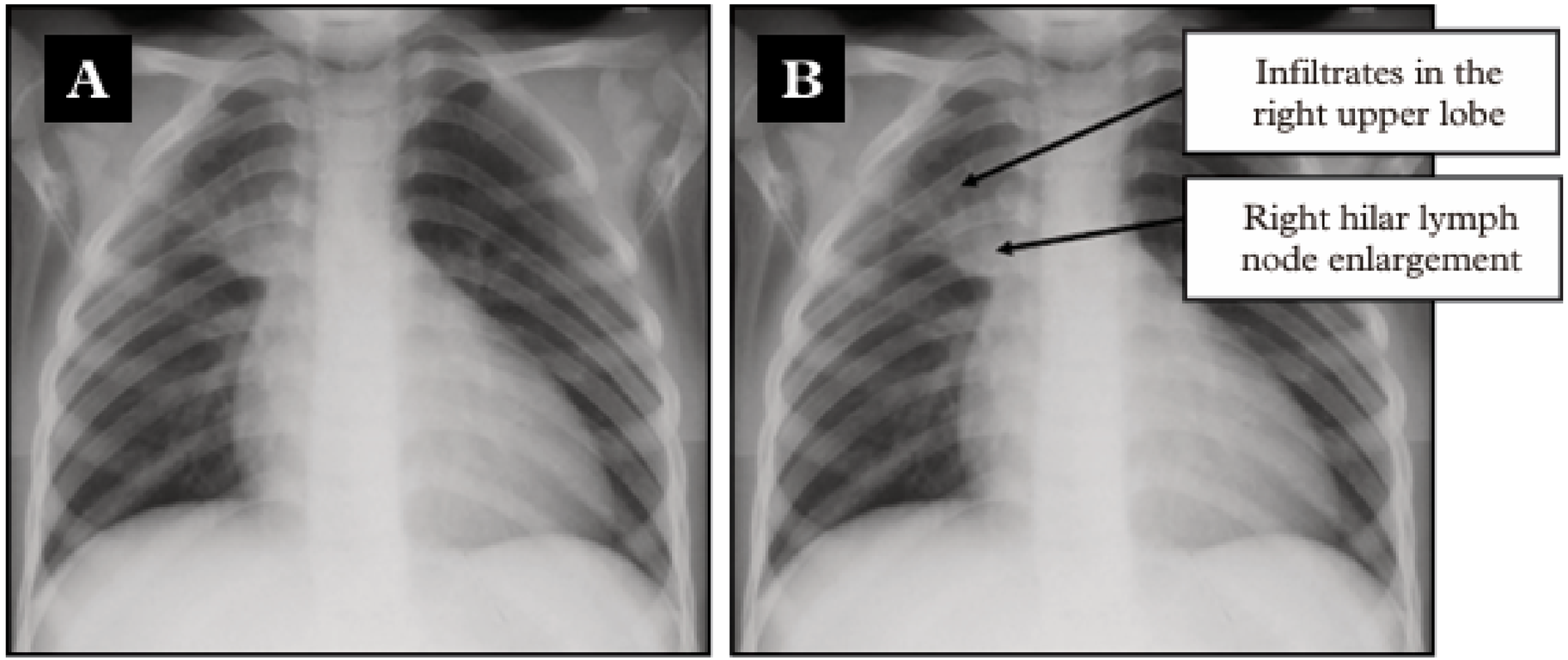

Figure 5.17: CXR B is an annotated version of CXR A taken from a 4-year-old child. This CXR shows hilar lymph node enlargement with segmental (<1 lobe) parenchymal involvement. This is radiologically non-severe disease.

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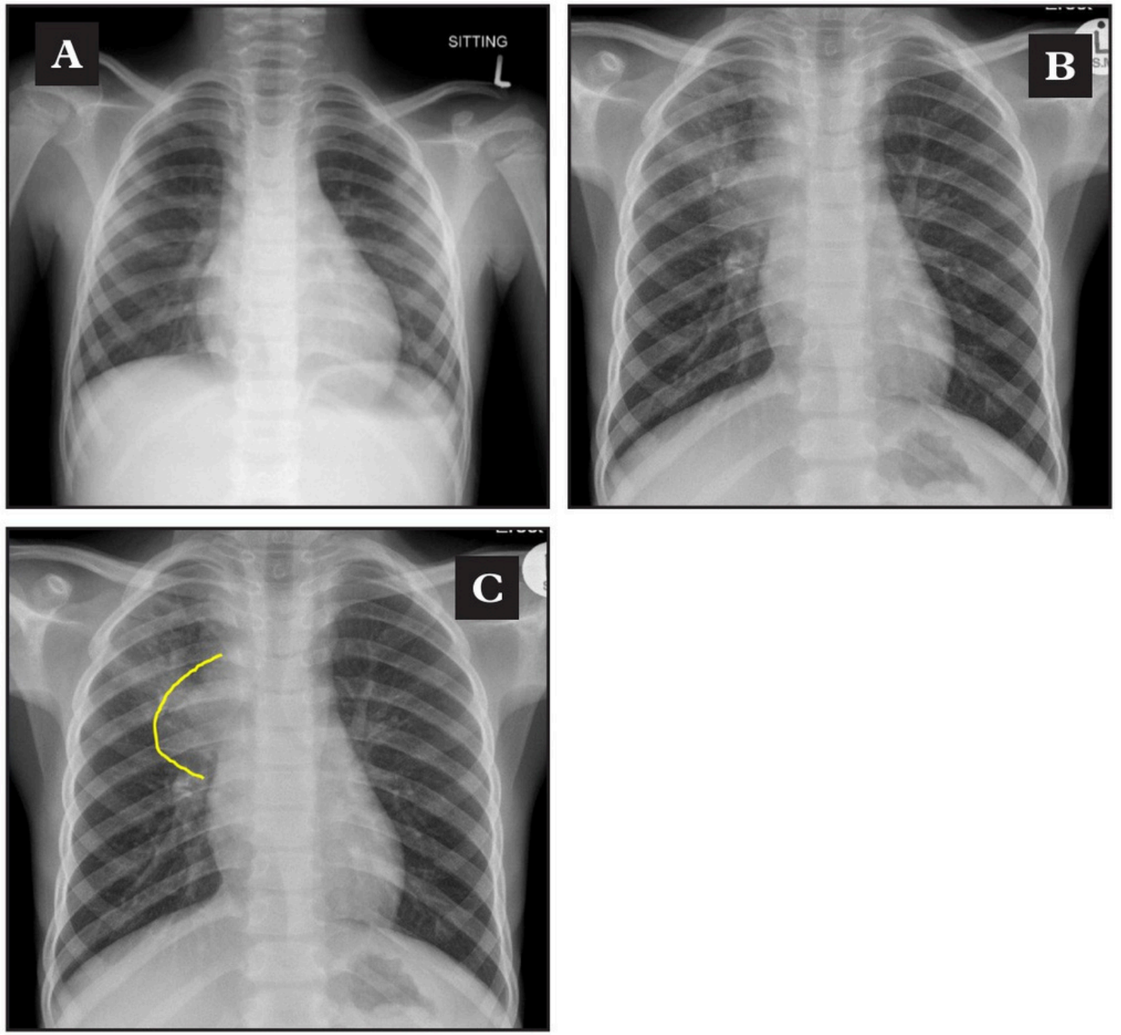

Figure 5.19: These CXRs are from 5-year-old children. CXR A is a normal CXR - note the normal concave shape of the right hilum. CXRs B and C are the same CXR but CXR C is annotated to show the opacity in the right hilar region that bulges outwards - this is not normal and is an enlarged right perihilar lymph node. This is radiologically non-severe disease.

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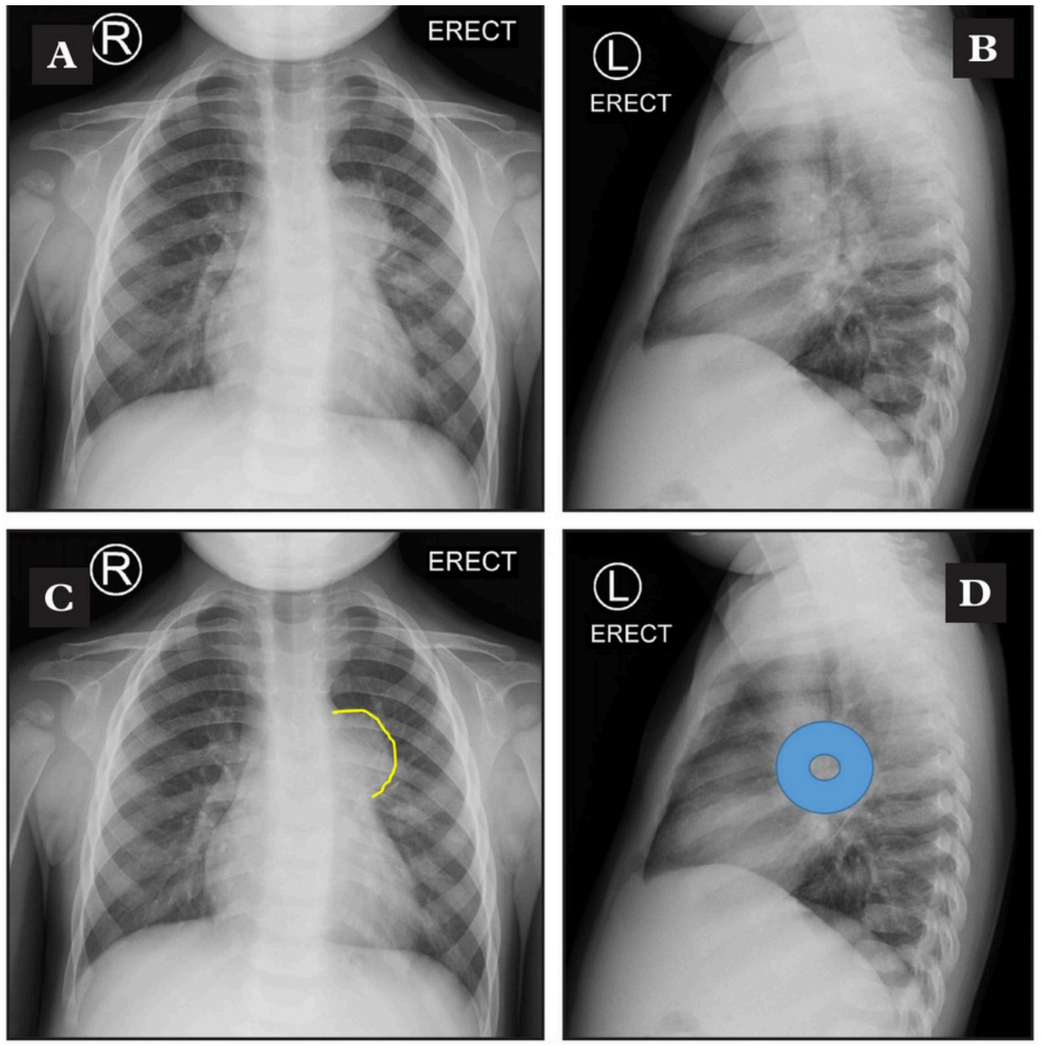

Figure 5.16: CXR C and D are annotated versions of CXR A and B. These are AP and lateral films taken from a 4-year-old child. They show enlargement of left perihilar lymph nodes with no airway or parenchymal involvement. Note the annotated doughnut/hamburger sign on CXR D. This is radiologically non-severe disease.

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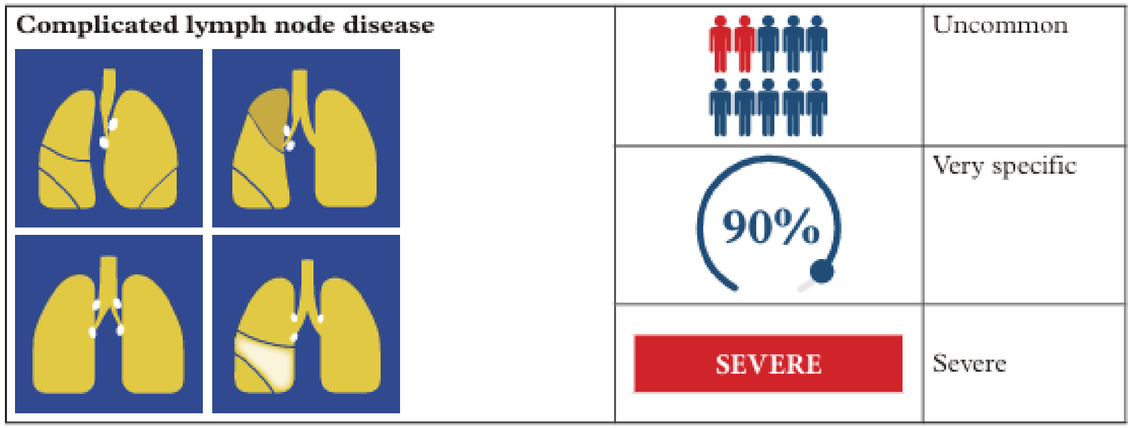
Adenomegalia complicada



Adenomegalia e:

- compressão ou desvio da via aérea;
- hiperinsuflação ou atelectasia;
- envolvimento de mais de um lobo.

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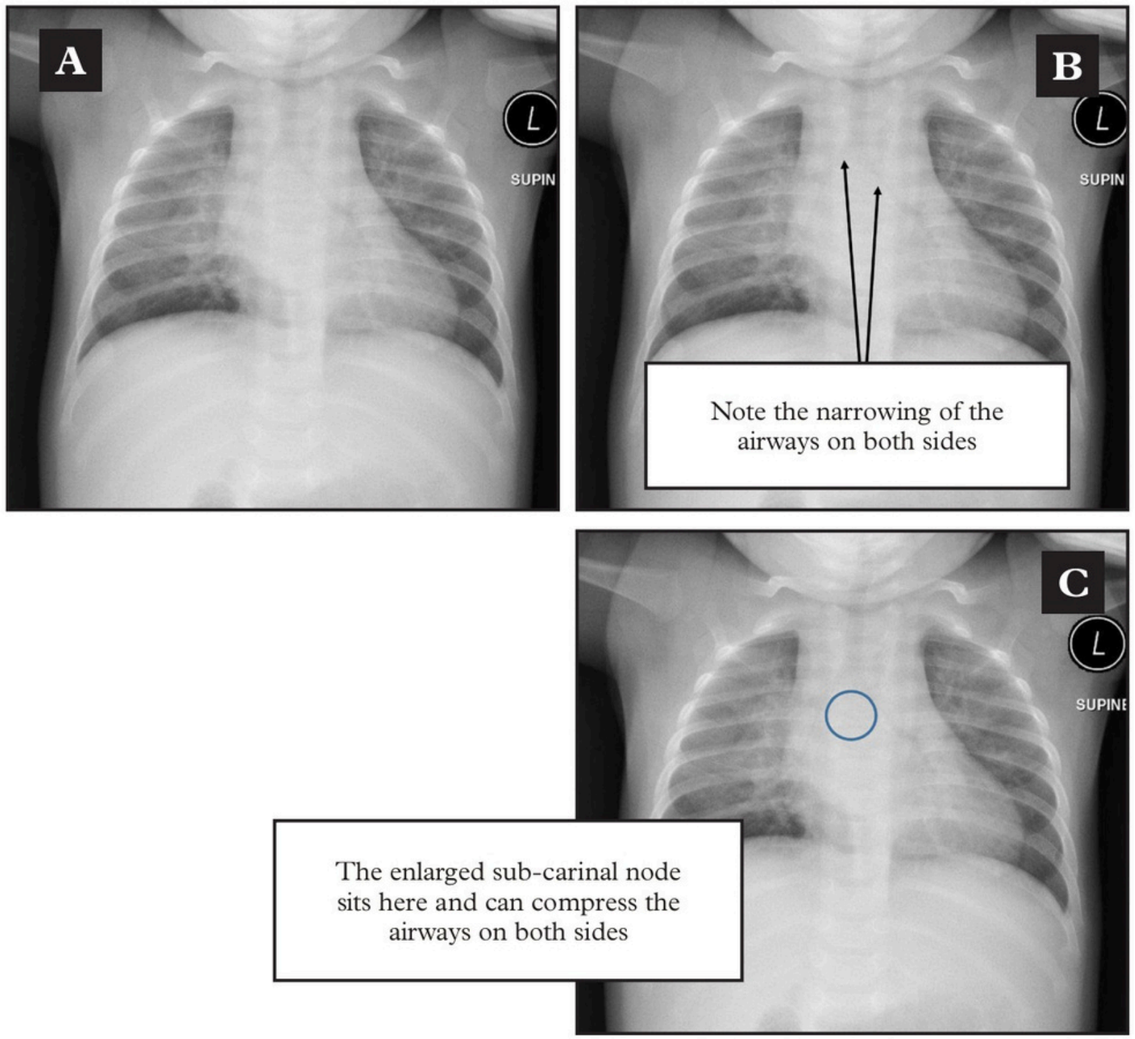

Figure 5.23: CXR A, B and C are all the same AP CXR, taken from a 1-year-old child. This CXR shows bilateral airway narrowing (annotated in CXR B). You can see the impression of an enlarged sub-carinal lymph node annotated as the circle on CXR C. This is radiologically severe disease because there is large airway involvement

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In young children, compression or deviation of the large airways can indicate enlargement of mediastinal lymph nodes, even if the lymph nodes cannot be seen.

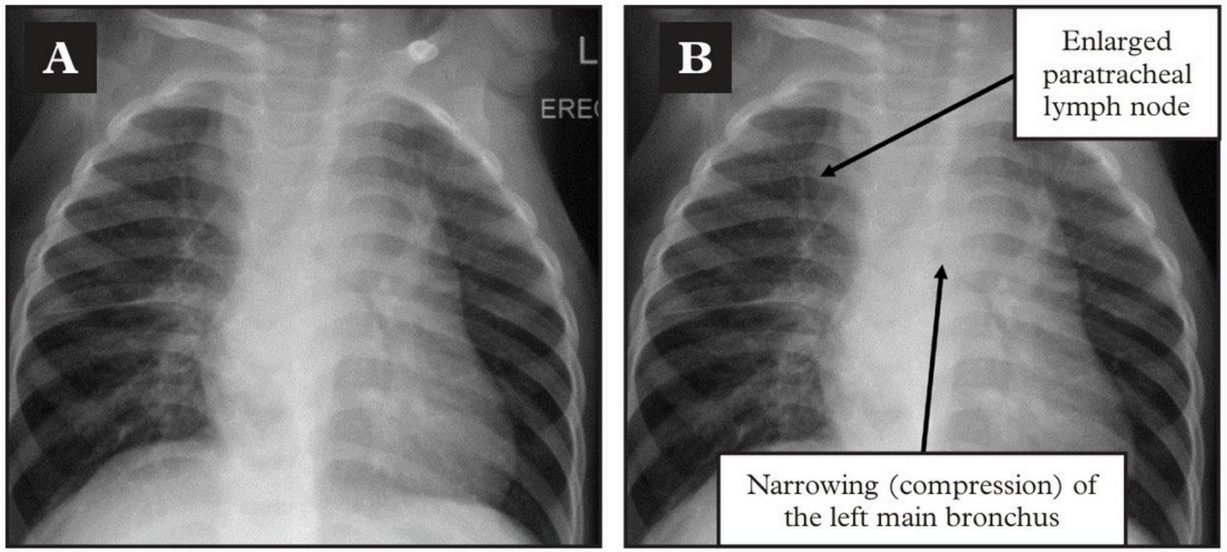

Figure 5.22 CXR B is an annotated version of CXR A, an AP CXR taken from a 3-year-old child. There is an enlarged right paratracheal lymph node that has caused the trachea to shift to the left. There is also narrowing of the left main bronchus – this is caused by enlarged hilar (including sub-carinal) lymph nodes compressing the airway. The lymph nodes themselves are not always easy to see (as is the case with the perihilar lymph nodes in this CXR).

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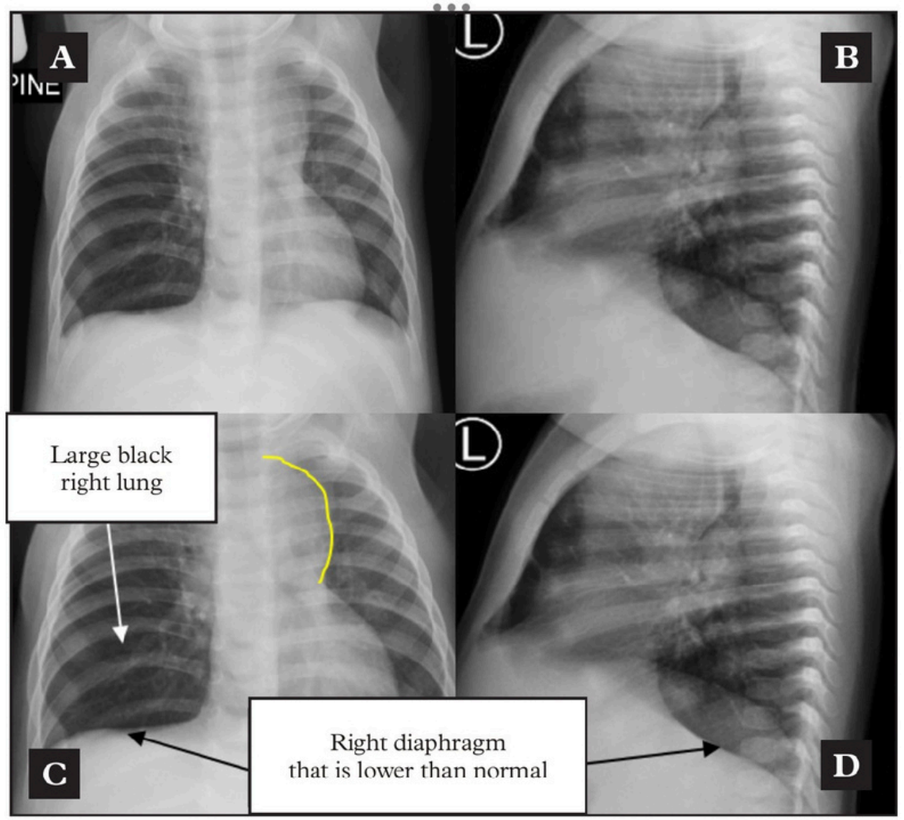

Figure 5.28: CXRs C and D are annotated versions of CXRs A and B that were taken from a 4-year-old child. Note that the right lung appears larger than the left and has decreased vascularity. The right diaphragm is lower than the left when it should be higher and is very flat. The mediastinal structures are pushed across to the left. There is air in front of the heart on the lateral film due to herniation of the right lung across the mediastinum. This is caused by partial obstruction of the right main bronchus/bronchus intermedius and hyperinflation of the right middle and lower lobes: check valve effect. This is radiologically severe disease.

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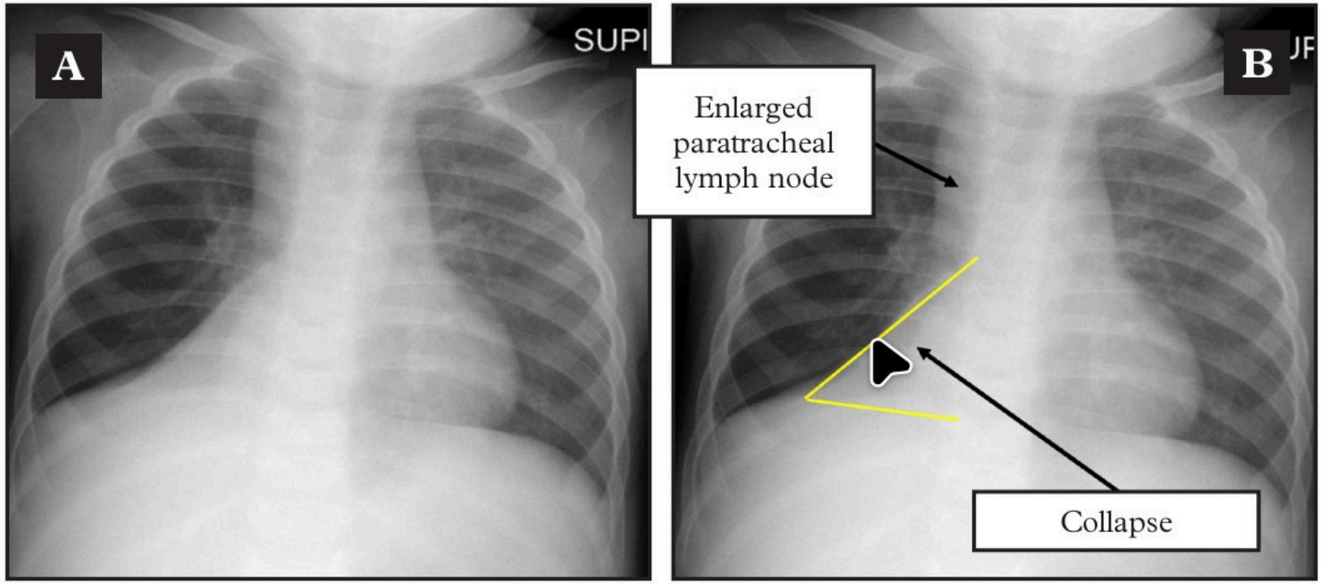

Figure 5.30: CXR B is an annotated version of CXR A which was taken from a 2-year-old child. This CXR shows collapse of the right middle lobe and right lower lobe due to lymph node compression of the bronchus intermedius. Note the large right paratracheal lymph node which is pushing the trachea to the left.

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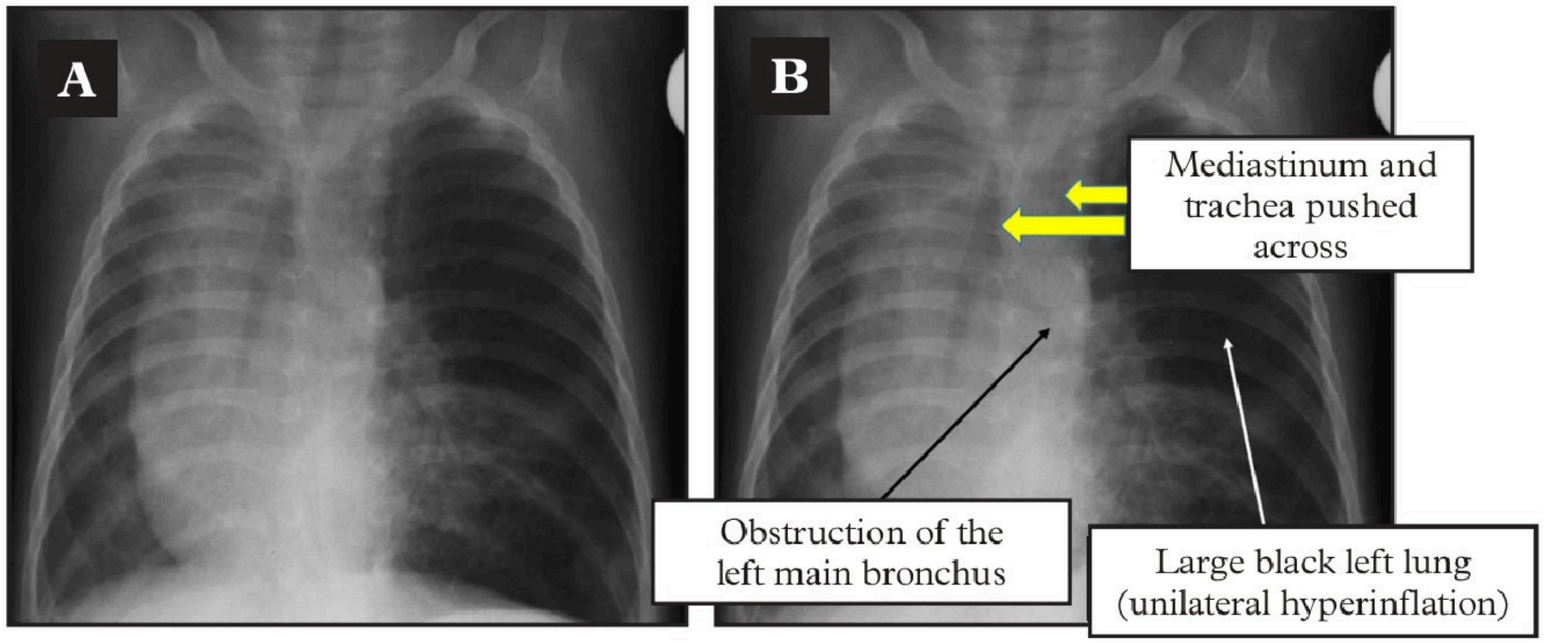

Figure 5.27: CXR B is an annotated version of CXR A. This CXR shows obstruction of the left main bronchus causing a "check valve" effect with hyperinflation of the left lung. Because the airway is only partially obstructed air can enter the left lung and is herniating across to the right but cannot exit – the left lung is enlarged with decreased vascularity and the mediastinal structures are pushed across to the right.

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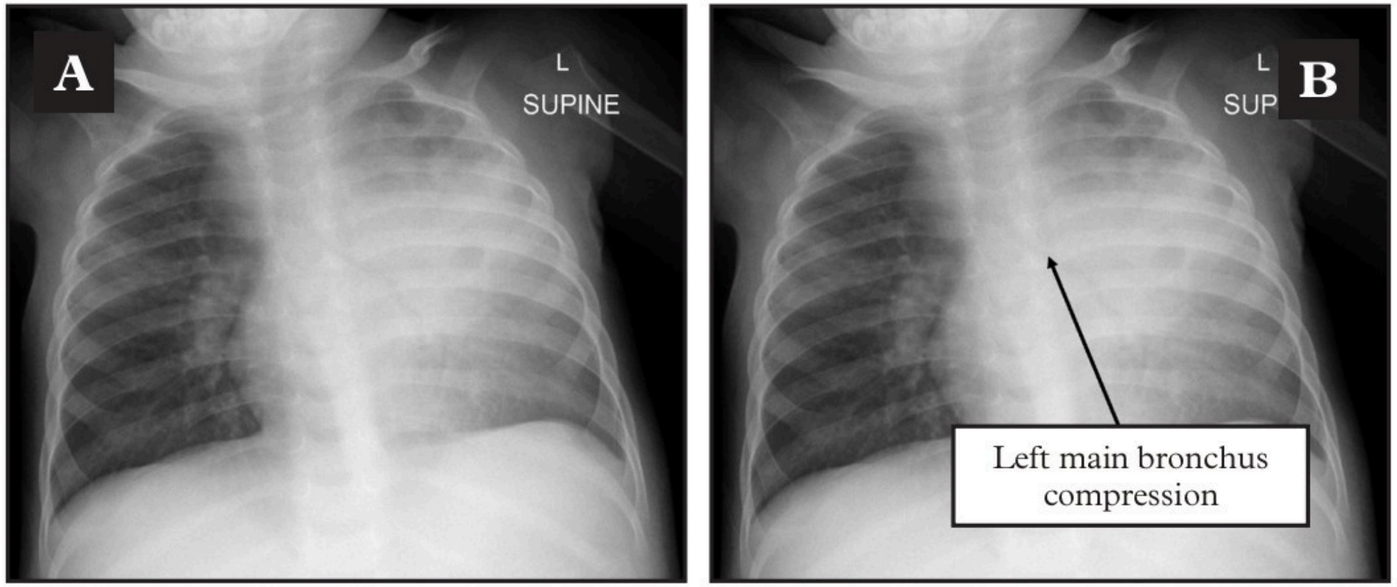

Figure 5.31: CXR B is an annotated version of CXR A showing dense lobar opacification of the left upper lobe with narrowing of the left main bronchus. This CXR nicely demonstrates how the effect of enlarged lymph nodes can be seen on the CXR (narrowing of the airway) even though the lymph nodes may not be clearly seen. A lateral film would have been helpful here. This is radiologically severe disease.

Complicated lymph node disease is the result of enlarged lymph nodes narrowing, obstructing or ulcerating into the large airways.

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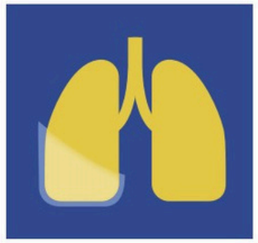
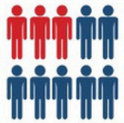
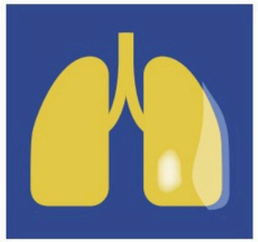
Derrame pleural

Simple pleural effusion 		Fairly common
		Specific
	NON-SEVERE	Non-severe
Complicated pleural effusion 		Uncommon
		Specific
	SEVERE	Severe

- O envolvimento pleural é considerado uma manifestação tardia da tuberculose primária.
- Ocorrendo em cerca de um quarto dos casos.
- É frequentemente unilateral e de pequeno volume.
    - Realizar cultura e ADA

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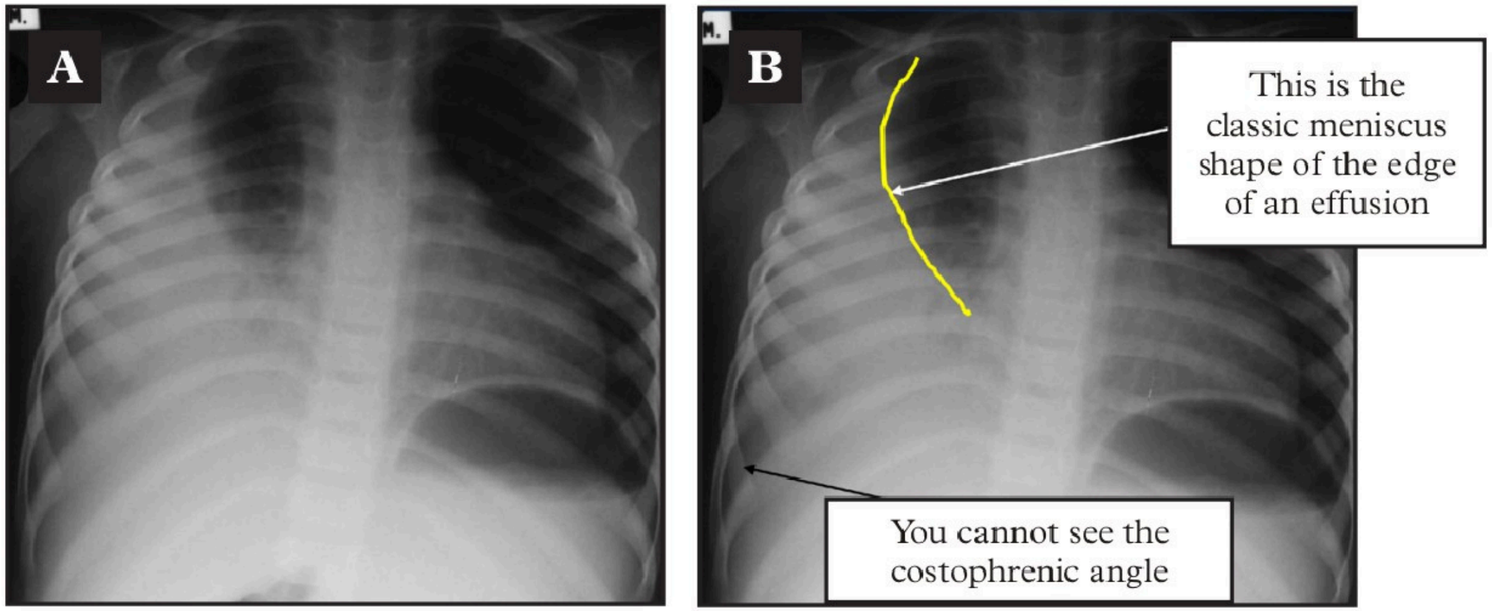

Figure 5.32: CXR B is an annotated version of CXR A, taken from a 6-year-old child. It shows a simple right-sided pleural effusion with no other radiological features of TB visible and no obvious parenchymal involvement. Note the classic meniscus shape of the effusion edge, which slopes downwards medially. This is a simple pleural effusion which is classified as non-severe radiological disease. This CXR pattern is more common in older children and adolescents.

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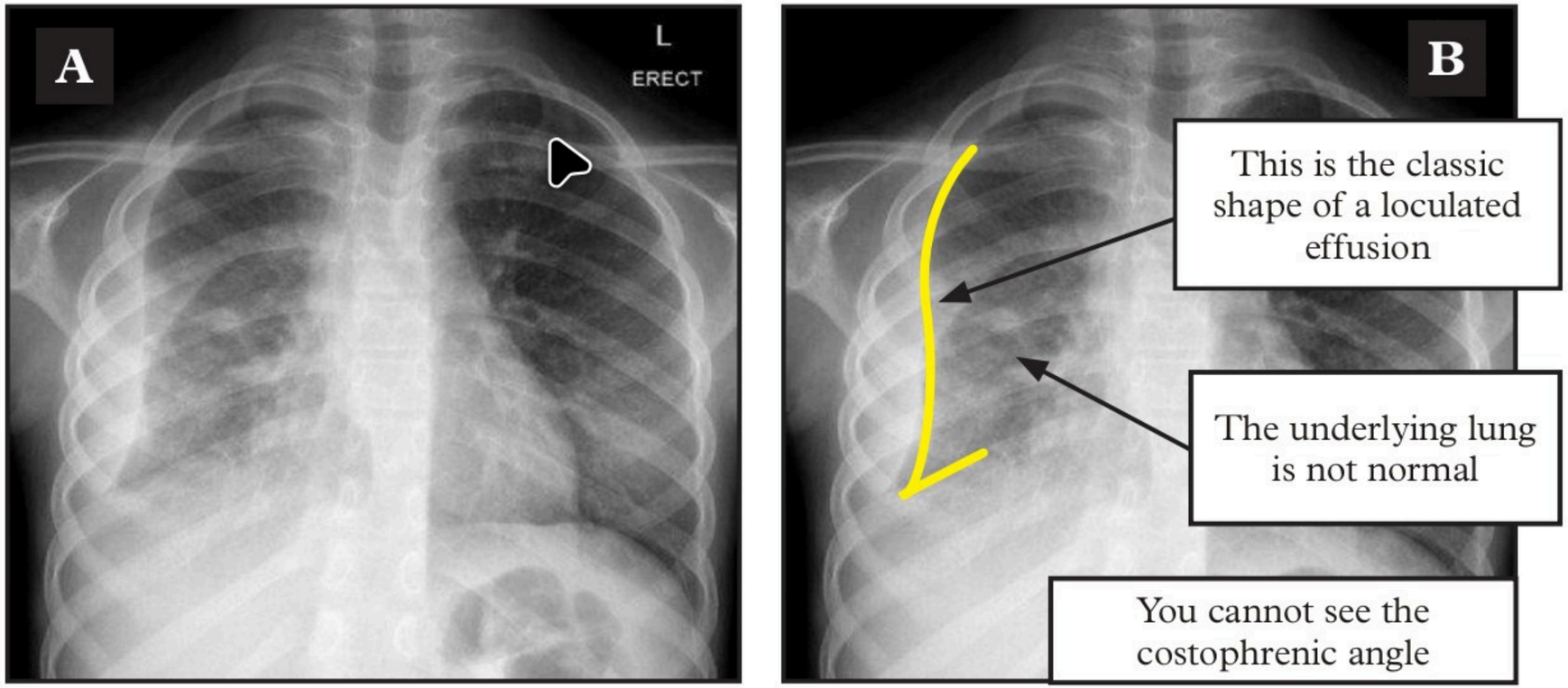

Figure 5.33: CXR B is an annotated version of CXR A and shows a right-sided loculated effusion with underlying lung disease. This is radiologically severe disease.

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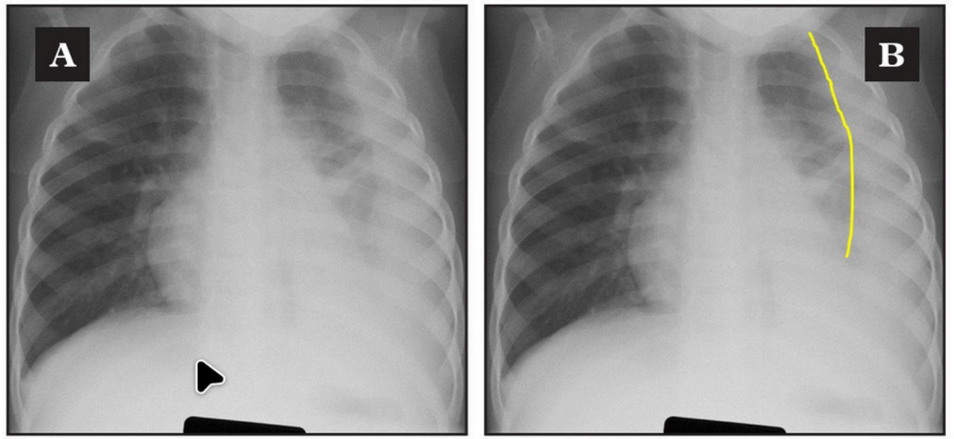

Figure 5.34: This CXR was taken from a 7-year-old child. CXR B is the same as CXR A but the edge of the effusion is annotated. This is a left-sided pleural effusion. There is also underlying lung parenchymal disease (the underlying lung appears whiter). This is radiologically severe disease.

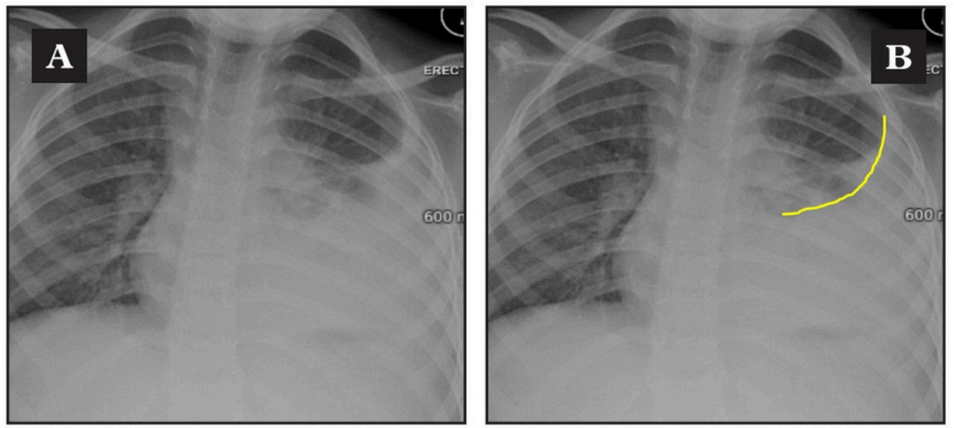

Figure 5.35: This CXR, from a 3-year-old child, shows a large simple pleural effusion on the left. Note the meniscus shape of the edge of the effusion annotated on CXR B (CXR A is a clean version of the same CXR). This is radiologically non-severe disease because there is no loculation, no significant mediastinal shift and because the underlying lung parenchyma that can be seen looks normal.

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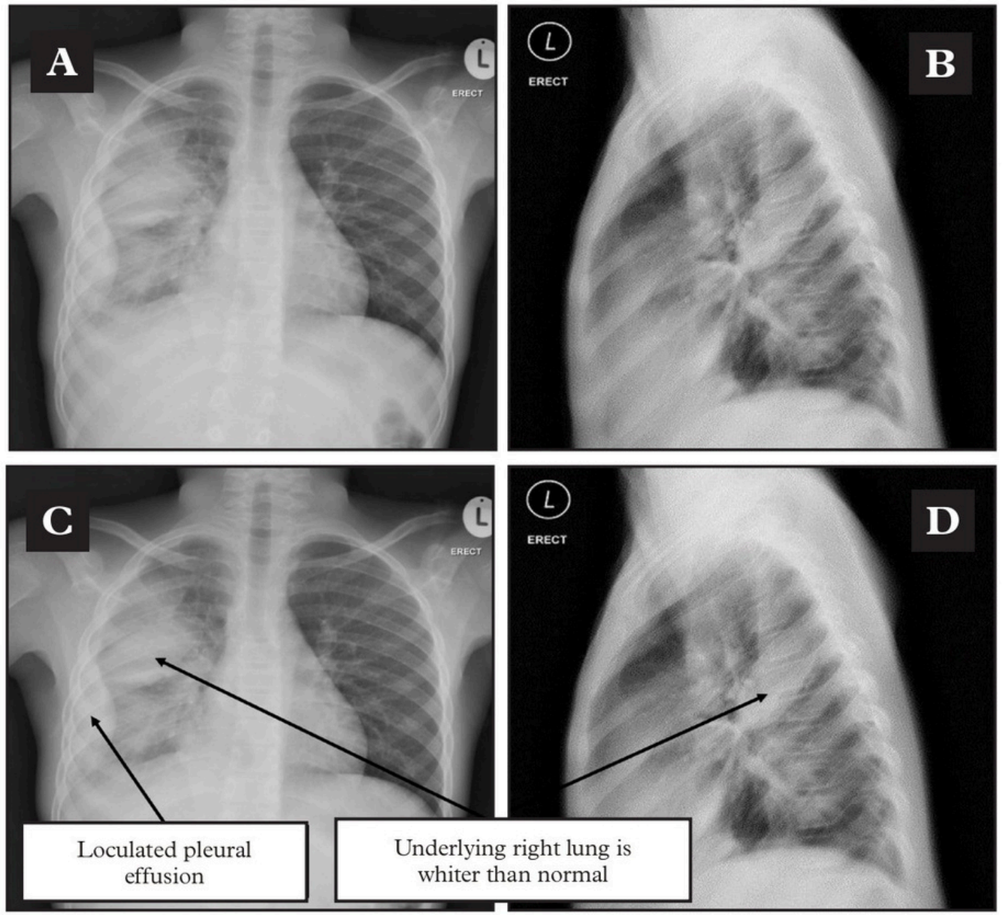

Figure 5.37: The set of CXRs A and B are the same as the set of CXRs C and D, but CXRs C and D are annotated. These CXRs were taken from an 8-year-old child and they show a right-sided loculated pleural effusion. Note the opacification that tracks the pleura on the right. This is the classic shape of a loculated pleural effusion. The underlying lung parenchyma on the right is not normal (whiter than usual). This is due to likely alveolar opacification "consolidation" in that lung. This is radiologically severe disease.

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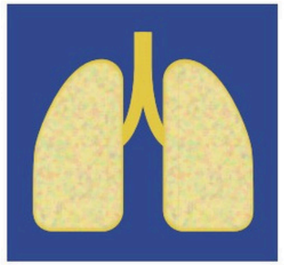
Miliar

5.2.4 Miliary disease

Miliary disease 		Uncommon
		Very specific
	SEVERE	Severe

- Traduz a forma disseminada da tuberculose
- Ocorre notadamente em indivíduos imunossuprimidos e crianças não vacinadas
- Pode haver comprometimento concomitante de outros órgãos.

PALMER, M. et al. Diagnostic CXR Atlas for Tuberculosis in Children. 2. ed. 2022

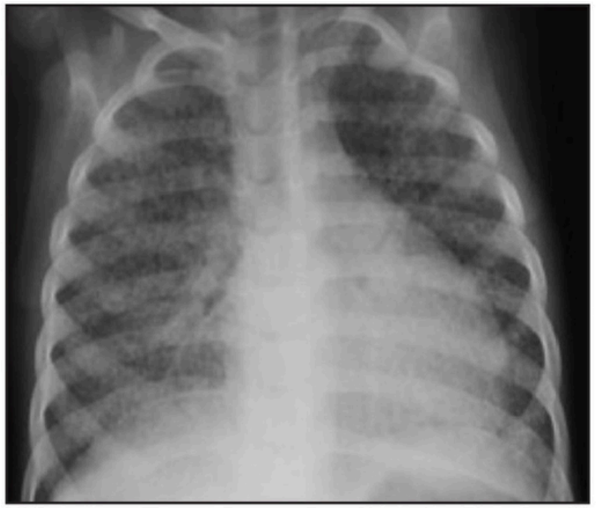


Figure 5.38: This CXR shows fine millet-sized nodules typically seen in miliary TB. The nodules are all of similar size and evenly spread throughout both lung fields. No other radiological signs of primary TB are visible. This is radiologically severe disease.

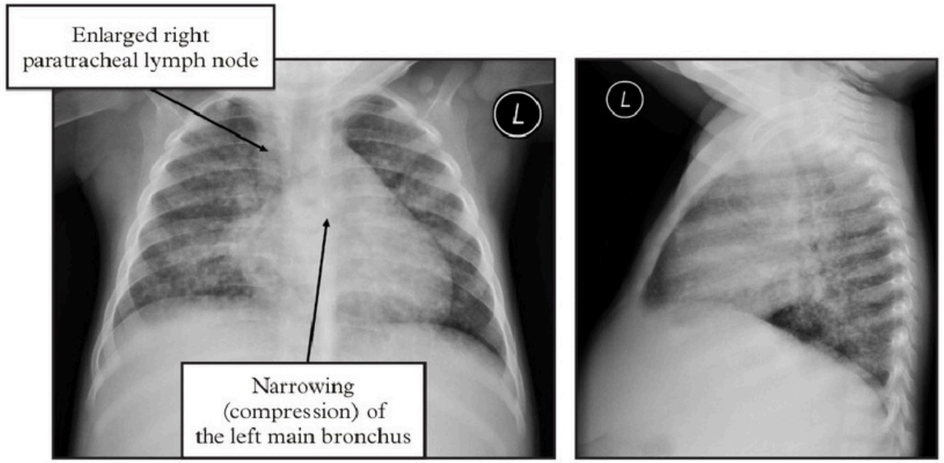


Figure 5.39: This CXR shows miliary infiltrates similar to those described in Figure 5.38. There is also an enlarged paratracheal lymph node on the right and the left main bronchus appears narrowed.

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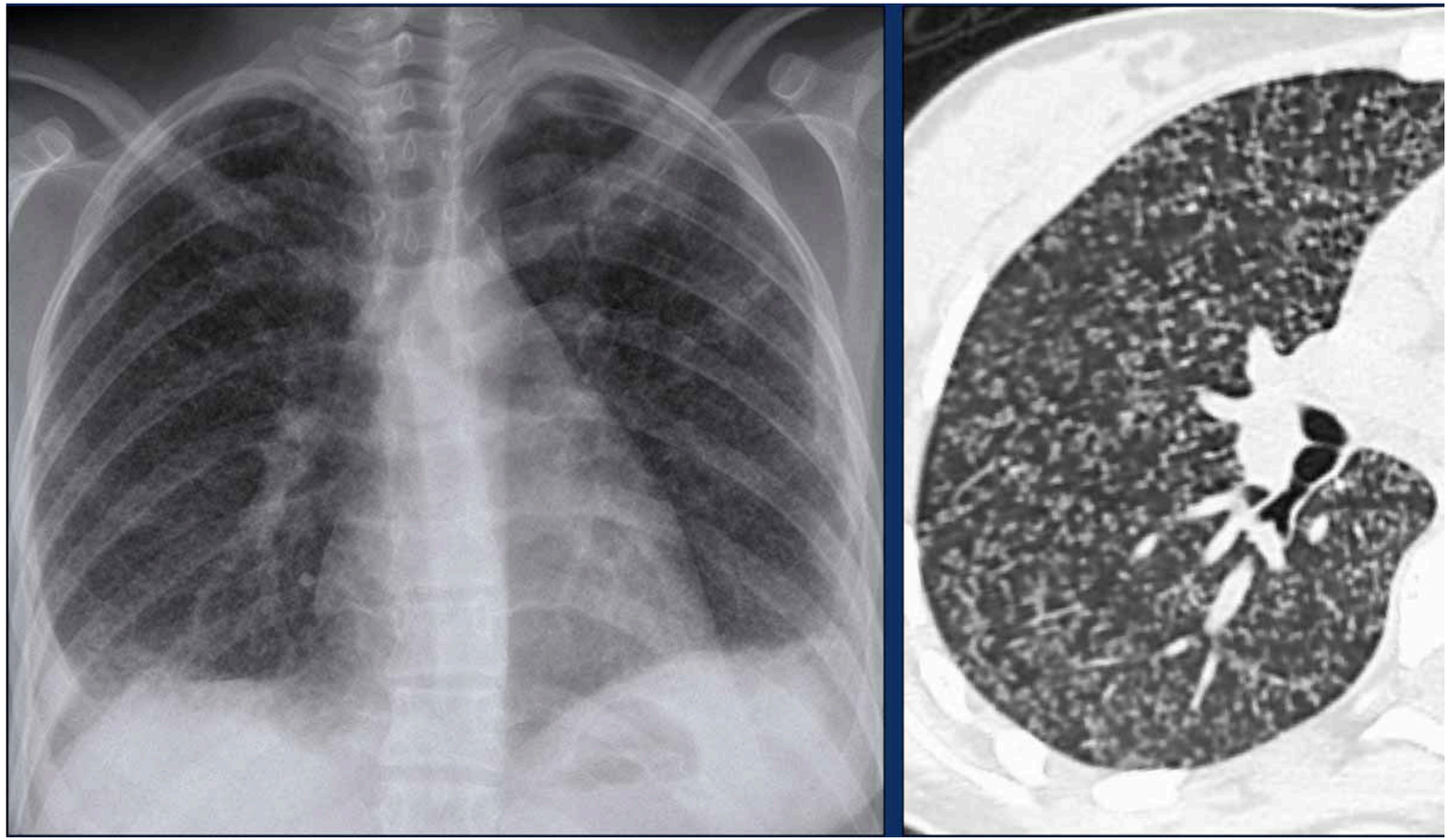
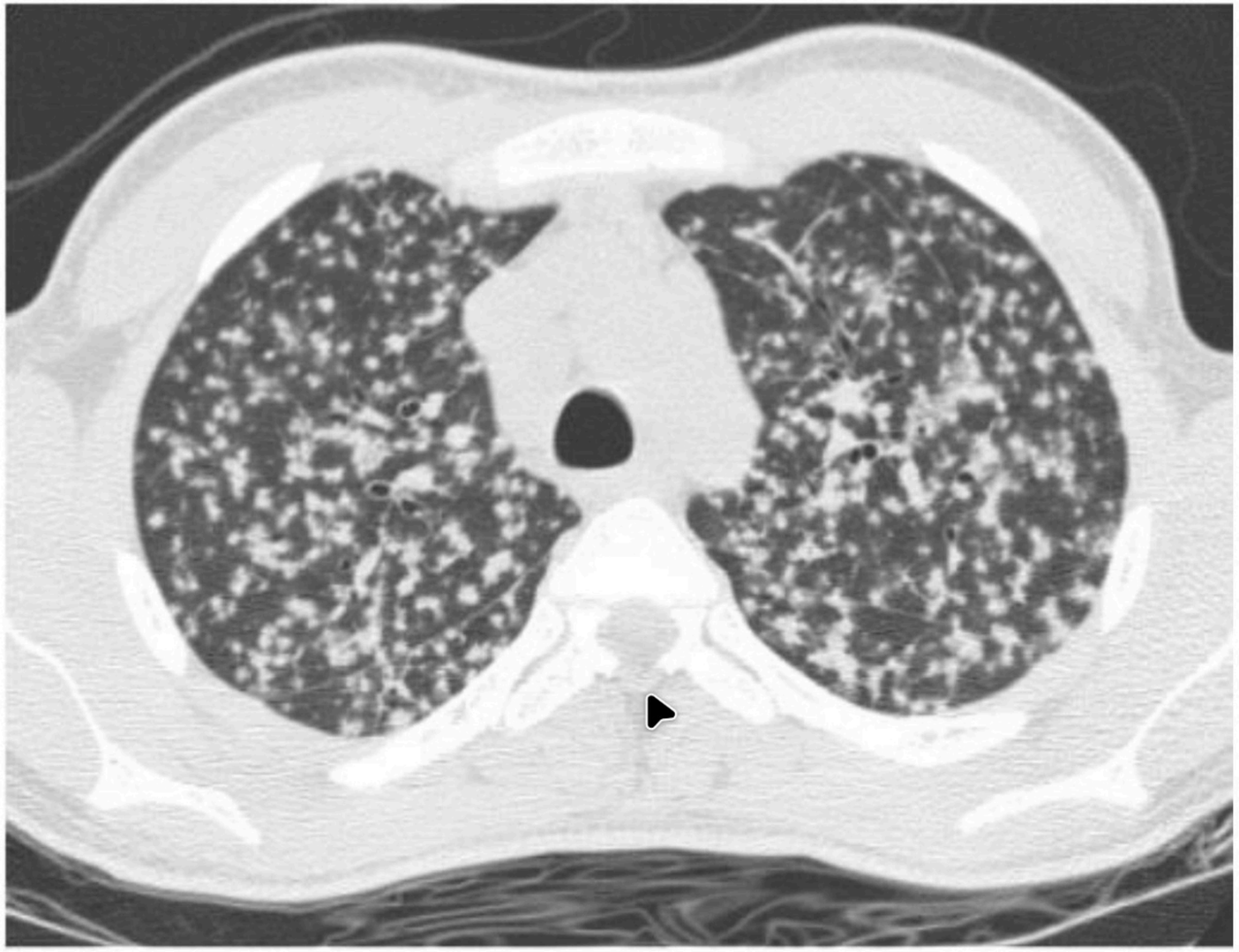


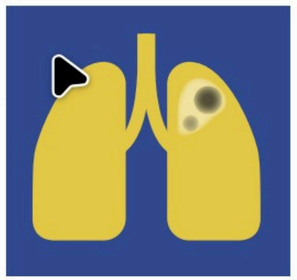
Disponível em: https://radiologyassistant.nl/chest/tb/tuberculosis



Case courtesy of Dr Mohammad Osama Yonso, Radiopaedia.org, rID: 22782

Cavidade

5.2.5 Cavitary disease

Cavitary disease 		Uncommon
		Very specific
	SEVERE	Severe

PALMER, M. et al. Diagnostic CXR Atlas for Tuberculosis in Children. 2. ed. 2022

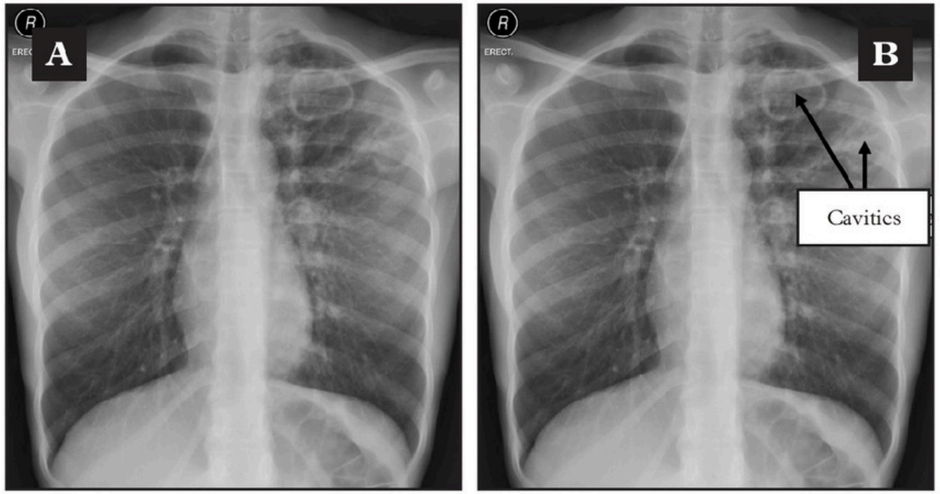


Figure 5.44: This PA CXR was taken from an 11-year-old child. This CXR (CXR A is clean and CXR B is annotated) shows cavities in the left upper lobe. In adult-type disease cavities are typically seen in the upper lobes and apices of the lower lobes.

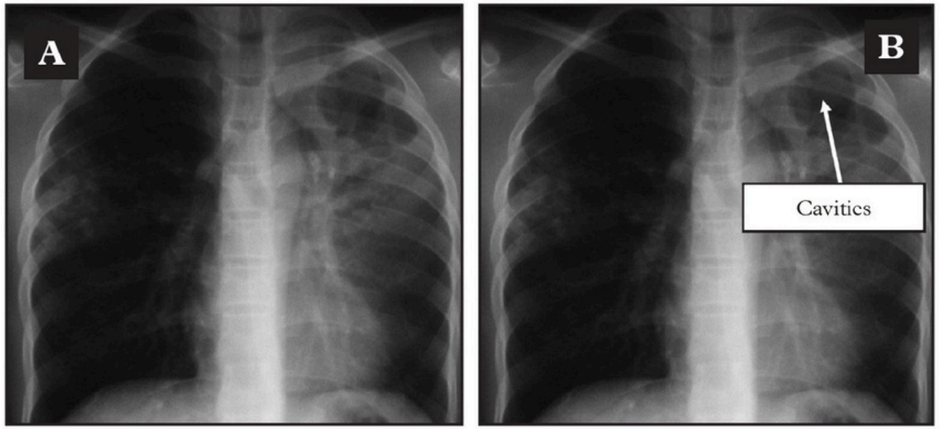


Figure 5.45: CXR B is an annotated version of CXR A. This CXR shows a case of post-primary TB in a 10-year-old child. Cavities are present in the left upper lobe. This patient was sputum smear positive. This CXR is over-penetrated.

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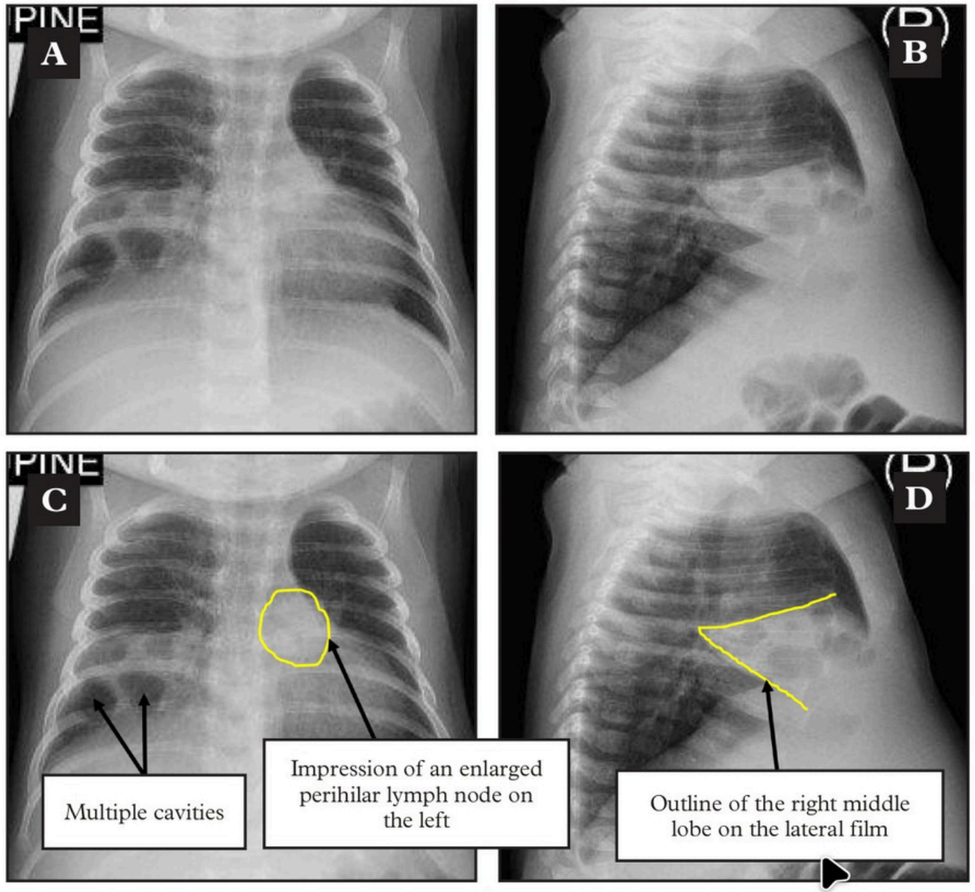

Figure 5.40: CXRs A and CXR B are a set of AP and lateral CXRs taken from a 3-year-old child. CXRs C and D are the same set of CXRs but they are annotated. Note the right middle lobe opacification with breakdown (cavity formation). There is possibly an enlarged left hilar node visible but it is not obvious. This is radiologically severe disease.

PALMER, M. et al. Diagnostic CXR Atlas for Tuberculosis in Children. 2. ed. 2022

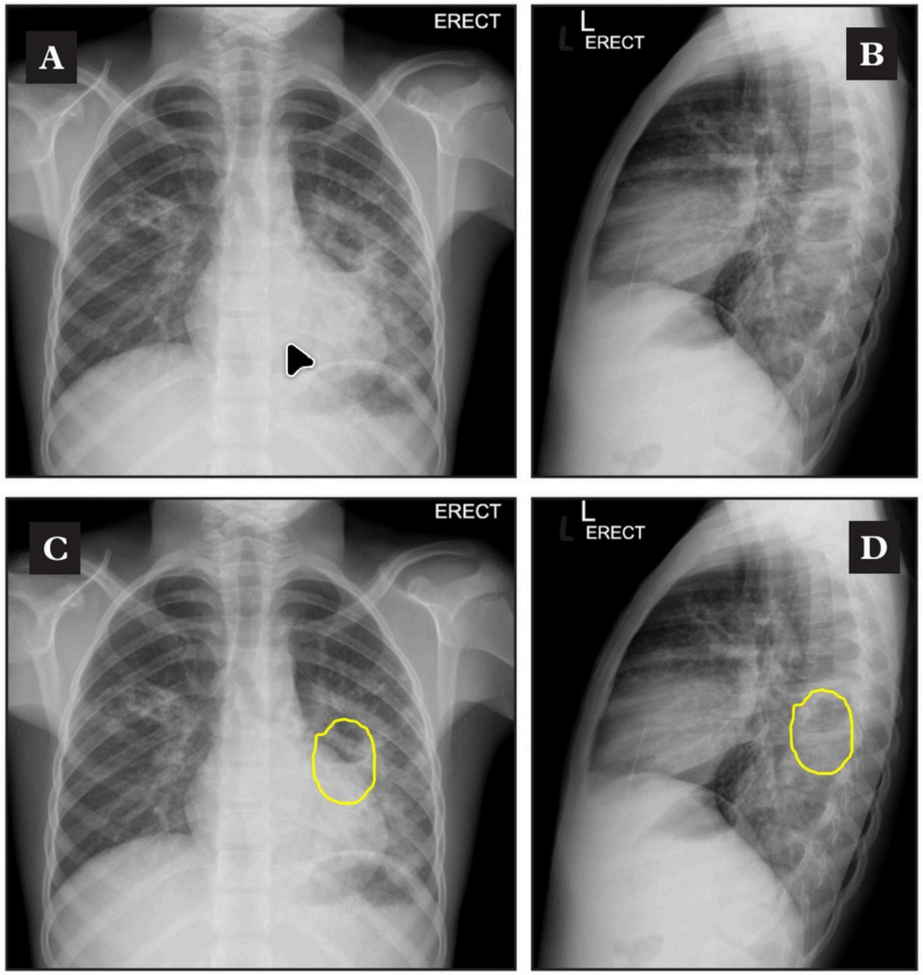

Figure 5.46: CXRs A and B are a set of CXRs taken from a 9-year-old child. CXRs C and D are the same set of CXRs but are annotated to show the cavity in the left lower lobe with bronchopneumonic infiltrates in both lungs. This is radiologically severe disease.

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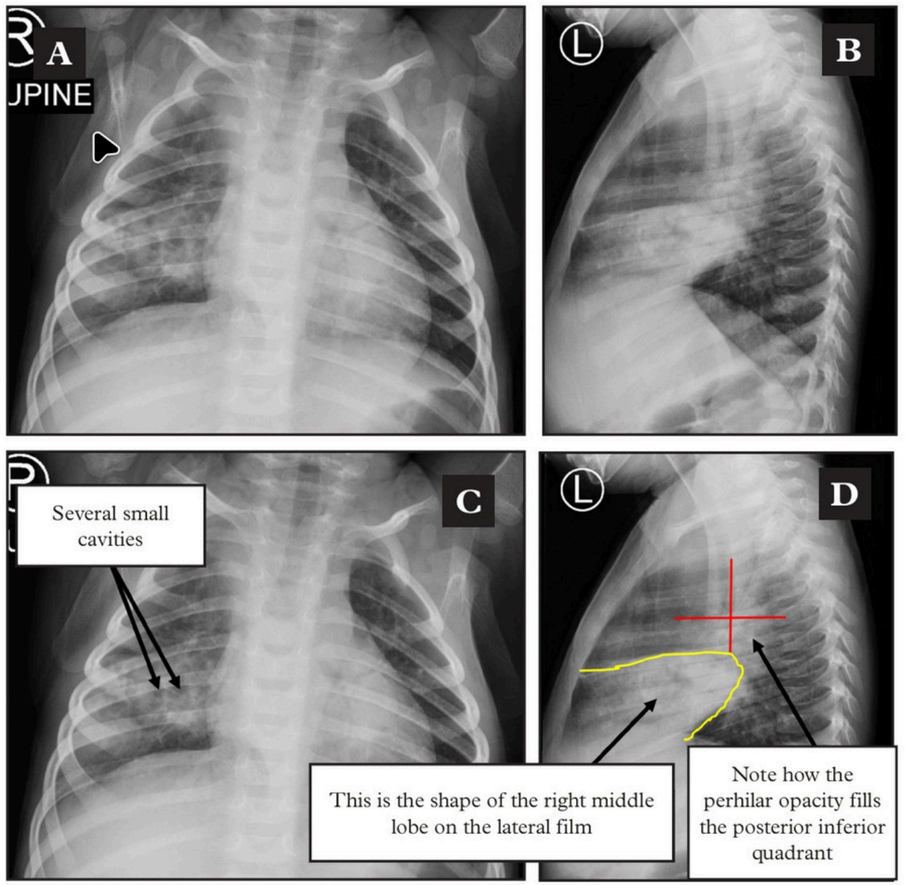

Figure 5.42: CXRs A and B and CXRs C and D are the same set of CXRs - AP and lateral films taken from a 4-year-old child. These CXRs show bronchopneumonic changes in the right middle lobe with cavity formation. There are enlarged perihilar nodes (more clearly seen on the lateral film) and compression of the bronchus intermedius on the right. There is also a right paratracheal lymph node. This is primary progressive disease and is classified radiologically as severe because there are cavities and there is airway compression.

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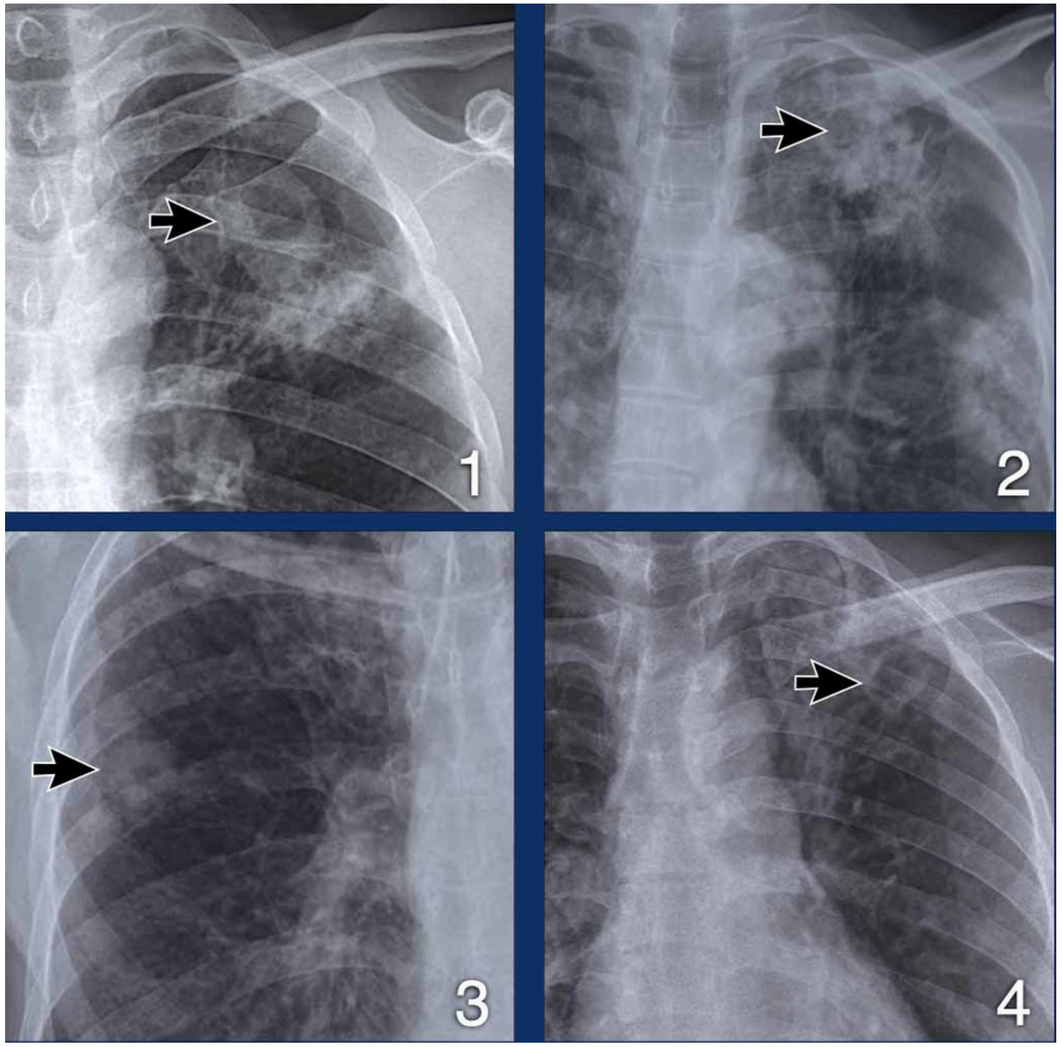
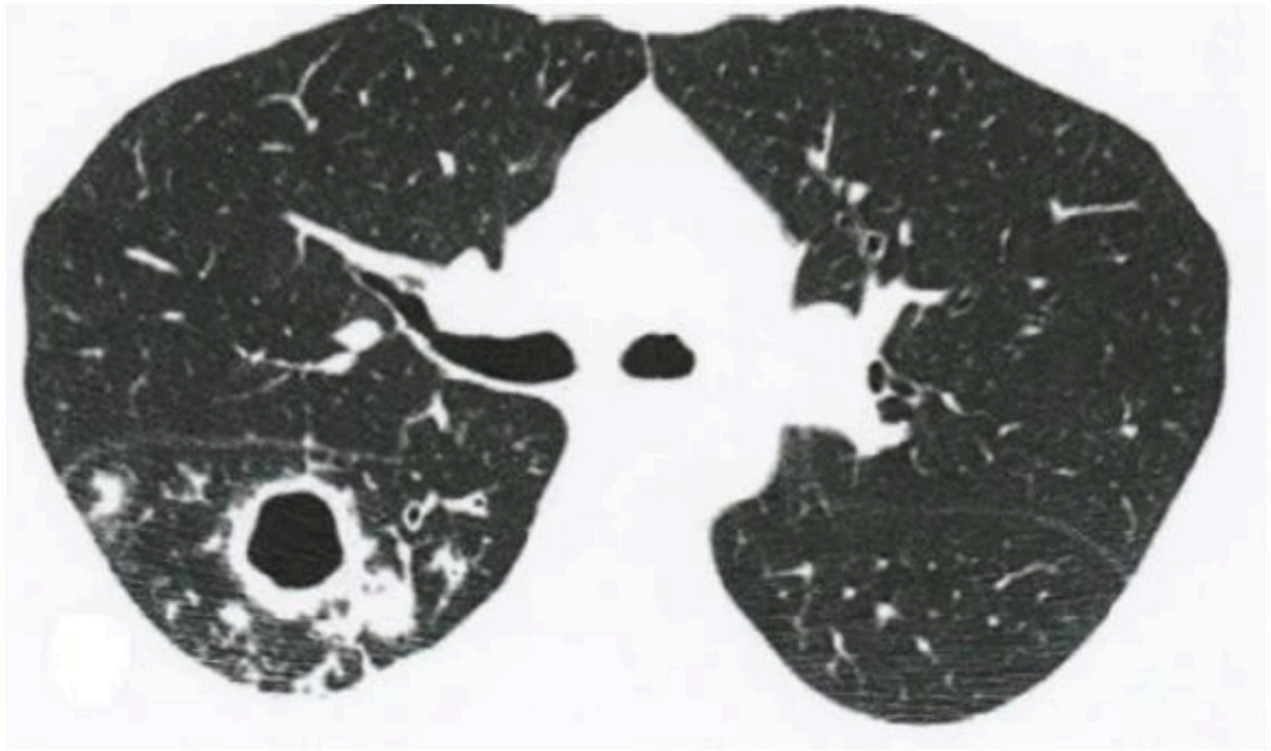


Disponível em: https://radiologyassistant.nl/chest/tb/tuberculosis

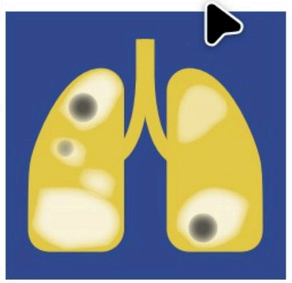
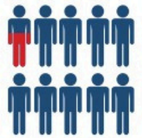


- Cavidade de paredes espessada e pequenos nódulos adjacentes configurando padrão clássico da tuberculose
- Segmento superior do LID

MULLER, N. Et al. Tórax - Série CBR, Editora Elsevier. 1ª Edição, 2010

TB broncopneumonia

TB bronchopneumonia

TB bronchopneumonia 		Very uncommon
		Very specific
	SEVERE	Severe

PALMER, M. et al. Diagnostic CXR Atlas for Tuberculosis in Children. 2. ed. 2022

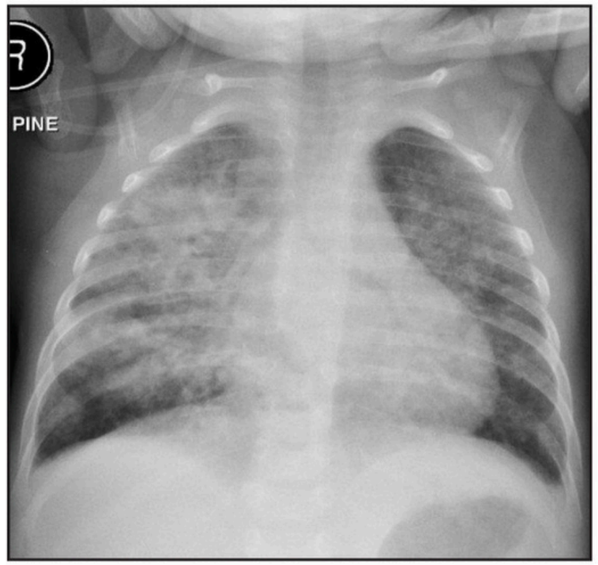


Figure 5.47: This CXR shows TB bronchopneumonia in an infant. Note the patchy opacifications which are widespread throughout both lungs and the areas of breakdown (cavity formation), predominantly on the right. There is also compression of the left main bronchus and likely an enlarged sub-carinal lymph node. This is radiologically severe disease.

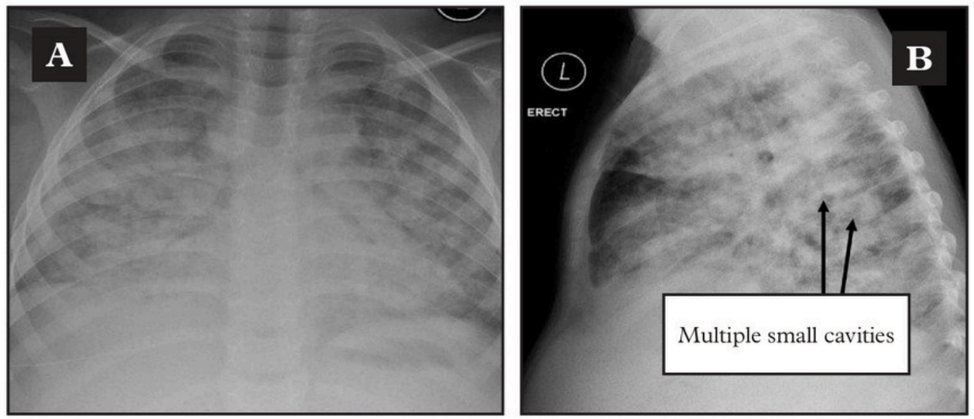


Figure 5.48: This AP and lateral CXR was taken from a 1-year-old child and is a case of TB bronchopneumonia. There are extensive patchy opacifications throughout both lungs with areas of breakdown (cavity formation).

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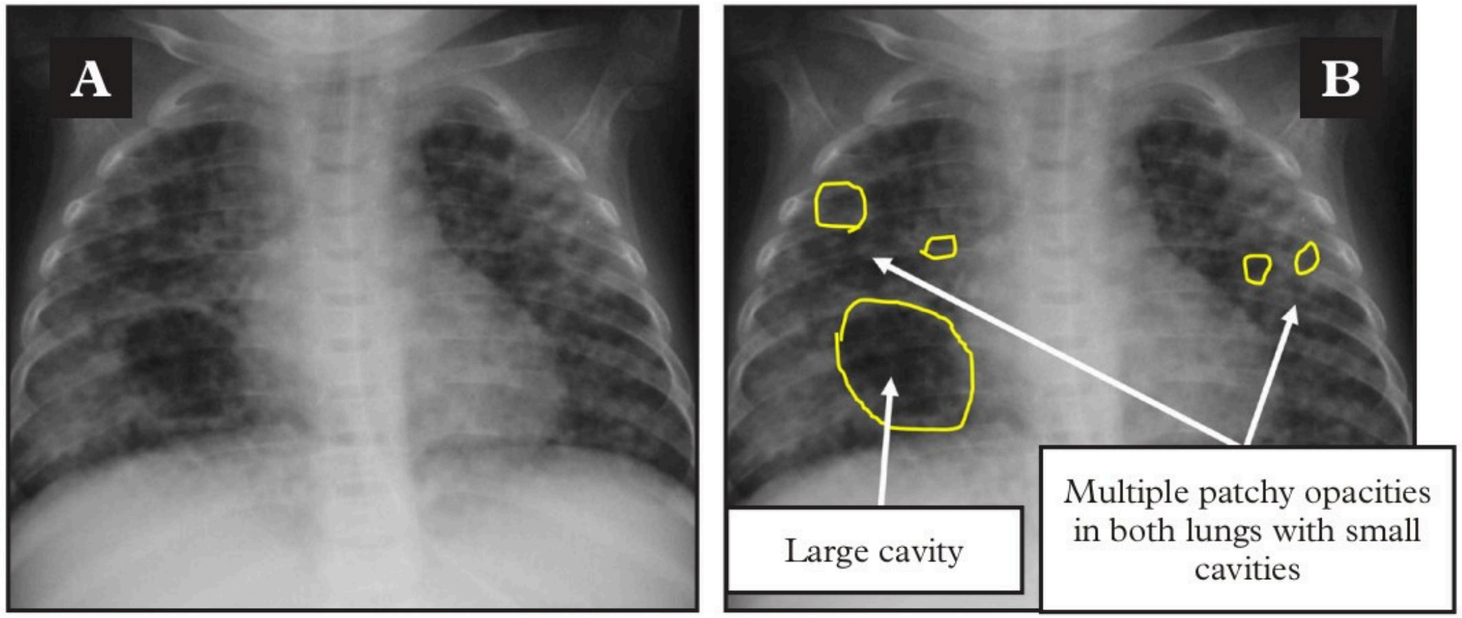


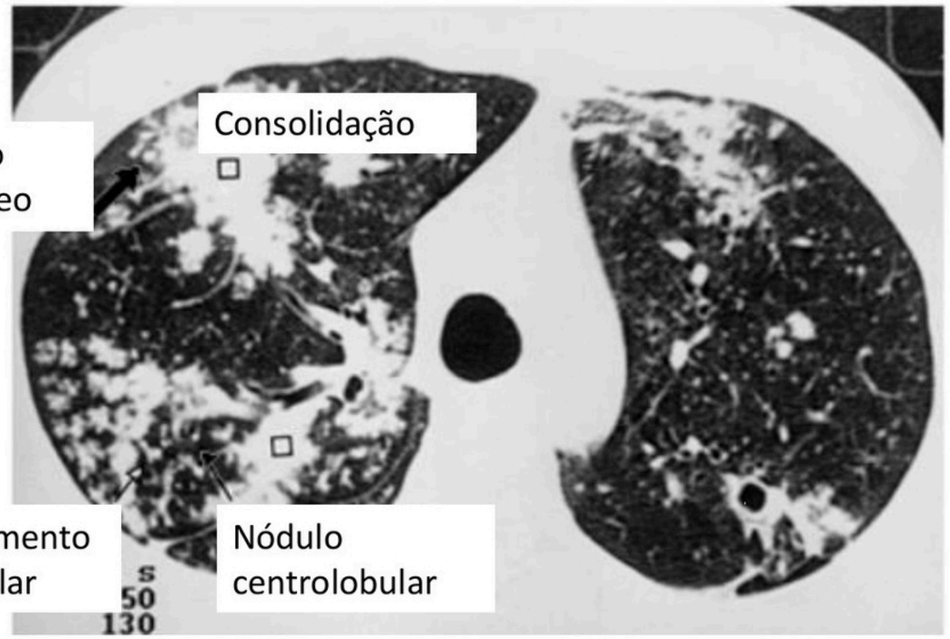
Figure 5.49: This CXR shows another case of TB bronchopneumonia (CXR A is clean and CXR B is the same CXR but annotated). Note the bilateral, widespread involvement of the lung parenchyma with patchy opacities that are larger than those seen in miliary TB. There are multiple small areas of breakdown (cavities) as well as a large cavity in the right middle lobe. This is radiologically severe disease.

PALMER, M. et al. Diagnostic CXR Atlas for Tuberculosis in Children. 2. ed. 2022

Outros achados na tomografia

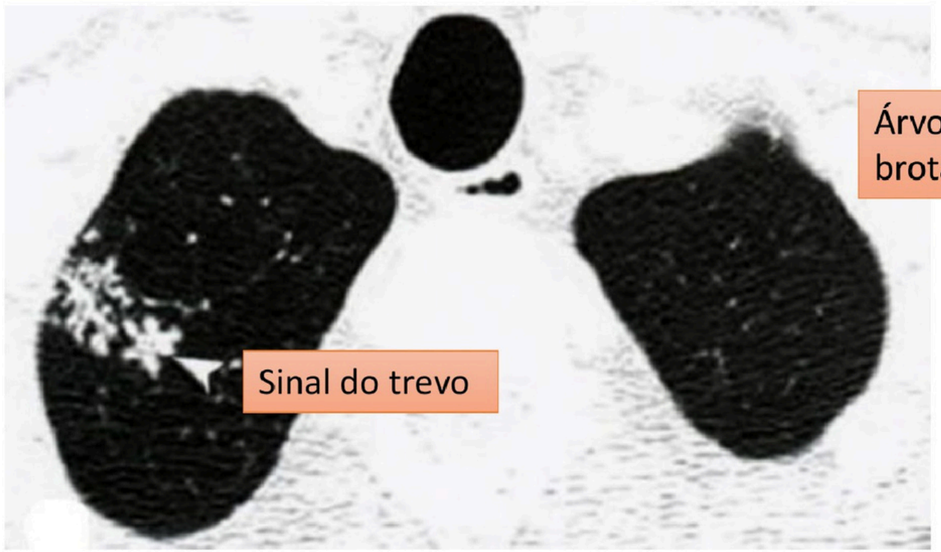
Tuberculose pulmonar: achados na tomografia computadorizada de alta resolução do tórax em pacientes com doença em atividade comprovada bacteriologicamente*

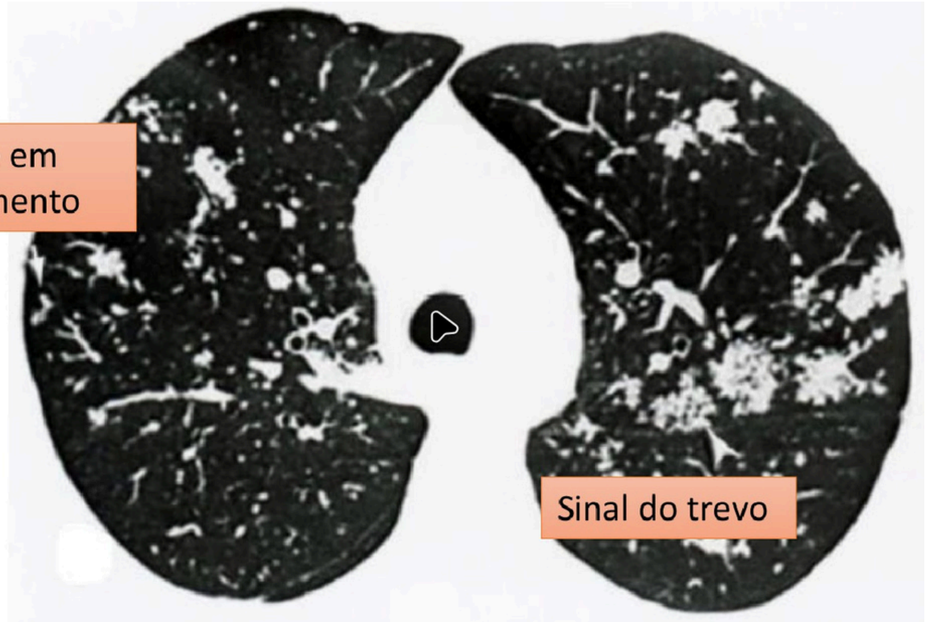
CRISTIANE ALÓ CAMPOS[1], EDSON MARCHIORI[2], ROSANA RODRIGUES[3]



- Nódulos centrolobulares
- Padrão de árvore em brotamento (opacidades nodulares ramificadas):
  - Representam necrose caseosa e inflamação granulomatosa no interior e ao redor dos bronquíolos terminais respiratórios e ductos alveolares.

Bronquiectasia e árvore em brotamento





- Sinal do trevo: **refere-se a um "arranjo" específico de pequenos nódulos centrolobulares,** geralmente organizado em três ou quatro pequenos focos próximos, lembrando a folha de um trevo. Esse achado representa a **disseminação endobrônquica da doença e o preenchimento de pequenas vias aéreas.**

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Bronquiectasia e árvore em brotamento

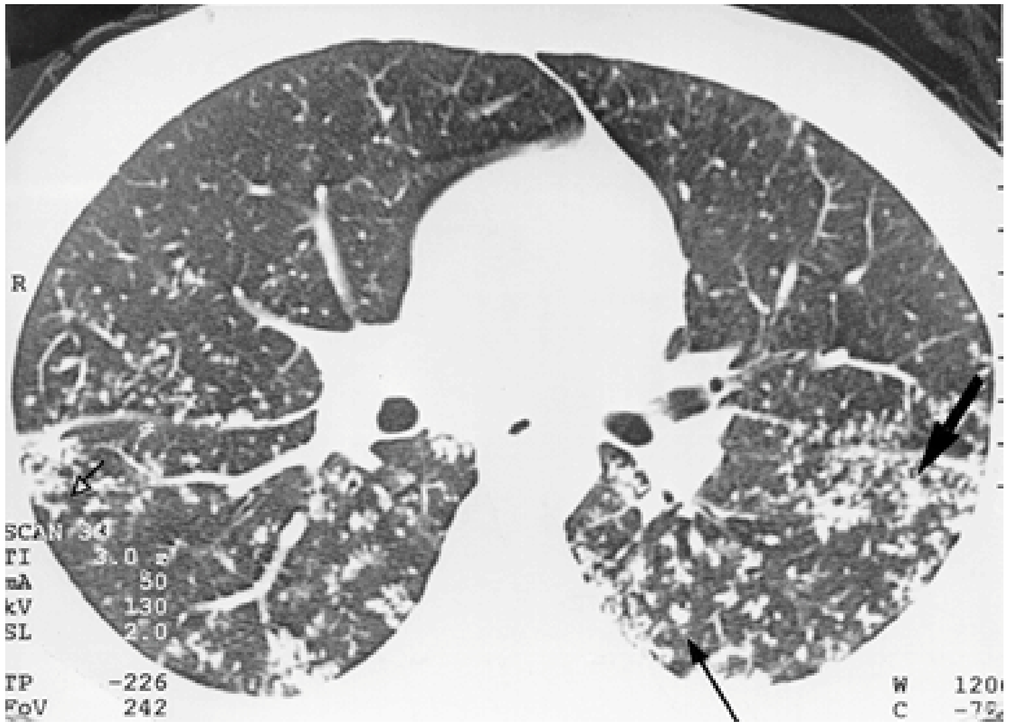


***Figura 2** – TCAR. Opacidades centrolobulares ramificadas (aspecto de árvore em brotação) (seta vazada), nódulos centrolobulares (seta fina) e do espaço aéreo (seta grossa), alguns confluentes, predominando nos segmentos superiores dos lobos inferiores.*

Campos et al. Tuberculose pulmonar na TC de alta resolução. J Pneumologia, 2022

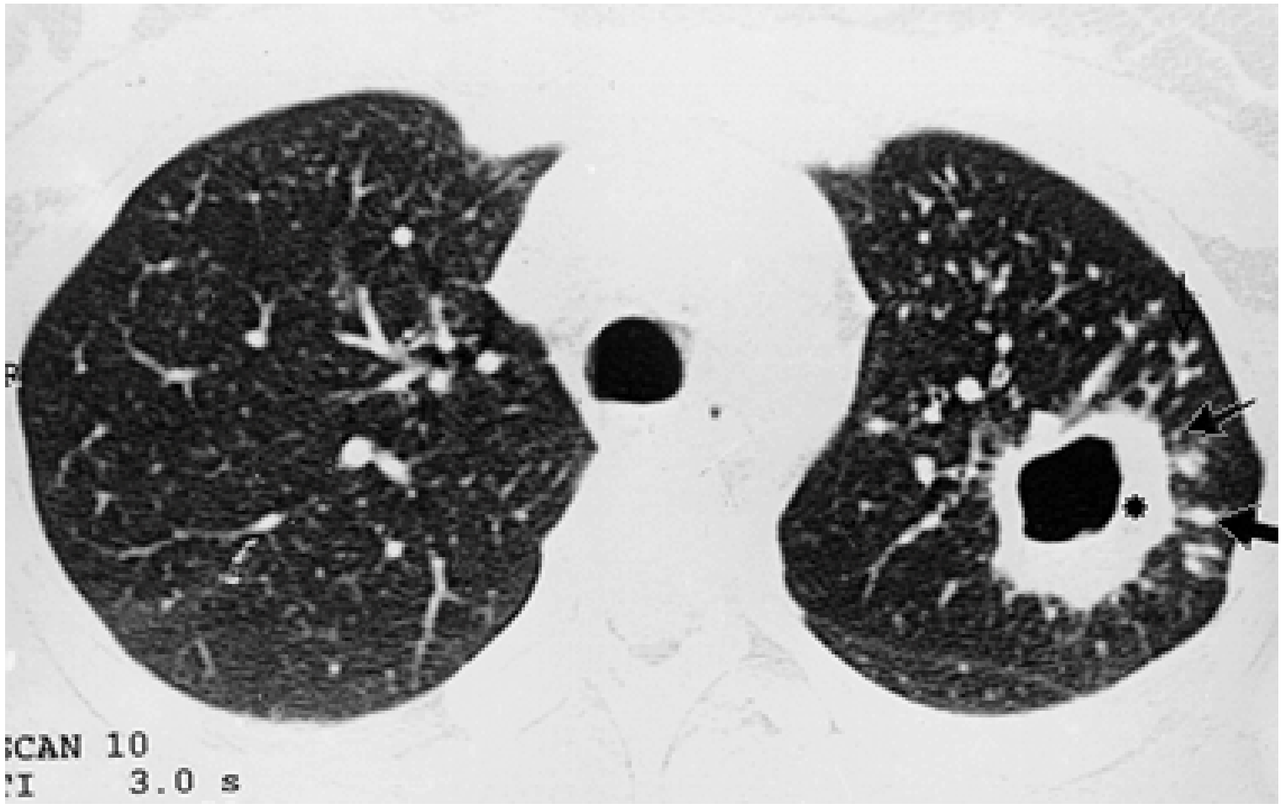


Figura 3 *– TCAR. Cavidade de paredes espessas e contornos externos irregulares (asterisco) no lobo superior esquerdo, associada a nódulos do espaço aéreo (seta grossa), opacidades com aspecto de árvore em brotamento (seta vazada) e nódulos centrolobulares (seta fina).*

Campos et al. Tuberculose pulmonar na TC de alta resolução. J Pneumologia, 2022

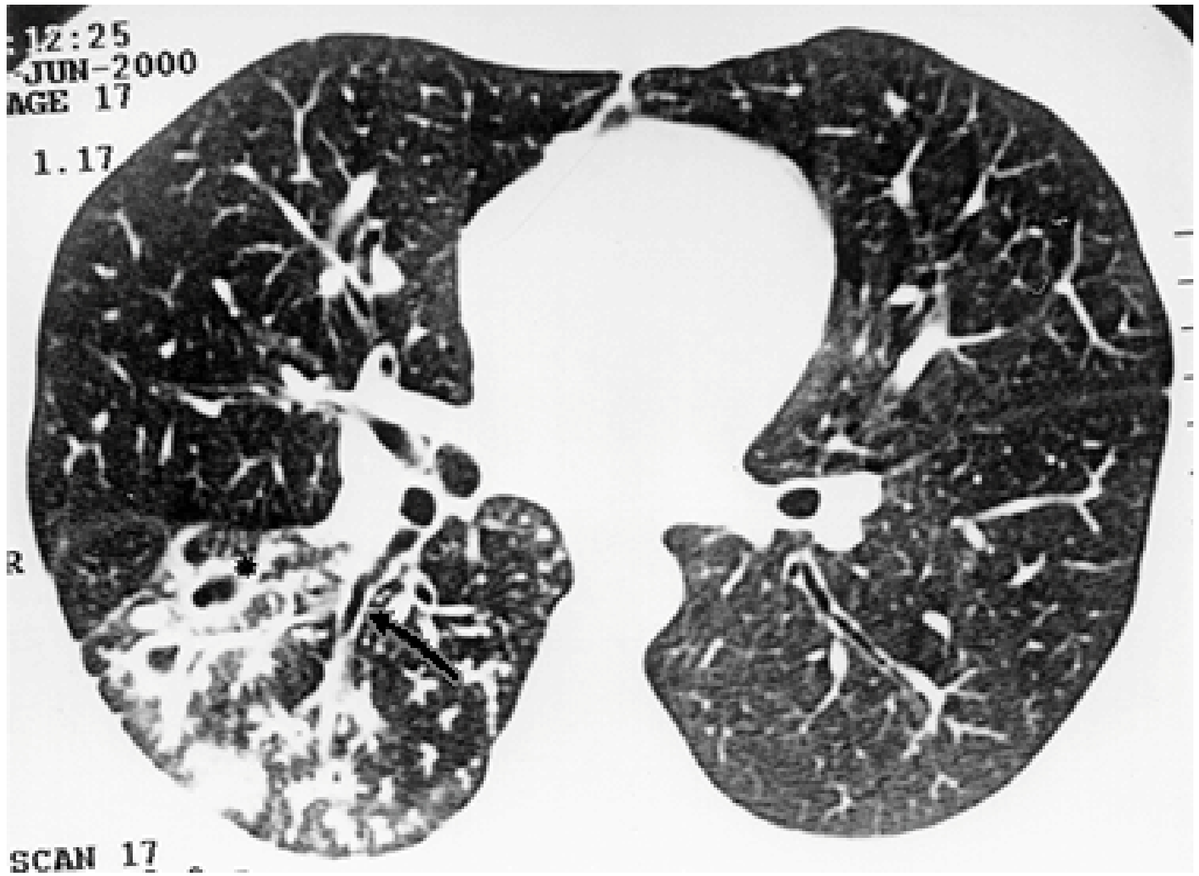


Figura 5 *– TCAR. Pequenas cavidades de paredes espessas e contornos irregulares (asterisco), associadas a nódulos do espaço aéreo, opacidades centrolobulares ramificadas e brônquio de paredes espessadas (seta curva) no segmento superior do lobo inferior direito.*

Campos et al. Tuberculose pulmonar na TC de alta resolução. J Pneumologia, 2022

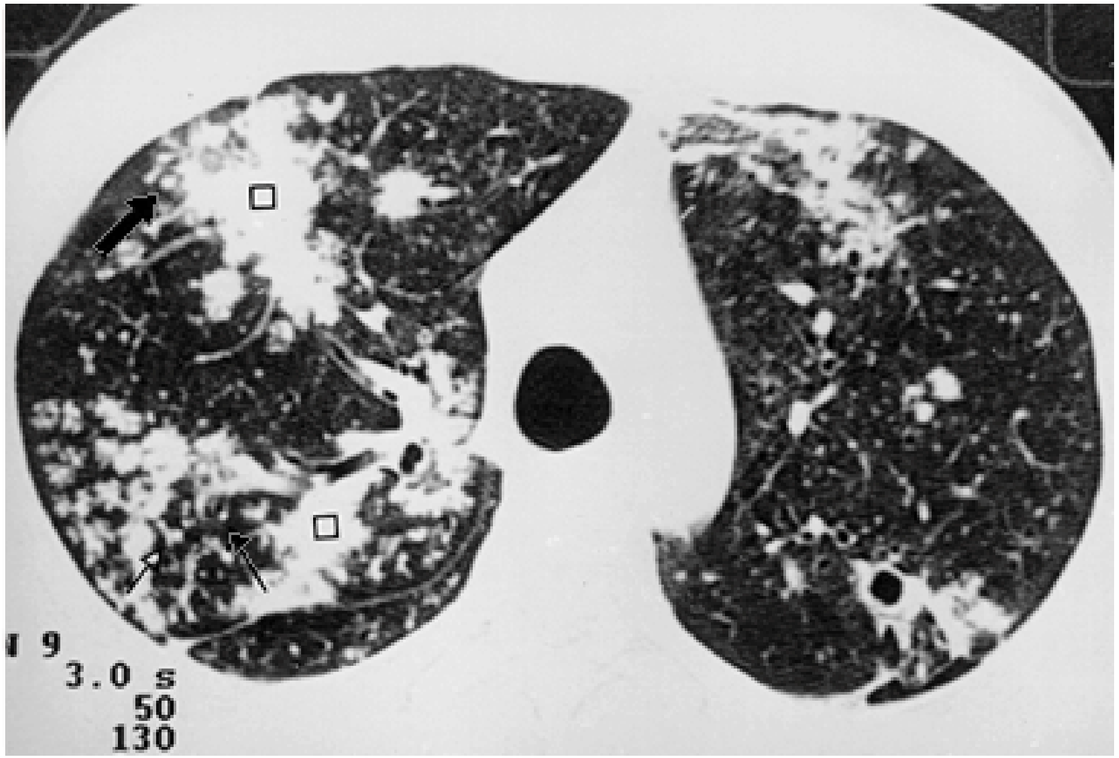
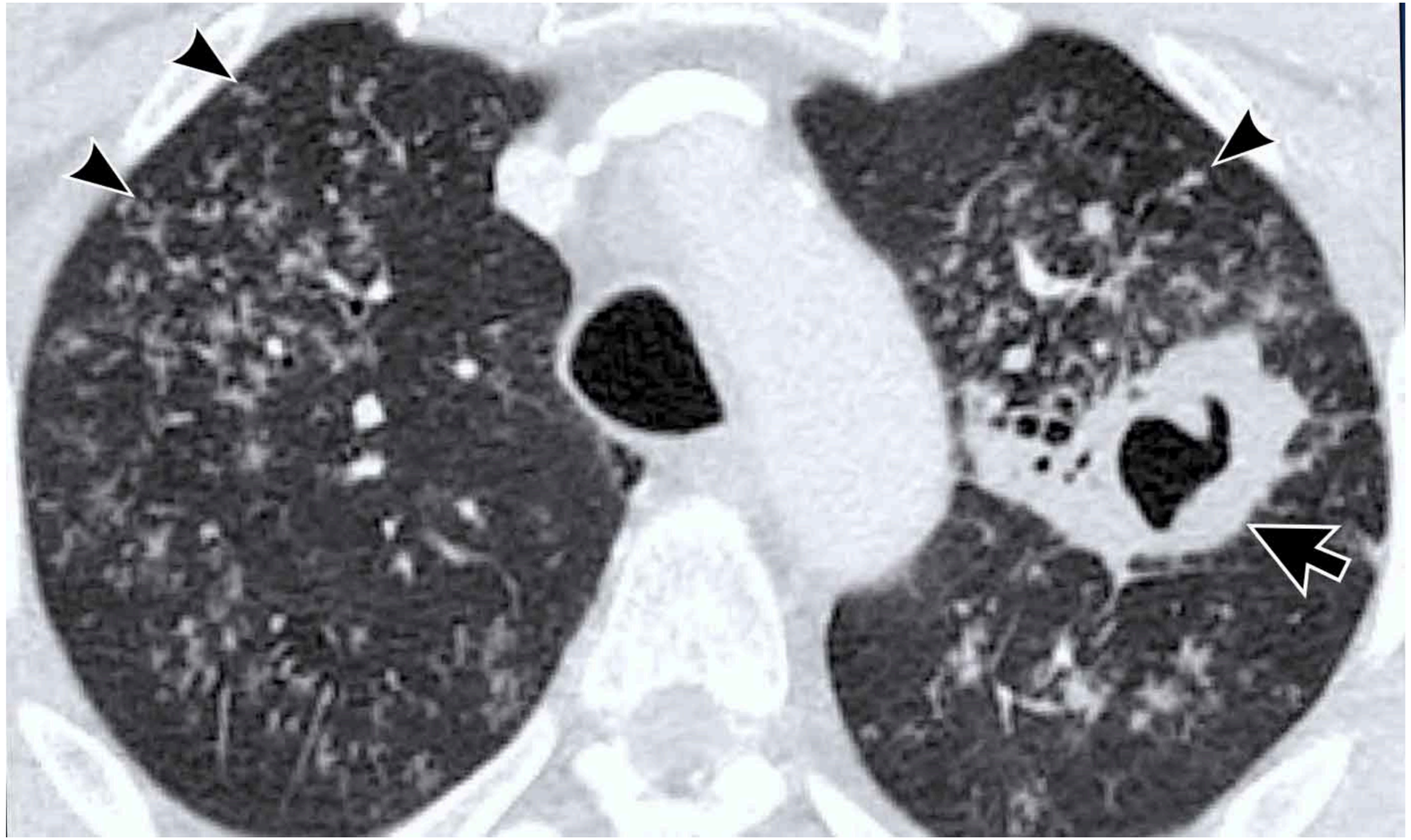


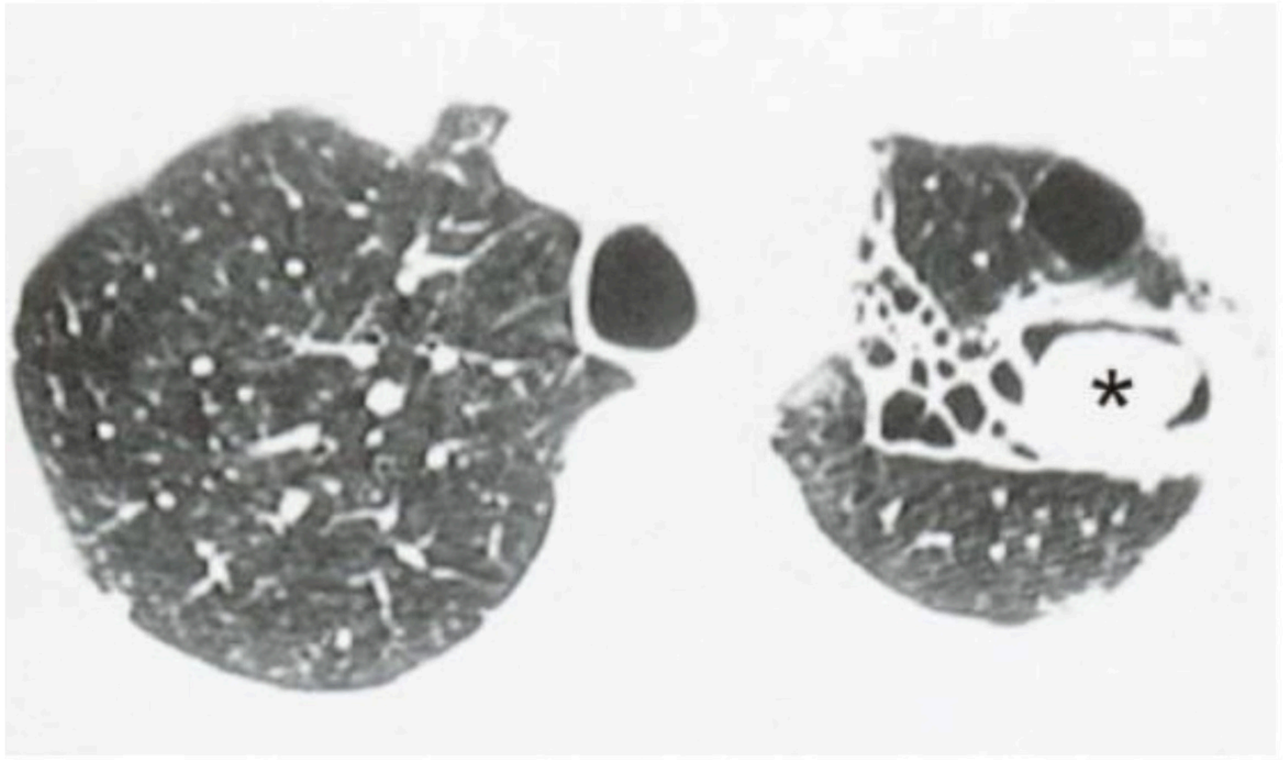
***Figura 1** – TCAR. Múltiplos focos de condensação dispersos pelo parênquima pulmonar (quadrado), com nódulos do espaço aéreo (seta grossa), nódulos centrolobulares (seta fina) e preenchimento bronquiolar adjacente (seta vazada). Observa-se também pequena cavidade no lobo superior esquerdo.*

Campos et al. Tuberculose pulmonar na TC de alta resolução. J Pneumologia, 2022



Disponível em: https://radiologyassistant.nl/chest/tb/tuberculosis

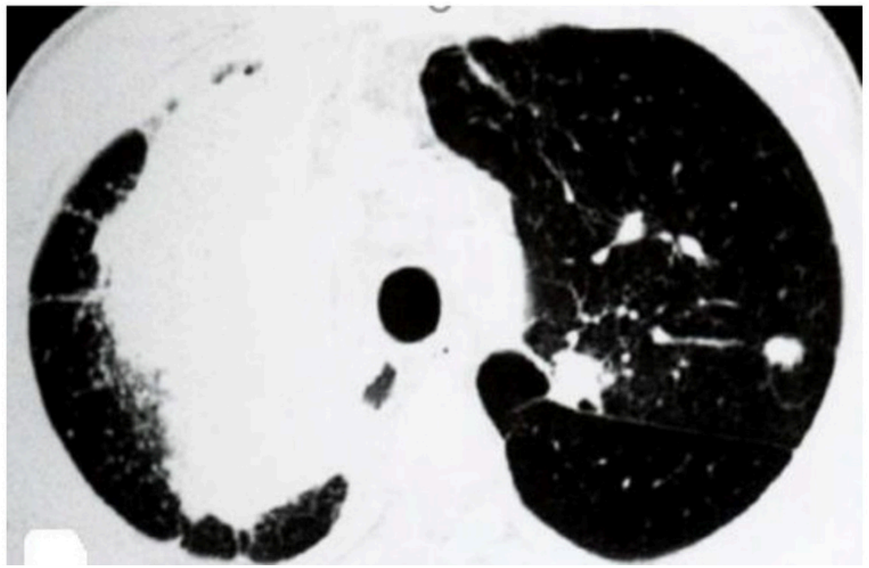
Bola fúngica

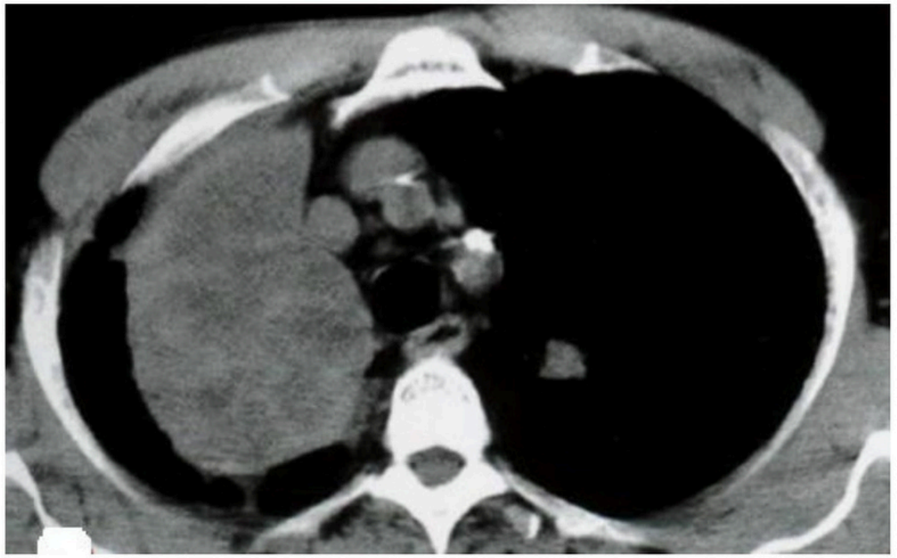


- Alterações retráteis no LSE com bronquiectasia
- Bola fúngica em cavidade pre-existente,

MULLER, N. Et al. Tórax - Série CBR, Editora Elsevier. 1ª Edição, 2010

Forma pseudotumoral (pós-primária)





- Massa de limites imprecisos e aspecto heterogêneo no LSD

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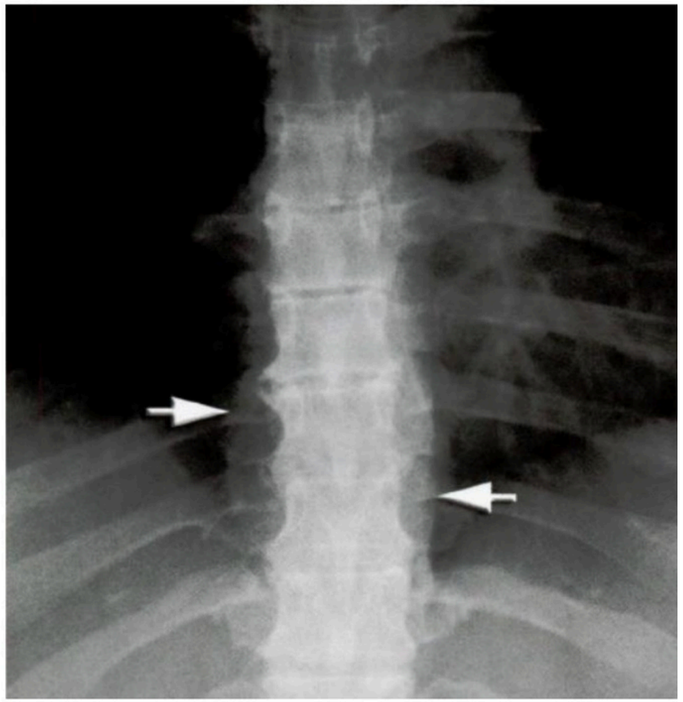
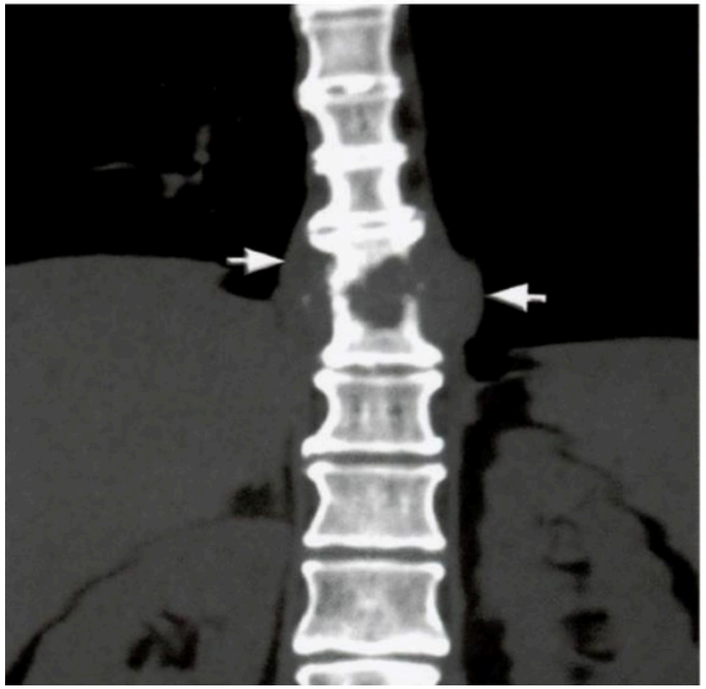
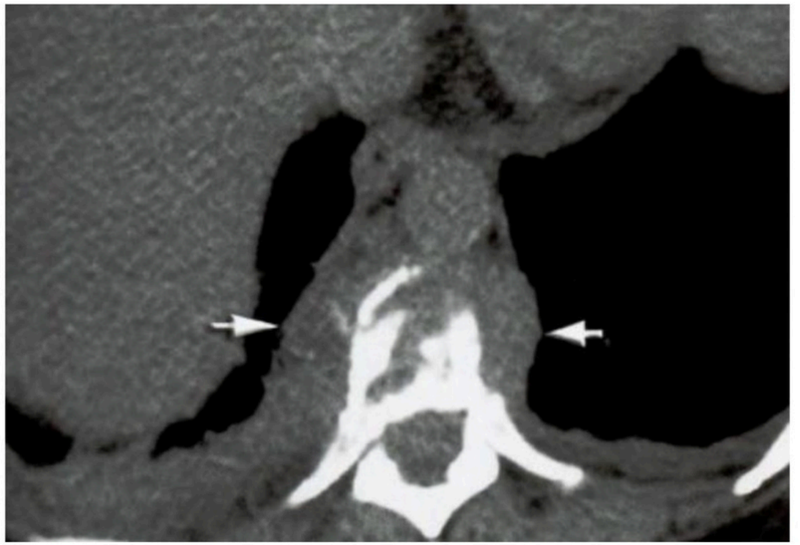
Tuberculose óssea





- Alargamento bilateral da faixa paraespinhal - "sinal do fuso"



- Lesão lítica do corpo vertebral e envolvimento pleural bilateral

MULLER, N. Et al. Tórax - Série CBR, Editora Elsevier. 1ª Edição, 2010

Caso clínico

Paciente do sexo feminino, 10 anos de idade, assintomática. Compareceu à consulta por ser contato domiciliar de adulto com TB pulmonar. Foram realizadas PT com 18 mm e radiografia de tórax com pequena alteração, o que levou à indicação de TC de tórax. Após a avaliação das imagens radiológicas, da coleta de escarro induzido e da utilização do escore pediátrico, foi iniciado o esquema básico para TB.

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Caso clínico

- **Exames: prova tuberculínica: 18 mm. TRM-TB no escarro induzido com MTB não detectado.**
- **Diagnóstico: escore de pontos (pediátrico): 35 pontos, indicativo de TB.**
- **Seguimento clínico: optou-se por iniciar tratamento com esquema básico. Posteriormente, a cultura resultou positiva para BAAR, confirmando o diagnóstico. A menor evoluiu clinicamente com melhora radiológica, recebendo alta por cura após seis meses.**

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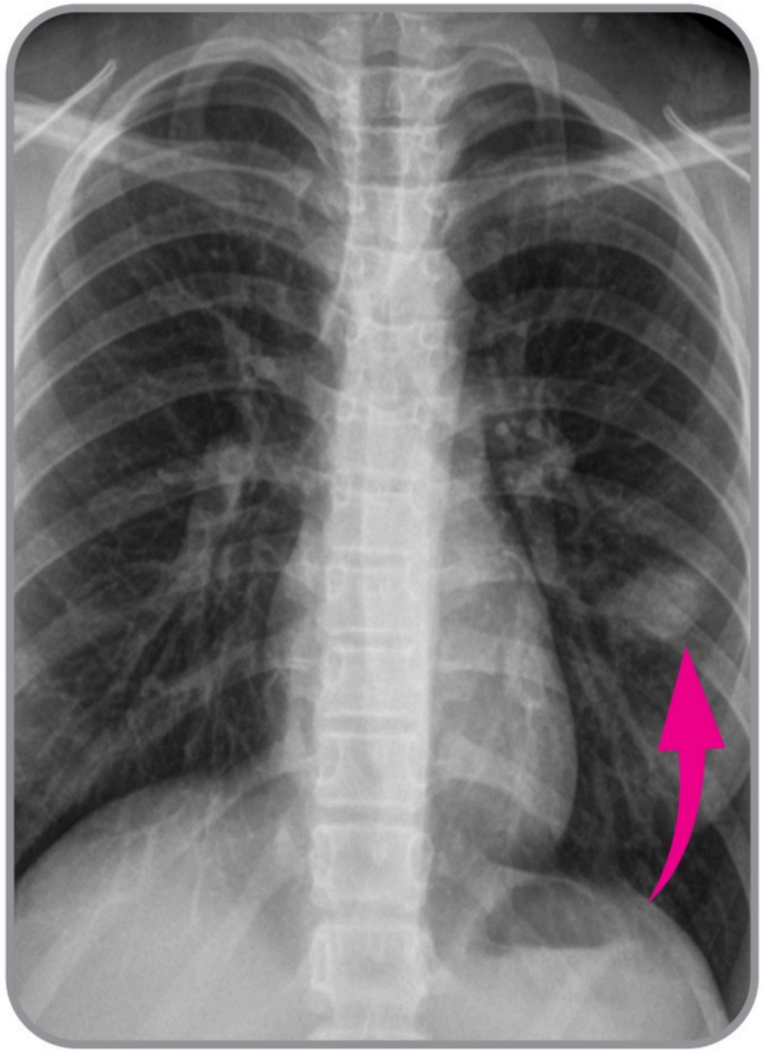
Aspectos radiológicos:

1) RADIOGRAFIA DE TÓRAX

Radiografia de tórax em PA, evidenciando opacidade nodular (seta) de contornos discretamente irregulares e mal definidos, projetada na transição dos campos médio e inferior do pulmão esquerdo.



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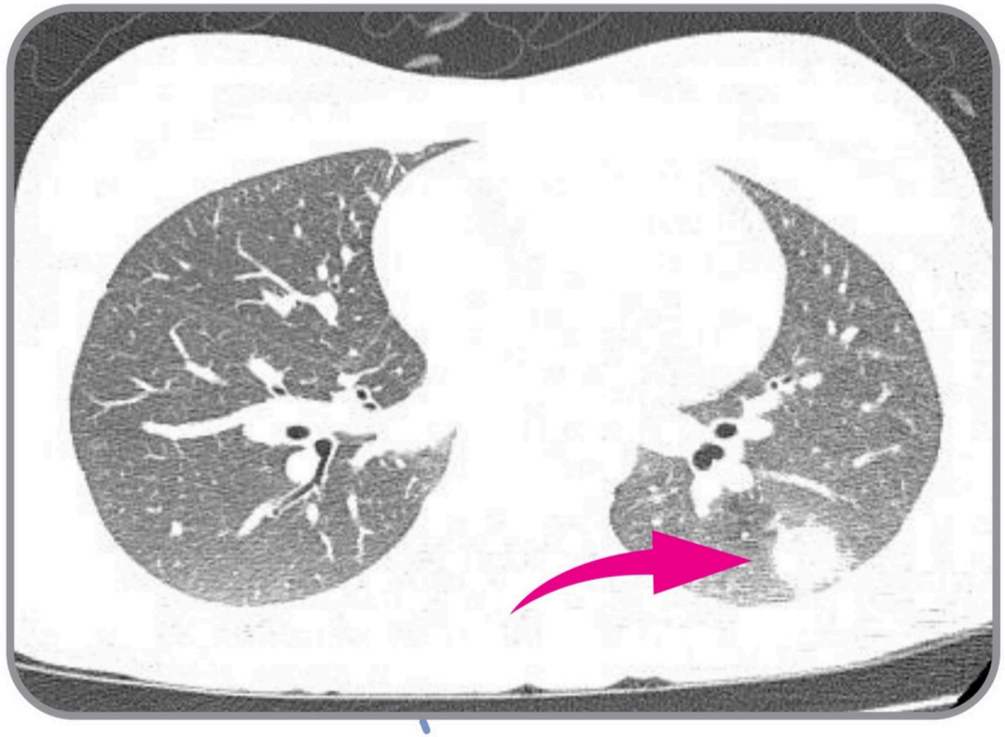
2) TOMOGRAFIA COMPUTADORIZADA DE TÓRAX

A. Tomografia computadorizada de tórax com janela de pulmão, mostrando nódulo pulmonar (seta) de contornos discretamente irregulares no lobo inferior esquerdo.



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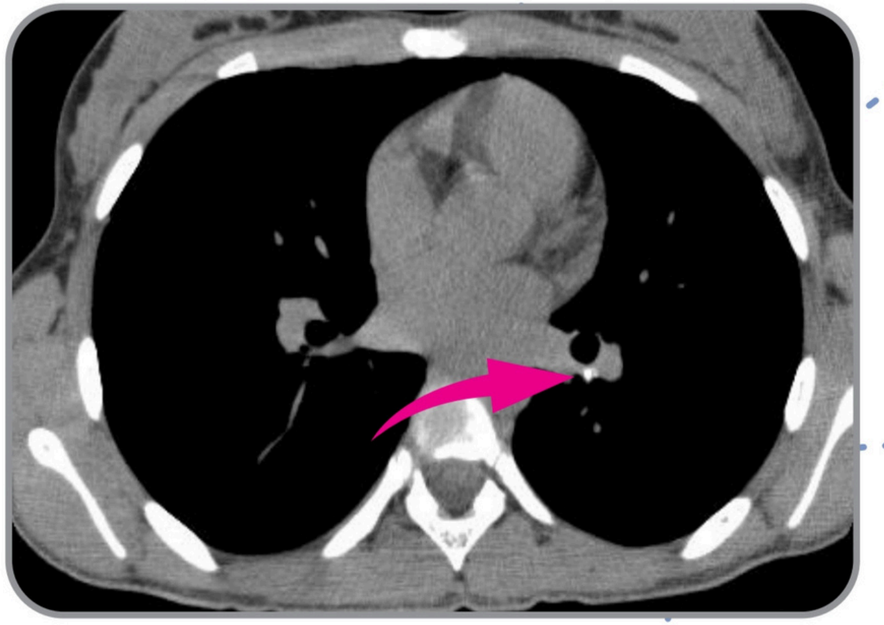
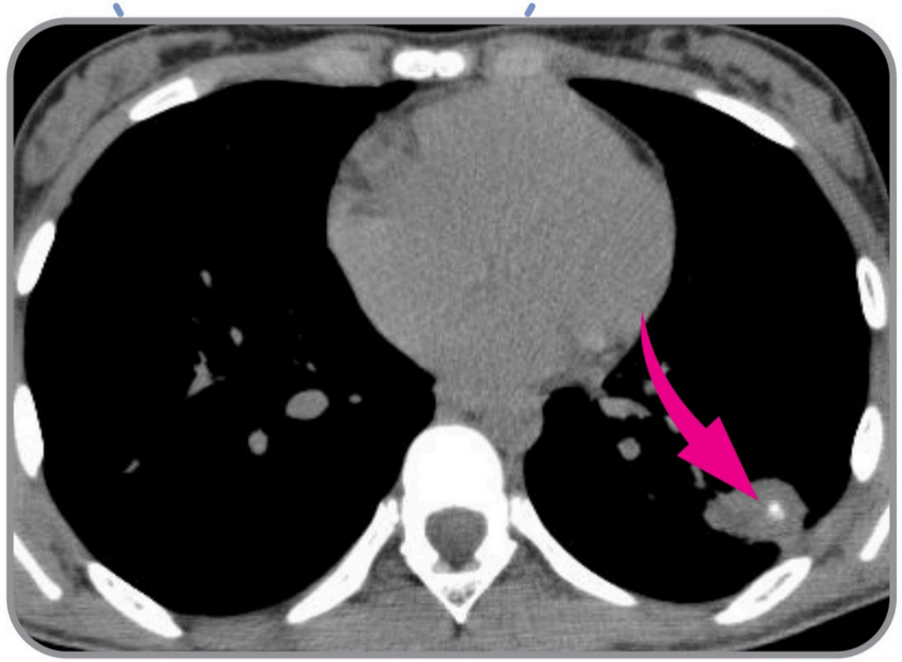


B. Tomografia computadorizada de tórax com janela de mediastino, em que se nota diminuto linfonodo calcificado peri-hilar (seta) no pulmão esquerdo, adjacente à veia pulmonar inferior esquerda.



C. Tomografia computadorizada de tórax com janela de mediastino, mostrando pequena calcificação de permeio em nódulo pulmonar (seta) de lobo inferior esquerdo, que, em conjunto com o lifonodo calcificado peri-hilar esquerdo, sugere a possibilidade de complexo primário da tuberculose.

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Obrigada!