Clinical and radiographic spectrum of septic pulmonary embolism

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Aims: To review the clinical presentation, radiographic findings, and outcome of therapy in children with septic pulmonary embolism.

Methods: Retrospective analysis of patients in a tertiary paediatric facility in northern Taiwan.

Results: Ten children were identified with septic pulmonary emboli in a four year retrospective chart review between 1998 and 2001. Seven were immunocompetent, two were premature infants, one had β thalassemia major. Seven had community acquired staphylococcal infections and bacteraemia, of which six were methicillin resistant Staphylococcus aureus (MRSA) isolates. Five had soft tissue infections, two bone infections, one supplicative otitis media, one catheter related infection, and one unknown foci of infection. Multiple and bilateral nodular pulmonary parenchymal lesions were common on plain chest radiographs, but chest computed tomography scans showed the additional findings of a “vessel sign” and central cavitations, confirming the existence of septic pulmonary embolism.

Conclusions: Community acquired MRSA infections occurred in seven patients with septic pulmonary embolism but without predisposing high risk factors. Critically ill children with skin, soft tissue, or bone infections, when associated with septic pulmonary embolism in an area with a high rate of MRSA, should be empirically treated with glycopeptides (such as vancomycin or teicoplanin) before susceptibility results are known, in order to minimise morbidity and avoid mortality.
developed suppurative discharge at the site of umbilical vein catheterisation, together with multiple nodular skin lesions at right ankle and left knee. Only two patients underwent echocardiography. Neither had valvular anomalies or vegetation. All 10 patients survived.

Pulmonary outcome
Patient 5 required open thoracotomy for treatment of a left sided tension pneumothorax and empyema. He subsequently required repeated insertion of a chest tube for recurrent pneumothorax caused by ruptured pneumatocele. Patient 9 underwent bilateral percutaneous needle aspiration of lung abscesses. Pneumatocele and chest wall retraction persisted at three months after discharge. Patient 10 had a tube drainage of a lung abscess.

Extrapulmonary sequelae
Soft tissue abscess formations were found in cases 1, 3, 4, and 8; each required local drainage, exploration, or debridement. Patients 2 and 7 had osteomyelitis at respectively the right distal tibia and left humerus, both of which needed open drainage. Patient 2 had chronic osteomyelitis and required oral antibiotics for three months. Endogenous endophthalmitis developed in patient 6 as reported previously.

Radiographic findings
Table 2 summarises the radiographic features of septic PE of these 10 patients. Diffuse bilateral nodular lesions were seen on radiographs in 70% of patients (fig 1A). Nodular densities, pulmonary cavities, and bilateral parenchymal involvement were seen in 80% of the patients on chest CT (fig 1B), five of whom had the “feeding artery” sign. Cases 9 and 10 had large solitary lung abscesses with an air–fluid level on frontal chest radiographs (fig 2A,B). Pneumatoceles developed in cases 5 and 9 after the acute embolic stage of the disease (fig 2C). Empyema or pleural effusions were noted in six patients. One patient developed a pneumothorax.

Bacteriology and antimicrobial susceptibility
Staphylococcus aureus was the aetiologic pathogen in nine patients, eight of which were methicillin resistant Staphylococcus aureus (MRSA) (table 1). Seven had community acquired MRSA without predisposing factors. One MRSA isolate was hospital acquired with prior antibiotic therapy and associated with umbilical vein catheterisation. Case 6 had Klebsiella pneumoniae septicemia with underlying β thalassemia major following suppurative infection of the left ear. All nine patients with staphylococcal infections received vancomycin therapy before the drug susceptibility results were known;
patient 3 was given oxacillin therapy after the confirmation of susceptibility.

**DISCUSSION**

Clinically, all patients in this series were septic and toxic with evidence of metastatic infections. Two patients (cases 2 and 8) did not have respiratory embarrassment despite significant pulmonary abnormalities. Causes of septic PE in children described in the literature include right sided bacterial endocarditis, septic thrombophlebitis, osteomyelitis, soft tissue infections, or urinary tract infections. The commonest causes of septic PE in this study were soft tissue and bone infections. If the source is not clinically evident, a bone scan or white cell label scan may identify a focus. The pulmonary manifestations and radiographic changes of septic emboli are indicative of underlying infections. Early awareness and recognition of septic PE guide the right choice of antibiotics. Typical radiographic features of septic PE typically include patchy air space lesions simulating non-specific bronchopneumonia; multiple ill defined round or wedge shaped densities of varying sizes from 0.5 to 3.5 cm located peripherally; lesions abutting the pleura and located at the end of vessels (feeding vessel sign) seen on chest CT scans. Other pulmonary features suggesting septic PE include bilateral, occasional unilateral, rapid progression of cavities or abscess formations. Empyema, bronchopleural fistula, and pneumothorax were not common in this study. Hilar or mediastinal lymph node enlargement have been described but was not seen in our patients.
Primary staphylococcal pneumonia is usually unilateral. We presume the lung abscesses seen in patients 9 and 10 were secondary to septic embolisation, because they had previous umbilical catheterisation and preceding staphylococcal bacteremia.

Children with staphylococcal bacteremia are particularly prone to osteitis and myositis. In a study of 113 adults patients with community acquired *S aureus* bacteremia there was a high mortality of 35%. In methicillin sensitive *S aureus* infections, β lactam antibiotics are preferred, since glycopeptides (vancomycin and teicoplanin) are less bactercidal than β lactams. Previously, MRSA has been most commonly seen in hospitalised patients with prolonged hospitalisation, invasive or surgical procedures, indwelling catheters, endotracheal intubation, or prolonged or recurrent exposure to antibiotics. Glycopeptides are the drugs of choice for treating severe infections caused by methicillin and other β lactam resistant staphylococci.

Community acquired MRSA (CAMRSA) infections have been uncommon in the past. However, MRSA infections with no risk factors have become an important problem worldwide. In a recent report of four paediatric deaths caused by CAMRSA infections, the children had been initially treated with a cephalosporin antibiotic. The rationale of changing the empiric selection of antibiotics in order to assure appropriate coverage in severely ill children should therefore be emphasised. For critically ill patients with suspected CAMRSA infections, especially soft tissue infections such as cellulitis or abscess, vancomycin should be the initial empiric antibiotic because β lactams in general are ineffective for treating MRSA infections in such circumstances. Failure to respond promptly to adequate antibiotic treatment and continuing pulmonary seedings by septic PE signify the necessity for early surgical drainage of the infective lesion.

Conclusions

Pediatricians should be familiar with the radiographic features of PE to avoid delay in prompt diagnosis and therapeutic decisions. Although MRSA has not been a frequent pathogen in community acquired infections, paediatricians should be aware of this possibility. Its presence is no longer confined to children with established risk factors. CAMRSA infections present in children with skin, soft tissue, and bone and joint infections. Bacteremia caused by *S aureus* infections generally needs prolonged antibiotic therapy and has been associated with high morbidity and mortality. The emergence of CAMRSA as a cause of infections requires a change in the initial selection of antibiotics, such as glycopeptides (vancomycin or teicoplanin) to ensure appropriate coverage in critically ill children.

References

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