Chapter 16
Aftermath of SARS

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Introduction

This chapter briefly examines:
- the weaknesses in the healthcare systems exposed by the SARS epidemic in Hong Kong
- the sequelae of the disease

Audits

Two audit committees, set up by the Hong Kong Government and Hospital Authority respectively, reviewed the response of the health systems to the SARS epidemic. The findings of both audits were similar. The main criticism were that:
1. Government agencies were not prepared for an outbreak of such magnitude. Procedural mechanisms were not in place beforehand so agencies were always trying to catch up.
2. Information about an unusual viral infection in early February 2003 only had the status of rumor and early ‘soft’ evidence was neglected.
3. Not enough was done early in the epidemic to alert other hospitals and healthcare workers of potential risks. And when information was disseminated it was not very clearly communicated.

The following recommendations were made:
A. Effective surveillance, data collection and sharing
B. High level of awareness and implementation of effective infection control measures.
C. Rapid and comprehensive contact tracing
D. Timely declaration and enforcement of isolation and quarantine measures.

Both the audits were comprehensive, clearly identified the deficiencies and made suitable recommendations for future improvement.

Key Points

Recommendations of audits
- Improved surveillance
- Increased awareness
- Quicker response
Post- SARS sequelae

Following recovery from SARS, patients developed additional problems during convalescence related to the musculoskeletal system, adrenal insufficiency, and psychological well-being.

I. Musculoskeletal problems

Many patients experienced generalised muscular weakness, arthralgia and lethargy during the convalescent period.

Towards the end of the March to June 2003 SARS epidemic, the authors were presented with their first post-SARS patient (a young female healthcare worker) with severe hip and knee joint pain that had developed during her hospital stay and persisted since hospital discharge. MRI of the hips and knees revealed avascular necrosis of the femoral heads, femoral and tibial condyles and extensive intra-medullary bone infarcts in the femoral and tibial shafts.

A prospective study was therefore by the authors’ institution in September 2003. This showed avascular necrosis to be present in just under 5% of patients (all stage I disease using the University of Pennsylvania classification) at 6 months follow up with MRI (Figure 1).

![Figure 1](image_url)

34-year-old female previously treated with steroids for SARS. Sagittal T2-weighted images of knee showing severe avascular necrosis involving the subchondral bone on the mid-to posterior aspect of the medical femoral condyle (small arrows). No articular surface collapse is present. There is also a medullary infarcts in the distal femoral disphysis and the posterior aspect of the medial tibial plateau (large arrows).
This bone necrosis may be a complication of the infection or of the treatment (particularly corticosteroids) or both. It may be difficult to prove which factor is the major or sole cause since corticosteroids were almost uniformly used to treat SARS patients. Autopsy results on SARS patients have found fibrin thrombi in pulmonary vessels or intimal swelling of pulmonary vessels. It is conceivable that viral induced vascular damage or thrombosis may occur in other parts of the body and if present in bones may partially explain the high incidence of avascular necrosis and bone infarcts in the SARS patients.

Corticosteroids are postulated to induce osteonecrosis by a decrease in regional blood flow. Steroids may decrease blood flow by inducing a) formation of lipid emboli and lipid-loaded fibrin-platelet thrombi which occlude the subchondral arterioles and capillaries; or b) marrow fat hypertrophy which leads to increased intra-osseous pressure, compression of sinusoidal channels and impairment of venous flow.

It is known that high dose steroids administered over a short period to patients otherwise not predisposed to osteonecrosis seem to confer little or no risk of osteonecrosis. On the other hand, high dose steroids administered over a longer period to predisposed patients (patients with systemic lupus erythematosus, rheumatoid arthritis, malignancy, or following organ transplantation) have a dose-related risk of osteonecrosis varying from 4% to 52%. Using a multiple multinomial logistic regression model for the results, it emerged that the cumulative dose of corticosteroid was the most important risk factor for predicting osteonecrosis. In our experience, no osteonecrosis was observed in patients who received less than 3g prednisolone equivalent, while 12.5% of patients who received more than 3g developed osteonecrosis.

Unlike many of the other side effects of corticosteroid therapy (such as immunosuppression, myopathy and reduced bone density), osteonecrosis, once established, will not recover on discontinuation of steroid therapy. Given the implications of avascular necrosis and the possible subsequent joint destruction and disability, this side-effect/complication and its possible association with SARS treatment needs to be fully explained to the patient as part of informed consent before commencing treatment, if SARS does recur.

In addition to avascular necrosis, non-specific bone marrow abnormalities were present in the MRI of 34% of patients. These were:

A. subchondral bone marrow abnormality (28% of patients) which ranged from 3-26mm (mean 6.5mm) in size (Figure 2). Some of these patients had associated joint degenerative change. The MRI appearances of these subchondral marrow abnormalities
was comparable to that observed in severe degenerative disease \(^9\) and in keeping with this likelihood they did tend to occur in a relatively older age group to those with normal MRI examinations or osteonecrosis. Another probable cause of subchondral marrow abnormality is early subchondral osteonecrosis. The distribution of the marrow abnormalities around the knee was similar to that observed with osteonecrosis

B. intra-medullary bone marrow abnormality (17% patients). These ranged in size from 3-20mm (mean 5.9mm) (Figure 3). The incidence of intramedullary abnormalities in the normal population is not known. Although these lesions may potentially represent very small areas of osteonecrosis, they are of small size (mostly several millimeters) and by virtue or their location (not subchondral) unlikely to cause symptoms, structural weakening or long term problems.

**Figure 2**
31-year-old female following steroid treatment for SARS. T1-weighted coronal image of both femora. There are medullary infarcts in the distal femoral disaphysis bilaterally (arrows). No subchondral avascular necrosis is evident.

**Figure 3**
54-year-old female previously treated for SARS. T1-weighted oblique coronal image of the left hip. There is a small area of subchondral avascular necrosis involving the superior aspect of the femoral head. No articular surface collapse is present.
In our experience, more than 50% of patients experienced large joint pain following recovery from SARS. The vast majority of these joints show no abnormality on MRI examination. Joint pain following other viral infections is not uncommon. It is recognized that there are ‘arthriogenic’ viruses, including hepatitis C, rubella, and human T-cell lymphotrophic virus type 1 (HTLV-I) \(^7\). An important implication is that joint pain cannot be used as a reliable clinical indicator when screening for osteonecrosis following steroid treatment for SARS.

**Key Points**
- avascular necrosis is a sequlae of SARS
- ? effect of infection / illness and / or treatment
- some relationship between steroid dose and avascular necrosis
- non-specific abnormalities detected with MRI of unknown significance
- pain not a sensitive sign of avascular necrosis

**II. Adrenal Insufficiency**
As a result of steroid therapy, suppression of normal adrenal steroid production is to be expected. Many patients were still on steroid replacement therapy months after hospital discharge. They continued to fail steroid challenge tests and were thus not weaned off exogeneous corticosteroids.

**III. Psychological Scars**
During the post-epidemic period, it became apparent that significant psychological effects aside from physical scars were present in patients following the initial SARS outbreak. Many patients were still recovering from the initial trauma of the infection and “near death” experience six months after the event. In the authors’ institution, patients who developed psychiatric symptoms since their SARS infection underwent MRI of the brain after their hospital discharge. None of the MRIs demonstrated an abnormality (Figure 4).

In a study by Chan et al \(^{13}\), patients who have recovered from SARS show symptoms of psychological trauma. In the early recovery phase, about 5 weeks from onset of SARS, 26% (27 of 101) of inpatients showed moderate to severe degrees of anxiety; and 16% (16 of 101) inpatients showed moderate to severe degrees of depression. It was assumed this psychological aftermath will probably improve over time. The same study reported data from another series of 75 patients who were evaluated at one to two months after hospital discharge. Only 5% of these patients were reported to have moderate to severe anxiety and
depressive symptoms in this later stage. Other than anxiety or depression, post-SARS patients suffered from some impairment of health-related quality of life. Using the validated MOS 36-items Short Form Health Survey, this second series showed a decrease in health-related quality of life scores, particularly in the domains of physical and social functioning and bodily pain.

*Figure 4*

34-year-old male patient with psychiatric symptoms 6 months after treatment of SARS. Axial T2 FLAIR MRI scan demonstrates no focal abnormality.

Some post-SARS-infected healthcare workers have found it difficult to return to the workplace (e.g. a hospital ward) or their accommodation, which they associate with the source of their infection. This appears to be a form of post-traumatic stress disorder and may require long term rehabilitation. Will these healthcare workers, many of whom young nurses, be able to return to fulltime work? Only time will tell.

**Key Points**

- *psychological trauma may occur early and some persist after physical recovery*
- *most appear to improve with time*
CONCLUSION

Information from retrospective studies and reviews continue to stream in regarding various aspects of SARS. New protocols and practices are being instigated as new information become available. It is hoped that enough has now been learnt to effect a significant positive difference if and when the next outbreak occurs.
References