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Drowning with acute respiratory failure

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Abstract

We present the case of a 74-year-old male that was admitted to our Unit of Pulmonology for chlorinated freshwater drowning syndrome with acute hypoxemic respiratory failure. Despite an initial clinical response, with improvement of the respiratory failure and decreased number of the multifocal pulmonary opacities on chest CT, after about ten days from the admission, the patient developed intermittent fever (up to 39.3°C), re-worsening of the respiratory failure and pneumatocele. Blood cultures showed the presence of methicillin-resistant staphylococcal aureus (MRSA) sepsis. Despite many courses of different antibiotics, the patient died. MRSA is a rare cause of pneumonia after drowning with a high lethality rate

KeyWords: drowning, acute respiratory failure, acute respiratory distress syndrome (ARDS), methicillin-resistant staphylococcal aureus (MRSA) sepsis.

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Introduction

Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid (1,2,3). Pneumonia is the most common and life-threatening infectious complication of drowning (4,5). We present here a case of drowning with acute respiratory failure complicated by methicillin-resistant staphylococcal aureus pneumonia and sepsis.

Case presentation

A 74-year-old male, Chinese, living in the southwestern region of China (Chongqing), retired former municipal employee, never smoker, presented at the Emergency Room of the University Hospital Gaetano Martino of Messina, Italy (www.polime.it), for drowning syndrome with acute hypoxemic respiratory failure and was admitted to our ward of Pulmonology. A few hours earlier, he had fallen inside the swimming pool of a cruise ship, during water games, he was drowned and cardiopulmonary resuscitation maneuvers were performed. In his past history there were paroxysmal atrial fibrillation, kidney stones and benign prostatic hypertrophy, but he denied taking regular home drug therapy; he denied

previous respiratory diseases and other noteworthy comorbidities. History was collected with the help of a cultural mediator.

At the admission in our ward his vital signs were: systemic blood pressure 89/56 mmHg, pulse frequency 79/min rhythmic, respiratory rate acts 35/min, body axillary temperature 36.5°C. An arterial blood gas analysis, performed with the patient breathing oxygen with a Venturi mask (FiO2 40%), showed an acute hypoxemic respiratory failure (Table 1) and treatment with high flow nasal cannula (HFNC) was started after 2 days for the progressive worsening of the respiratory failure.

Physical examination of the chest revealed severe reduction of the vesicular sound bilaterally in the middle-basal lung fields with the concomitant presence of crackles, in the same locations. A chest X-ray showed mainly the presence of bilateral multifocal lung opacities with a "cotton-like" appearance (Figure 1).

Fig. 1 Chest X-ray at the admission

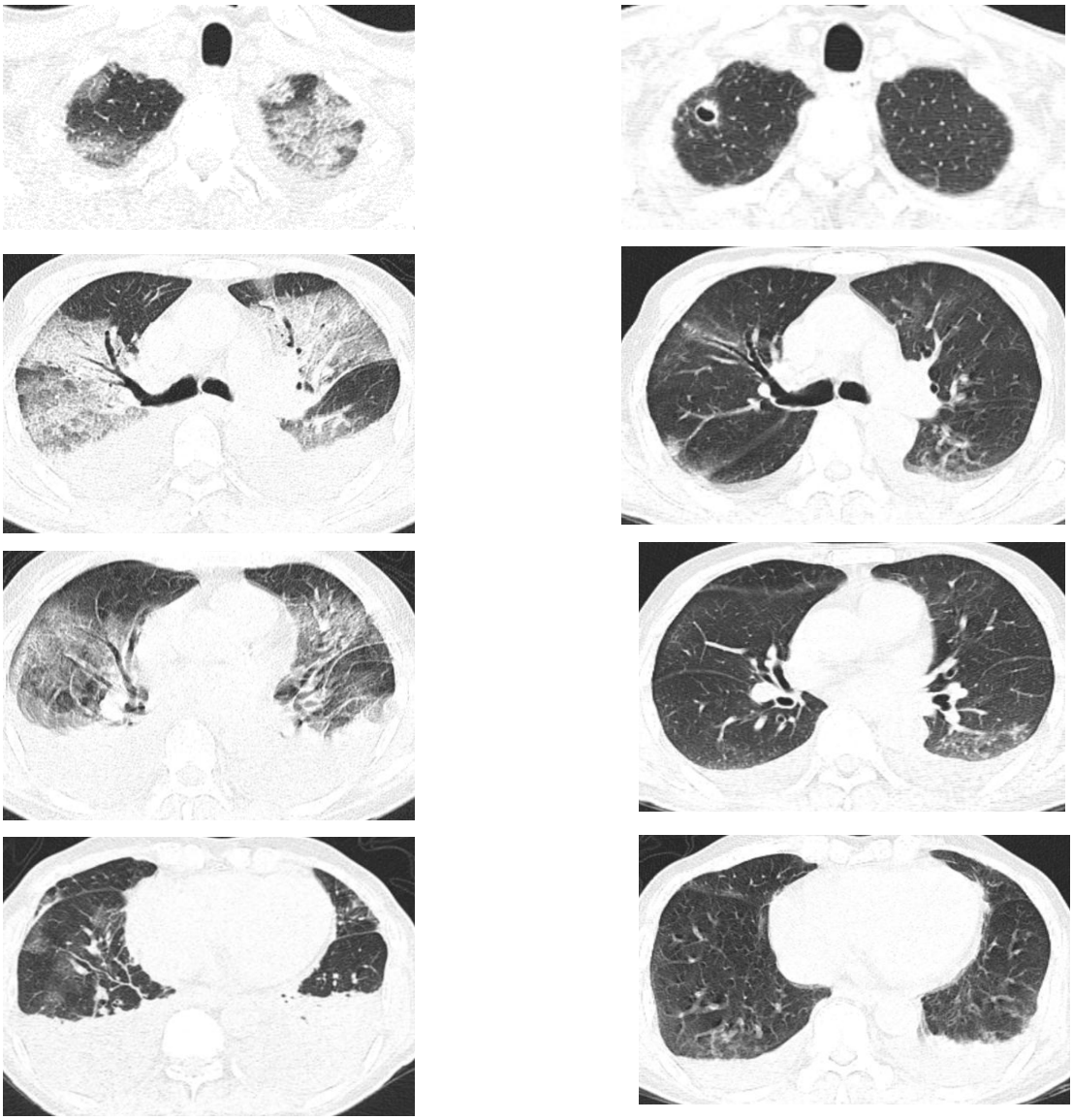
Laboratory data at the admission are shown in Table 2. It was started empiric wide spectrum antibiotic therapy (amoxicillin/clavulanic acid 1 g thrice daily plus levofloxacin 750 mg once daily, both intravenous for 7 days).

After 5 days from the admission, was performed a computed tomography (CT) of the chest that showed the presence of bilateral pleural effusions and multifocal lung opacities, with a mixed pattern consolidative and ground glass (Figure 2a).

Fig. 2 Evolution of the computed tomography (CT) scans of the chest

2a Chest CT after 5 days from the admission

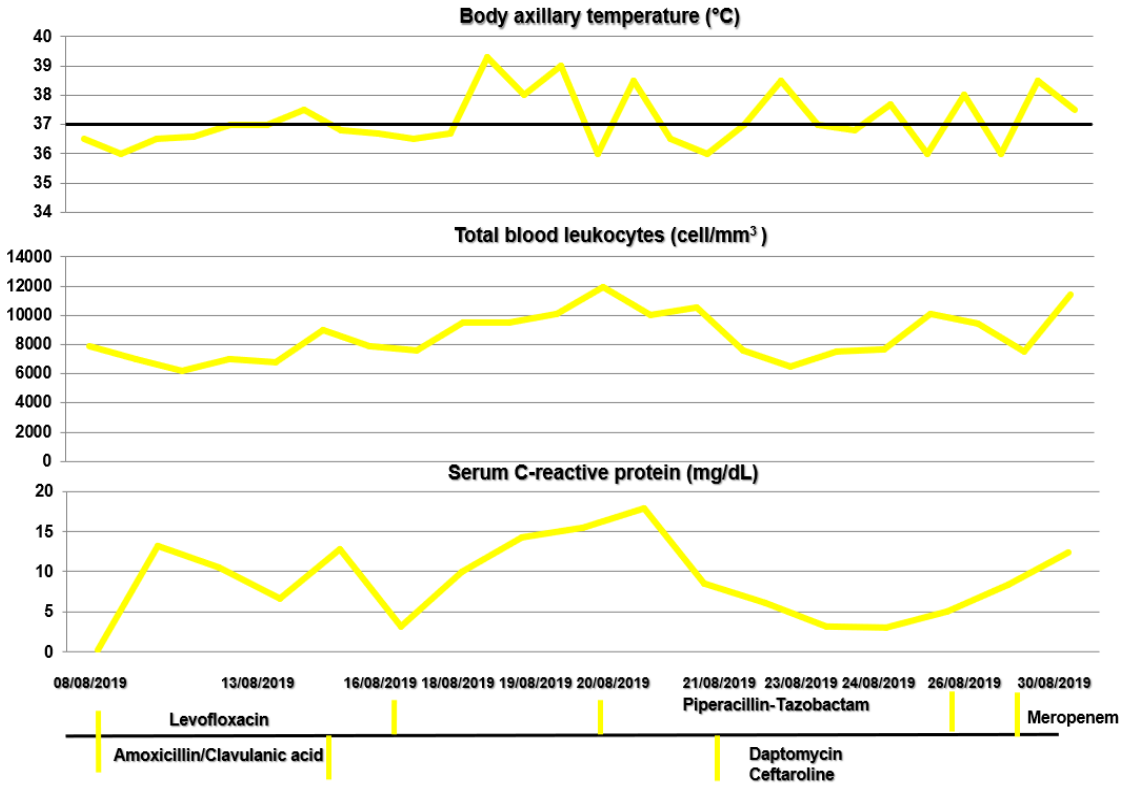
2b. Chest CT after 16 days from the admission



In the first ten days, the patient had a progressive improvement of the respiratory failure (Table 1). Subsequently, he developed intermittent fever (up to 39.3°C) and re-worsening of the respiratory failure. Four blood cultures, were positive for methicillin-resistant staphylococcal aureus (MRSA) sepsis.

With the support of the infectious disease consultants many courses of different antibiotics [piperacillin/tazobactam 4.5 g IV (every 6 hours) plus daptomycin 500 mg(IV every 24 hours) plus ceftaroline (600 mg IV every 12 hours) for 7 days, then only daptomycin plus ceftaroline for other 5 days, then daptomycin plus ceftaroline plus meropenem 1 g IV every (8 hours for 3 days)] were administered to the patients but both the fever and the neutrophilic leukocytosis with increased serum levels of C reactive protein persisted (Figure 3).

Fig.3 Trends during the hospitalization of the body axillary temperature, total blood leukocytes and serum C-reactive protein (CRP)



For this reason, after 16 days from the admission was performed another CT of the chest that showed reduction of the volume of the bilateral pleural effusions with almost complete resolution of the bilateral multifocal lung opacities; but with the appearance of a pneumatocele in the apical segment of the right upper lobe (Figure 2b).

After 7 days from the admission was performed an echocardiogram that showed moderate tricuspid insufficiency, and an estimation indirect estimate of systolic pulmonary arterial pressure (SPAP) of about 55 mmHg.

A second echocardiogram performed after 23 days from the admission, showed severe mitral insufficiency (anterior flap perforation), moderate-severe tricuspid insufficiency with SPAP estimated at 55-60 mmHg, right retroatrial pericardial detachment and it was not possible to exclude the presence of cardiac valve vegetations. After 16 days from the admission a brain CT showed in the right fronto-insular region an intraparenchymal hematoma (19x12 mm) and multiple bilateral hemorrhagic foci. The peripheral blood smear documented normocytic normochromic anemia, neutrophilic leukocytosis and thrombocytopenia.

After 21 days from the admission an endoscopy of upper digestive tract documented a small antral ulcer in active phase. After 10 days from the first isolation of MRSA on blood culture, the patient further deteriorated and respiratory failure reappeared (Table 1) and after 2 days with the support of an intensive care specialist was started non-invasive mechanical

ventilation (SOFA score=4); however the patient deceased for multi-organ failure 2 days later after 25 days from the admission.

Discussion

Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid (1,2,3). The mechanism of drowning involves aspiration of water into the lung which damages surfactant, disrupts the alveolar capillary membrane and leads to the development of alveolar oedema, resulting in acute respiratory distress syndrome (ARDS) (6). Accidental falls are a major drowning cause in adults and age>65 years is a predictor of mortality/morbidity after submersion injury (7,8).

The hospital management of acute respiratory failure in these patients includes the administration of high-flow oxygen or non-invasive/invasive mechanical ventilation (4,9,10). In some patients, with refractory acute respiratory failure adequate oxygenation can be maintained only with the use of extracorporeal membrane oxygenation (4). There is little evidence on the use of systemic glucocorticoids for reducing pulmonary injury. The use of prophylactic antibiotics is not recommended (3,4,11).

Pneumonia is the most common and life-threatening infectious complication of drowning (4,5). Early-onset pneumonia can be due to the aspiration of polluted water, endogenous flora, or gastric contents. Among the bacteria isolated in the tracheal aspirate of these patients were found, staphylococcus aureus, enterobacter spp pseudomonas aeruginosa, aeromonas hydrophilia (8).

Methicillin-resistant staphylococcus aureus (MRSA) pneumonia is associated with high lethality rate, until 60%; because it is often complicated by infectious endocarditis, sepsis and toxic shock syndrome (12,13).

MRSA usually does not survive for long time in swimming pools that have proper disinfectant (chlorine) and pH levels, however, MRSA can be spread at recreational water facilities and other places by direct and indirect contact with infected persons (14,15,16).

When MRSA pneumonia is suspected, empirical antibiotic therapy should be started and definitive therapy should be substituted once the results of culture and sensitivity testing are available (4,5,8,12,13,17,18,19,20).

Treatment of MRSA pneumonia/sepsis is based on administration of parenteral vancomycin, in some cases associated and/or replaced by linezolid, daptomycin, tigecycline, ceftaroline or ceftobiprole (13,18,19).

Conclusion

We presented here a case of drowning complicated by MRSA sepsis in a 74-year-old Patient.

Table 1. Arterial blood gas data during the hospitalization

DAYS	pH	PaO2	PaCO2	SaO	PaO2/FiO2	OXYGEN THERAPY/ NIMV
Admission	7.39	57	34	89%	142	Venturi mask FiO2 40%
1 dayafter	7.50	52	32	89%	185	Venturi mask FiO2 28%
2 daysafter	7.48	54	33	93%	135	Venturi mask FiO2 40%
2 daysafter	7.40	64	35	94%	160	HFNC FiO2 40%
3 daysafter	7.40	72	34	95%	184	HFNC FiO2 39%
5 days after	7.48	58	34	93%	141	HFNC FiO2 41%
6 days after	7.47	57	32	93%	114	HFNC FiO2 50%
7 days after	7.47	65	34	94%	180	HFNC FiO2 36%
8 days after	7.45	61	34	92%	174	Venturi mask FiO2 35%
9 days after	7.46	92	36	98%	328	Venturi mask FiO2 28%
10 days after	7.45	72	36	95%	341	Room Air
20 days after	7.51	55	28	91%	261	Room Air
24 days after	7.26	66	49	92%	110	NIMV FiO2 60%
24 days after	7.37	55	48	89%	68	NIMV FiO2 80%

PaO2: partial pressure of oxygen
PaCO2: partial pressure of carbon dioxide
SaO2: oxygen saturation in the arterial blood
FiO2: inhaled fraction of oxygen
HFNC: high flow nasal cannula
NIMV:non invasive mechanical ventilation

Table 2. Laboratory data at the admission

LABORATORY DATA	VALUE	NORMAL VALUES
Erythrocytes (cell/mm3)	3260000	4500000-5500000
Hemoglobin (g/dL)	11.4	13.5 – 18
MCV (fl)	93	80 - 100
MCHC (%)	35	32 - 37
Hematocrit (%)	32	38 - 46
Total leukocytes (cell/mm^3)	7000	4500 - 9000
Neutrophils (cell/mm^3)	5950	1500 - 7700
Lymphocytes (cell/mm^3)	560	1500 - 3500
Eosinophils (cell/mm^3)	70	40 - 500
Monocytes (cell/mm^3)	420	< 1000
Basophils (cell/mm^3)	0	0 - 300
Platelets (cell/mm^3)	80000	150000 - 350000
Serum CRP (mg/dL)	13.25	0 – 0.50
Serum PCT (ng/mL)	5.75	Bacterial infection of the lower respiratory tract: <0.10: absence 0.10 – 0.25: probable 0.25 – 0.50: possible >0.50: presence of bacterial infection Systemic bacterial infection / sepsis: <0.50: absence 0.50 – 10: possible >10: high probability of sepsis
Serum D-dimer (µg/mL)	1.44	0 – 0.50

MCV: mean cell volume
MCHC: mean cell hemoglobin concentration
CRP: C-reactive protein
PCT: procalcitonin

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