RadiologicalAppearancesofRecentCasesofAtypicalPneumoniainHongKong

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Amessage towourvisitors

Ayear has passed since the end of the SARS outbreak in Hong Kong and it appears that we (the world community in general) have been spared of a massive recurrence of this infection this year. Nonetheless, research on this disease is on-going and we would like to congratulate all who have contributed to furthering our knowledge of this disease.

The convalescent period of this disease has not been uneventful. Complications of the disease such as Lung fibrosis resulting in limitations to respiratory function, post-traumatic stress disorder like psychological trauma, side-effects of corticosteroid therapy (adrenal insufficiency and osteonecrosis) continue to surface. We have included some of the relevant images and references with this update.

With the help of many co-workers from Hong Kong and other countries, we are pleased to announce that we have compiled a book documenting our collective knowledge and experience on SARS. This book is titled "Imaging in SARS", published by Cambridge University Press (http://www.cambridge.org/uk/catalogue/catalogue.asp?isbn=1841102199). Despite its title, this book contains extensive information on the epidemiology, clinical diagnosis and treatment, emergency medicine, intensive care medicine and infection control related to SARS.

On another front, a different viral infection has re-surfaced this past winter, the Avian Influenza. We have created a webpage similar to this SARS webpage for sharing images of that infection with all. The address of the Avian Influenza webpage is: http://www.diir.cuhk.edu.hk/web/specials/avian_flu/avian_flu.htm

If you come across something interesting in your management of SARS or Avian Influenza patients and would like to share this with the rest of the medical community, we would be more than happy to post it on our website. Acknowledgement and copyright will obviously be granted to the contributor and institution.

Again we like to thank our support staff for the great work they have done and the personal sacrifices they have made to get both webpages up and running. We would also like to thank the numerous visitors who have given us very valuable feed back to help us improve our website.

With our sincere thanks,
TheDepartmentofImagingandInterventionalRadiology,TheChineseUniversityofHongKong.
INTRODUCTION

The beginning of 2004 saw the confirmation of the first community acquired case of SARS since the end of the 2003 epidemic. We now know much more about this novo disease and the United States Centers of Disease Control and prevention has issued an updated case definition in December 2003. Radiology continues to be an integral part of the diagnosis and management of patients with SARS.

The following are the radiological and CT features of this disease based on our experience (336 patients imaged during after the epidemic) at the Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Prince of Wales Hospital, Hong Kong.

These are presented here to facilitate early diagnosis and management should it be encountered in other centres.
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INTRODUCTION

Patient One

55 year old male admitted on 17th March 2003 with SARS Co-V infection. Serial follow up HRCT of the same level demonstrate evolution of lesions. There is significant clearing of most changes on 3rd and 6th month follow-up. Some residual abnormalities may represent fibrosis.
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INTRODUCTION

Patient Two

32 year old male previous treated for SARS Co-V infection. MRI of the right hip shows abnormal subchondral areas bound by geographic borders in the femoral head: (a) T1W coronal (b) T2W fat-saturated coronal (c) PD sagittal. The appearances are consistent with avascular necrosis.
ACUTE IMAGING FINDINGS IN SARS

Radiographs:

In the early stage of the disease, a peripheral / pleural-based opacity may be the only abnormality. This may range from ground-glass to consolidation in appearance. A particular area to review is the paraspinal region behind the heart. In our experience, this is frequently where lung lesions are detected on HRCT in suspected SARS patients with normal radiographs.

In the more advanced cases, there is widespread opacification which may be ground-glass or consolidative affecting large areas. This tends to affect the lower zones first and is not uncommonly bilateral. Calcification, cavitation, pleural effusion or lymphadenopathy are not features of this disease.

HRCT:

Solitary or multiple patchy area(s) of

1. Ground-glass opacification with or without thickening of the intra-lobular interstitium or interlobular interstitium.

2. Consolidation

3. A combination of 1 & 2

These tend to occupy a sub-pleural position rather than axial. Again, calcification, cavitation, pleural effusion or lymphadenopathy are not features of this disease.
CXR WITH CORRESPONDING HRCT

**Patient Three**
24 year old symptomatic female. Frontal view shows vague paraspinal opacity in the left lower zone

**Patient Four**
9 year old symptomatic female with normal radiographic appearance

Frontal view shows vague paraspinal opacity in the left lower zone

Normal appearance
CXR WITH CORRESPONDING HRCT

Patient One
27 year old symptomatic female with subtle
left lower zone opacity
Case 1
A 31-year-old health-care worker presented with 2-day history of fever, chills and myalgia.

Figure 1
- CXR at the time of diagnosis showed ill-defined air space opacification in right lower zone

Figure 2
- CXR after 3 days showed partial resolution of consolidative changes in right lower zone. There is a new finding of ill-defined air space opacification in left lower zone

Figure 3
- CXR after another 4 days showed progressive resolution of the changes in both lower zones
PROGRESS CXR

Case 2
A 34-year-old presented with 3-day history of fever, chills and malaise.

Figure 1
- CXR (7 days after admission) showed ill-defined air space opacification in periphery of right lower zone

Figure 2
- CXR (2 days later) showed progression of air space opacification in right lower zone and a new finding of similar changes in left mid and lower zones after initial treatment

Figure 3
- CXR (after another 4 days) showed marked resolution of the consolidative changes in both lungs after treatment
PROGRESS CXR

Case 3
A 34-year-old health care worker presented with fever, chills and myalgia for 2 days.

Figure 1
- CXR showed ill-defined air-space opacity in periphery of left upper and mid zones

Figure 2
- CXR (after 5 days) showed progressive air-space opacities in both lungs

Figure 3
- CXR (after another 7 days) showed resolution of radiographic changes after successful treatment
IMAGES FROM OTHER CENTERS

Boca Raton, Florida, USA
Courtesy of Dr. Michael E. Katz M D

52-year-old symptomatic female from Virginia

15 MARCH 2003
(On presentation to A&E)

19 MARCH 2003

20 MARCH 2003
Images from Other Centers

Changi General Hospital, Singapore
Courtesy of Dr Augustine Tee

24-year-old Filipino nursing aid from nursing home with one week history of fever, dry cough and myalgia.

Day 1
- CXR showed subtle left lower zone airspace infiltrates.

Day 5
- CXR showed left lower zone consolidation became more obvious.

Day 7
- Patient became hypoxic & required subsequent intubation. CXR showed bilateral widespread airspace infiltrates.
IMAGES FROM OTHER CENTERS

Li Shin Hospital, Taiwan
Courtesy of Dr Lu Yeh-Chiu

16 years old male c/o swinging but persisted fever above 38 degree Celius for a few days with dry cough CXR taken on the 10th day in our OPD department. No fever at that time.

CXR PA: bronchitis?
Repeated CXR PA another 10 days later.
Repeated CXR PA on the 20th day.
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IMAGE GALLERY

CHEST RADIOGRAPHS

Fig 1: (day 3 after onset of symptoms)
Ill-defined air-space opacification in right lower zone

Fig 2: (day 4 after onset of symptoms)
Confluent air-space opacification in left lower zone

Fig 3: (day 5 after onset of symptoms)
Air-space opacification in the periphery of middle lobe abutting the superior aspect of the horizontal fissure
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IMAGE GALLERY

CHEST RADIOGRAPHS

Fig 4: (day 3 after onset of symptoms)
Ill-defined opacity in left lower zone

Fig 5: (day 4 after onset of symptoms)
Bilateral lower zones air-space opacities in para-cardiac areas

Fig 6: (day 2 after onset of symptoms)
Middle lobe air-space opacity obscuring part of right heart border
IMAGE GALLERY

CHEST RADIOGRAPHS

Fig 7: (day 4 after onset of symptoms)
Peripheral segmental air-space opacification in right upper lobe

Fig 8: (day 5 after onset of symptoms)
Patchy peripheral opacities involving both lower lobes

Fig 9: (day 6 after onset of symptoms)
Multi-focal ill-defined air-space opacities in both lower and right upper zones
**IMAGE GALLERY**

**CHEST RADIOGRAPHS**

Fig 10: (day 5 after onset of symptoms)
Patchy air-space opacification in both mid and lower zones

Fig 11: (day 4 after onset of symptoms)
Peripheral patchy opacification in right upper and left lower zones

Fig 12: (day 7 after onset of symptoms)
Multi-focal diffuse air-space opacities in both lungs
Fig 13: (day 5 after onset of symptoms)

Multi-focal confluent areas of air-space opacities in both lungs

Fig 14: (day 6 after onset of symptoms)

Diffuse and widespread consolidative changes in both lungs (patient is intubated)
2-year-old boy presented with febrile convulsion and cough. CXR on admission showed air-space opacities in left mid and lower zones.

6-year-old girl presented with fever, running nose and cough. CXR on admission showed focal air-space consolidation in left upper zone.

5-year-old girl presented with fever for 4 days. CXR showed air-space opacity in left lower zone.
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IMAGE GALLERY

CT

Fig 1: (day 3 after onset of symptoms)
Peripheral ill-defined consolidation in the lateral basal segment of left lower lobe and lower zones.

Fig 2: (day 2 after onset of symptoms)
Peripheral ground-glass opacification in middle lobe

Fig 3: (day 2 after onset of symptoms)
Patchy ground-glass opacification in periphery of both lower lobes (R>L)

Fig 4: (day 3 after onset of symptoms)
Ill-defined consolidation with air-bronchogram in apical segment of right lower lobe

Fig 5: (day 5 after onset of symptoms)
Multi-focal peripheral consolidation in posterior basal segments of both lower lobes and an area of ground-glass opacification in left lingular segment

Fig 6: (day 5 after onset of symptoms)
Patchy, multi-focal, ground-glass opacification and consolidation in both upper lobes

Prepared on behalf of Faculty of Medicine, CUHK, PWH
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IMAGE GALLERY

CT

Fig 7: (day 4 after onset of symptoms)

Multiple confluent areas of consolidation in the middle lower and both lower lobes.
Our current imaging protocol is

1. If SARS is clinically suspected, a chest radiograph should be performed.

2. If the chest radiograph is abnormal, then no further imaging investigation is required other than serial radiographs for follow up.

3. If the chest radiograph is normal, a HRCT is performed. This may show changes one to two days before they become radiographically apparent.

4. All patients currently admitted with this syndrome have abnormal chest imaging findings.

5. Please note that as the disease is contagious appropriate personal precautions need to be taken as well as appropriate cleansing of radiographic or CT equipment.

N.B. Initially we performed both conventional and high resolution CT of the thorax on all patients. With increasing experience, it became apparent that pleural effusion or lymphadenopathy was not a feature of this disease. CT examination is now limited to **HRCT only.**
IMAGING PROTOCOL

STRICT INFECTION CONTROL IS A MUST.

PLEASE REFER TO OUR GUIDELINES REGARDING MANAGEMENT AND INFECTION CONTROL IN A RADIOLOGY DEPARTMENT DURING THE SARS OUTBREAK.

All staff in the radiology department must be absolutely familiar with and adhere to infection control guidelines.

Suggested algorithm for imaging investigation of SARS:

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CXR
   +ve
   ↓
   treatment (no further imaging required for diagnosis)
   -ve
   ↓
   HRCT thorax*
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* HRCT should be used with caution as it may result in overdiagnosis. It should be used only if:

- there is a history of contact OR
- the clinical signs, such as a continuing fever, leucopenia etc., are strongly suggestive of SARS, AND
- the initial chest radiograph is normal
MANAGEMENT AND INFECTION CONTROL IN A RADIOLOGY DEPARTMENT DURING THE SARS OUTBREAK

1. Basic considerations regarding the spread of SARS

2. Problems related to Radiology

3. Infection control measures
   A) Specific personal infection control guidelines for staff and patients
   B) General infection control guidelines for staff
   C) Main areas of attention when re-organising the Radiology Department
   D) Practical checklist for running the Department
   E) Specific problems related to individual imaging modalities
   F) Update on new measures (15.5.03)

4. Final comment
IMAGING OF SARS PATIENTS AT DISCHARGE

As SARS is a new disease, there is no previously established imaging policy at the time of discharge for reference. We have adopted the following protocol for imaging SARS patients on discharge. This may evolve with greater experience. Our current protocol for imaging SARS patients on discharge is:

For patients with positive initial CXR and displaying resolution of radiographic changes on treatment, we perform a CXR on discharge (and subsequently monitor their clinical progress).

For patients with normal chest radiographs and lung changes were detected only on HRCT, we perform a HRCT on discharge (and subsequently monitor their clinical progress).
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DIIR SARS ACTIVITIES

Indexed Publications on SARS:


DIIR SARS ACTIVITIES


Conference Lectures/ Presentations on SARS:

1. Hong Kong College of Radiologists, Hong Kong Academy of Medicine and Hong Kong Hospital Authority. SARS Imaging Symposium. Hong Kong, China. 7th June 2003
   Pneumonia, atypical pneumonia and pneumonia-like conditions "Pneumonia in children including SARS"
   Dr. Winnie Chu

2. Hong Kong College of Radiologists, Hong Kong Academy of Medicine and Hong Kong Hospital Authority. SARS Imaging Symposium. Hong Kong, China. 7th June 2003
   Pneumonia, atypical pneumonia and pneumonia-like conditions "Application & Imaging Features of SARS on HRCT"
   Dr. KT Wong

3. World Health Organization, SARS Clinical Management Workshop, Hong Kong, China, 13th June 2003. "Imaging in SARS: The Hong Kong Experience"
   Dr. Ahuja

4. The Second Chinese Medical Association Medical Forum, Beijing, China. 9th September 2003. "Imaging of Severe Acute Respiratory Syndrome (SARS)"
   Dr. Antonio

   Dr. Antonio

6. 16th European Congress of Radiology, 8 March, 2004 "Steroid-induced AVN in patients treated for SARS: Early observations." (abstract B-702)
   Dr. Antonio

7. 16th European Congress of Radiology, 9 March, 2004 "Radiographic appearances and pattern of progression of Severe Acute Respiratory Syndrome (SARS)." (abstract B-862)
   Dr. Antonio

   Dr. Antonio
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DIIR SARS ACTIVITIES

Scientific Exhibits on SARS:
1. SARS Imaging - What do we need to know?
   Shetty S, Burney K, Hopkins R, Antonio GE, Ahuja AT
   Annual Meeting of The Royal College of Radiologists UK September 2003

2. Severe Acute Respiratory Syndrome (SARS): Correlation of Clinical Outcome and Radiological Features.
   Hong Kong College of Radiologists 11th Annual Scientific Meeting, Hong Kong, 18th -19th October 2003.

3. Computerised tomography (CT) in severe acute respiratory syndrome 9SARS): late-stage acute respiratory disease syndrome (ARDS) and follow-up findings.
   24th International Symposium on Intensive Care and Emergency Medicine
   Brussels, Belgium, 30 March - 2 April 2004

4. Texture Classification of SARS Infected Region in Radiographic Image
   Xiaoxiu Tang, Dacheng Tao, Gregory E Antonio
   Institute of Electrical and Electronics Engineers, 11th International Conference on Image Processing, Singapore October 2004

Books on SARS:
1. Imaging in SARS
   Editors: Anil T Ahuja and Clara GC Ooi

Book Chapters:
1. SARS. Editor: Joseph JY Sung
   Imaging in Severe Acute Respiratory Syndrome (SARS)
   KT Wong, Gregory E Antonio, Anil T Ahuja,

2. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 5
   The Role of Chest Radiographs in the Diagnosis of SARS
   KT Wong, Gregory E Antonio, Anil T Ahuja

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DIIR SARS ACTIVITIES

3. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 6
   Chest radiography: Clinical correlation and its role in the management of Severe Acute Respiratory Syndrome (SARS)
   David SC Hui, KT Wong, Gregory E Antonio, Anil T Ahuja, Joseph JY Sung

4. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 7
   The Role of High-resolution Computed Tomography (HRCT) in Diagnosis of SARS
   Gregory E Antonio, KT Wong, Anil T Ahuja

5. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 8
   The Role of Imaging in the Follow up of SARS
   Gregory E Antonio, KT Wong, Anil T Ahuja

6. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 9
   Treatment of Severe Acute Respiratory Syndrome
   Joseph JY Sung, Alan Wu

7. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 10
   SARS in the Intensive Care Unit
   Gavin M Joyn, Gregory E Antonio, Charles D Gomersall.

8. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 11
   Imaging of Pneumonia in Children
   Winnie CW Chu
DIIR SARS ACTIVITIES

9. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
   Chapter 12
   Imaging and Clinical Management of Paediatric SARS
   Winnie CW Chu, Ellis KL Hon, Frankie WT Cheng, TF Fok

10. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
    Chapter 14
    Radiographers' Perspective in the Outbreak of SARS
    Stella SY Ho

11. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
    Chapter 15
    Implementation of Measures to Prevent the Spread of SARS in a Radiology Department
    Anne D King and Alex SC Ching

12. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
    Chapter 16
    Post-mortem of SARS
    Gregory E Antonio, James F Griffith, Anil T Ahuja

13. Imaging in SARS. Editors: Anil T Ahuja and Clara GC Ooi
    Chapter 17
    The Future of Severe Acute Respiratory Syndrome
    Anil T Ahuja, Gregory E Antonio
ARTICLES ON SARS

- NEW ENGLAND JOURNAL of MEDICINE
- Radiology
- American Journal of Roentgenology

USEFUL LINKS

- WHO
- Aunt Minnie
- Diagnostic Imaging
- ICU information
FREQUENTLY ASKED QUESTIONS:

1. Should I perform CT on all suspected SARS patients?
   HRCT should be used with caution as it may result in over-diagnosis. It should be used only if there is a history of contact OR the clinical signs, such as a continuing fever, leucopenia etc., are strongly suggestive of SARS, AND the initial chest radiograph is normal.

2. What are the findings on radiographs and CT?
   Please refer to the section on imaging findings.

3. Are the imaging findings specific?
   The findings are non-specific and resemble those of other types of atypical pneumonia, BOOP, eosinophilic pneumonia, Langerhan Cell Histiocytosis etc. This is why the clinical context is very important for diagnosis.

4. What precautions are needed when scanning SARS patients?
   The area should be declared an Ultra-High risk area when SARS are being examined. Infection control measures are tabulated as a link at the end of the section the title MANAGEMENT AND INFECTION CONTROL IN A RADIOLOGY DEPARTMENT DURING THE SARS OUTBREAK.

5. What preventive measures should our staff take?
   Follow the infection control guidelines at work. Infection control measures are tabulated as a link at the end of the section the title MANAGEMENT AND INFECTION CONTROL IN A RADIOLOGY DEPARTMENT DURING THE SARS OUTBREAK.

6. In what order showed I put on or take off the protective apparel?
   Please see the new link at the end of the second last paragraph under the title MANAGEMENT AND INFECTION CONTROL IN A RADIOLOGY DEPARTMENT DURING THE SARS OUTBREAK.

7. Does a normal HRCT exclude SARS?
   Most probably it does. In our experience, no patient with suspected SARS symptoms and a completely normal HRCT at that time subsequently went on to develop SARS.