Clinical Note

Treatment of postoperative purulent pericarditis and streptococcal toxic shock syndrome by intensive blood purification

Xin Lin, MD,
Xian-Qing Shi, MD, PhD,
Yan Zha, MD, PhD.

Streptococcal toxic shock syndrome (STSS), a severe infectious disease caused by group A hemolytic streptococcus (*Streptococcus pyogenes* [*S. pyogenes*]) in patients with purulent pericarditis has hardly ever been reported in the literature. We experienced an extremely rare case of STSS caused by a purulent pericarditis following multiple stab wounds. The patient was successfully treated with intensive blood purification techniques and penicillin. The case we present suggests that intensive blood purification might be useful in alleviating development of *S. pyogenes* infection by protecting important organs, and removing endotoxins before the outcome of bacterial cultivates.

A 27-year-old male was admitted to the emergency department with stab wounds on his left shoulder, chest, upper and middle abdomen, and thigh. An urgent exploratory thoracotomy with cardiorrhaphy, pulmonary lobe repair, and exploratory laparotomy with liver and stomach rupture repair were performed. After 4 days, laboratory studies revealed a white blood cell (WBC) count of 13×10^9/L, liver and renal function tests were normal. After 10 days, he became dysphoric with profuse sweating, dyspnea, and chest pain. Physical examination revealed a temperature of 36.4°C, heart rate of 149 beats/min, respiratory rate of 35/min, blood pressure (BP) of 84/60 mm Hg, paleness, clammy palms and soles, and peripheral cyanosis. A decreased breath sound of the left lung, and low intensity heart sounds were found. Oxygen saturation measured by pulse oximetry was 86%. Laboratory tests showed a WBC of 38.94×10^9/L, 92.7% neutrophil percentage, and high levels of aspartate aminotransferase (AST [1395 IU/L]), and alanine transaminase (ALT [1093 IU/L]). The chest CT showed a large amount of pericardial effusion and bilateral pleural effusion (**Figures 1A & 1B**). His urine volume was 460 ml/day.

He was initially thought to be in septic shock introduced by purulent pericarditis. He therefore received intravenous fluid resuscitation, imipenem and ornidazole, and support care including nutrition, breathing, and so forth. A follow-up examination showed a substantial elevation of ALT, AST, serum creatinine (sCr) and cystatin C (CysC), and we considered the need for circulation support and toxin removal. Continuous veno-venous hemodiafiltration (CVVH) was performed on the patient using PRISMA platform (AN69-ST membranes, Gambro, Hechingen, Germany). The ultrafiltration rate dose was targeted to 50 mL/kg/hour. Meanwhile, a left exploratory thoracotomy was carried out. A large amount of yellowish-white pus overflowed from the pericardial cavity, (a total of approximately 10 ml) and part of the pus was sent to the laboratory for bacterial cultivate and drug susceptibility tests. After the operation, plasma exchange (PE) was performed. The filter was a membrane filter (Plasmaflo OP-05W, Kasei, Japan), and the exchange volume was fresh-frozen plasma (approximately 3,000 ml) at an exchange rate of 15 ml/min. The first PE was carried out in the morning of the eleventh day, and the second at night. He became calm, his BP was 100/62 mm Hg, and his heart rate was 101 beats/min after the first PE. On day 13, the WBC count, AST, and ALT decreased, and the urine volume increased to 1160 ml/day. The changes of indicators are shown in **Figure 2**. The output of bacterial cultivates was pyogenic streptococcus. The organism was susceptible to ampicillin, cefotaxime, and ceftriaxone.

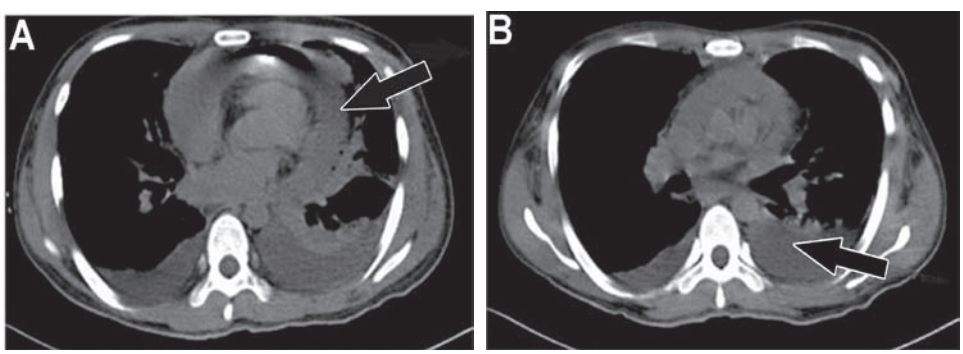

Figure 1 - A chest CT showing a large amount of: **A**) pericardial effusion; and **B**) bilateral pleural effusion.

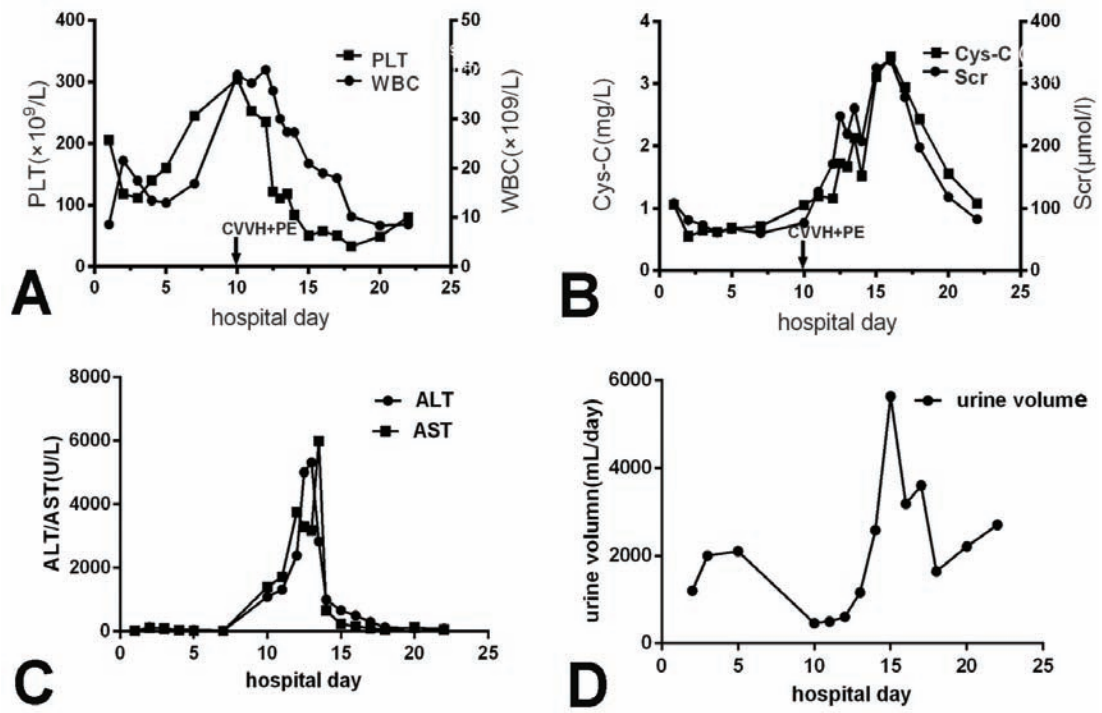

Figure 2 - Clinical course and hematology showing the: **A**) changes of PLT and WBC; **B**) changes of CysC and Scr; **C**) changes of ALT and AST; and **D**) changes of urine volume. WBC - white blood cells, PLT - platelet, ALT - alanine transaminase, AST - aspartate aminotransferase, sCr - serum creatinine, CysC - cystatin C.

The diagnosis of purulent pericarditis and TSS were established following the definition of the Working Group on Severe Streptococcal Infections:[1] isolation of group A streptococci, presence of signs associated with severe infection. Antibiotic therapy was changed to intravenous penicillin G at a dose of 300,000 U/kg per day. On hospital day 15, the CVVH was cancelled. His diuresis reached to 3180 ml/day. Treatment was continued with intravenous penicillin G for a total of 2 weeks. He had an uneventful recovery with normal liver and renal function, and had no cardiac complications, one and a half years after his illness.

Toxic shock syndrome (TSS) is caused by toxins from *Staphylococcus aureus* (*SA*), and group A Streptococcus (GAS). It can quickly affect several important organs including the liver, lungs, and kidneys. Women who use tampons, diaphragms, or contraceptive sponges, and underwent surgery, or parturition are easy to suffer from this disease. Approximately 15% cases are patients who experienced operation. With the development of sepsis, the mortality becomes higher. Traditional treatment of serious infections includes control of the source of infection, intravenous antibiotic therapy, aggressive replacement of fluids, inotrope and vasopressor therapy, as well as supportive therapies. Wiles et al[2] first reported 4 patients with STSS treated with continuous renal replacement therapy (CRRT) and plasmapheresis, and Hoeper et al[3] reported the clinical course of a patient with near-fatal STSS in whom plasmapheresis was apparently life saving. Extracorporeal blood purification is an adjuvant method for the treatment of the critically ill, particularly infection or inflammatory associated disease with, or without renal failure, CVVH, and plasmapheresis are most commonly used. On literature review, no more than 20 STSS cases treated with PE and CRRT were reported. In Wiles's report,[2] 2 of the 4 cases died.

Theoretical considerations, modern high flux membranes with an average cutoff approximately 30-40 kD should be capable of eliminating significant amounts of inflammatory mediators. Servillo et al[4] performed a clinical study, applying to septic patients CVVH with high flux (60 mL/Kg/hr), ultrafiltration rate of 4 L/hr, and polyether sulphone filter. They found that transcriptional activity of an inflammatory cytokine, such as interleukin (IL)-6 significantly decreased after 12 hours of treatment, therefore, they suggested that there might be an immunomodulatory effect of CVVH during sepsis.

Both clinical and experimental studies have shown that plasmapheresis lowers the circulating levels of endotoxin and cytokines. The separation of material, in which the diameter is less than the membrane aperture is nonselective. Using fresh-frozen plasma as replacement fluid, the procedure also replenishes deficiencies, such as the immunoglobulins (Ig)M and IgA, and coagulation factors and inhibitors, such as proteins C and S, and antithrombin III. In Busund et al's study,[5] a prospective, randomized, controlled trial in 106 severe sepsis and septic shock adults, the 28-day all-cause mortality in the plasmapheresis group was 33.3%, compared with 53.8% in the control group (p=0.050). They suggest plasmapheresis may be an important adjuvant to conventional treatment to reduce mortality in patients with severe sepsis or septic shock, and it is a safe procedure in the treatment of septic patients.

The most suitable timing of CRRT initiation has been difficult to investigate. In a recent retrospective cohort study,[6] the 28-day overall mortality rates in the early CRRT group were significantly lower than those in the late CRRT group (p=0.034), and the early CRRT treatment was independently associated with a lower mortality rate, "early" RRT might be beneficial, but a standardized and clinically relevant definition of "early" should be provided in the near future. The definition of "normal dose" is now recommended in a range of 20-30 ml/kg per hour for continuous therapies, and thrice weekly intermittent hemodialysis. However, that is the dose of "renal", which is based on acute kidney injury, some studies in sepsis and other cases suggest a high dose, and "early RRT" have higher survival rates and better prognosis.

Pericardial drainage operation and timely clearing of pus were effective treatments to control the development of sepsis. Special anti-infection treatment was also of importance; penicillin is the best choice and the duration of treatment is well-established as being 10 days minimum.[7]

In conclusion, we present an unusual case of STSS due to *S. pyogenes* infection after an emergency surgery of multiple stab wounds that was successfully treated with intensive blood purification techniques. It was suggested that intensive blood purification might be useful in alleviating development of *S. pyogenes* infection, and protecting vital organs before the outcome of bacterial cultivates. As the STSS is a very rare disease, it seems virtually impossible to conduct a randomized double blind study to prove the therapeutic efficacy of plasmapheresis in this condition.

Acknowledgment. *The authors gratefully acknowledge Dr. Rong-Ping Wang from the Department of Radiology, People's Hospital of Guizhou Province, Guiyang, China for advice on the diagnosis of CT imaging.*

Received 30th April 2104. Accepted 1st July 2014.

From the Department of Nephrology (Lin), Nanfang Hospital, Southern Medical University, Guangzhou, and the Departments of Nephrology (Lin, Zha), Intensive Care Unit (Shi), People's Hospital of Guizhou Province, Guiyang, Guizhou Province, People's Republic of China. Address correspondence and reprints request to: Dr. Yan Zha, Department of Nephrology, People's Hospital of Guizhou Province, no. 83, Zhongshan East Road, Guiyang 550002, Guizhou Province, People's Republic of China. E-mail:zhayan72com@163.com

References

1. The Working Group on Severe Streptococcal Infections. Defining the group A streptococcal toxic shock syndrome. Rationale and consensus definition. ***JAMA*** 1993; 269: 390-391.
2. Wiles CE 3rd, Reynolds HN, Bar-Lavie Y. Flush resuscitation for group A streptococcus toxin shock: a possible role for continuous renal replacement therapy and plasmapheresis. ***Md Med J*** 1998; 47: 1888-1890.
3. Hoeper MM, Abou-Rebyeh F, Athman C, Schwarz A. Plasmapheresis in streptococcal toxic shock syndrome. ***Crit Care Med*** 2001; 29: 2399.
4. Servillo G, Vargas M, Pastore A, Procino A, Lannuzzi M, Capuano A, et al. Immunomodulatory effect of continuous venovenous hemofiltration during sepsis: preliminary data. ***Biomed Res Int*** 2013; 2013: 108951.
5. Busund R, Koukline V, Utrobin U, Nedashkovsky E. Plasmapheresis in severe sepsis and septic shock: a prospective, randomized, controlled trial. ***Intensive Care Med*** 2002; 28: 1434-1439.
6. Oh HJ, Shin DH, Lee MJ, Koo HM, Doh FM, Kim HF. Early initiation of continuous renal replacement therapy improves patient survival in severe progressive septic acute kidney injury. ***J Crit Care*** 2012; 27: 9-18.
7. Falagas ME, Vouloumanou EK, Matthaiou DK, Kapaskelis AM, Karageorgopouls DE. Effectiveness and safety of short-course vs long-course antibiotic therapy for group a beta hemolytic streptococcal tonsillopharyngitis: a meta-analysis of randomized trials. ***Mayo Clin Proc*** 2008; 83: 880-889.