

# Point of Care Ultrasound Diagnosis of Perioperative Sepsis Shock

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## Abstract

Point-of-care ultrasound of echocardiographic is capable of identifying the precise causes of hemodynamic disorder in patients with sepsis especially septic shock [1]. Patients in sepsis demonstrate complex alterations in their circulation, including changes in preload and afterload and right ventricle dysfunction [2]. Based on systemic inflammation it can also cause a significant proportion of acute lung injury, as the most common manifestation of sepsis with multiple organ dysfunction [3], real-time bedside assessment of lung function is required, simple using of cardiac ultrasound may lead to the omission of clinical information.

Combined use of point of care echocardiography and pulmonary echocardiography can quickly detect circulatory and respiratory problems in critically ill perioperative patients, and can dynamically evaluate and guide treatment. The author combined with cardiopulmonary ultrasound to evaluate 4 patients during perioperative period to achieve visual diagnosis and treatment.

**Keywords:** Point of care ultrasound; Septic shock; Perioperative; Cardiopulmonary ultrasound

**Abbreviations:** ICU: Intensive Care Unit; ARDS: Acute Respiratory Distress Syndrome; ALI: Acute Lung Injury; LVEF: Left Ventricular Ejection Fraction; LAP: Left Atrial Pressure

## The First Case

The patient, male, 56-years old, had no previous cardiopulmonary diseases. Severe trauma, ruptured intestine, Enteroplasty was performed under emergency general anesthesia. Norepinephrine was used to maintain blood pressure at 110/50 mmHg, heart rate at 95 beats/min, SpO<sub>2</sub> was 96% under pure oxygen inhalation, and auscultation was normal. Point of care echocardiography showed rapid heart rate and good left ventricular systolic function. Lung ultrasound examination found multiple B-lines in both lungs, which was consistent with septic ALI or ARDS, and was sent to ICU after surgery.

## The Second Case

The patient, male, 48-years old, had no previous cardiopulmonary diseases. Severe trauma, leg amputation was planned in the emergency department 5 days after ICU admission. Blood pressure 90/55 mmHg, heart rate 100 beats/min, SpO<sub>2</sub> 91%. Preoperative echocardiography showed strong left ventricular contraction and left ventricular ejection fraction of 70%. Lung ultrasound showed multiple B-lines in both lungs. Norepinephrine was continuously pumped intraoperatively, methylprednisolone was used to suppress the inflammatory response, and ICU was sent after surgery.

## The Third Case

Patient, female, 74-years old, she had a history of hypertension for more than 10 years. An emergency appendectomy was performed. Blood pressure was 125/70 mmHg, heart rate was 110 beats/min, SpO<sub>2</sub> was 93%. Point of care echocardiography showed a left ventricular ejection fraction of 50%. Lung ultrasound examination showed multiple B-lines in both lungs, and the lower lungs were heavy. Laparoscopic appendectomy was performed under general anesthesia. Noradrenaline was continuously pumped during the operation to maintain blood pressure at 120/55 mmHg and heart rate at 90 beats/min. The patients were sent to ICU after surgery.

## The Fourth Case

Patient, male, 31-years old, previous health- he was admitted to hospital with acute abdominal pain and underwent emergency general anesthesia for colon rupture and transverse colostomy. Postoperative admission to ICU-Hypotension and hypoxemia appeared 3 days after operation. Point of care echocardiography revealed decreased left ventricular systolic function, left ventricular ejection fraction of 40%, and decreased overall left heart activity. Lung ultrasound revealed multiple B-lines in both lungs. In addition to conventional treatment, continuous renal replacement therapy was used to remove

inflammatory factors. The respiratory circulation was stable after 3 days.

## Discussion

Sepsis is one of the most common causes of death worldwide, with significant hospital costs [4]. As the inflammatory response progresses, multiple organ failure often occur, with the lungs being the most likely organ to be affected [5]. How to detect lung injury early can improve patient prognosis and improve the outcomes. Perioperative sepsis management circulatory function is the first consideration. With the development of point of care ultrasound technology, acute lung injury caused by sepsis can also be identified early, and can detect pulmonary edema earlier than clinical symptoms. Even in the ARDS stage, point of care ultrasound can guide treatment by real-time assessment of lung ventilation, especially in perioperative and intensive care units where patients are not easily to be moved.

Lung ultrasound is simple to identify acute lung injury and its operation is not complicated as showed below [6]. In lung ultrasound, low-frequency probes are generally selected, which are perpendicular to the ribs to quickly identify the pleura. There are several basic images of lung ultrasound. Normally ventilated lungs exhibit pleural slip. Lines that appear parallel to the pleura and decay with distance become lines A.

When pneumothorax is present, it usually shows the disappearance of pleural sliding. It is better to find that the pleural sliding and non-sliding are in the same intercostal space. Radium-like rays that extend perpendicular to the pleural line to the far field of the screen do not decay as they move with breathing except for line B. More than three intercostal spaces represent pathological changes, including pulmonary edema or pulmonary fibrosis, the latter of which can be known from past history.

The common causes of perioperative hypoxemia are pneumothorax, pulmonary edema and atelectasis, which can be diagnosed quickly by bedside ultrasound with the same accuracy as CT.

On this basis, point of care ultrasound can help diagnose sepsis-related lung injury and assess cardiac function, including right heart function, which is often difficult to obtain clinically.

A review confirmed that lung ultrasound can quickly identify pulmonary edema and lung consolidation in ARDS lung pathological changes and reduce the use of clinical X-ray and CT, which has become a potential tool for lung assessment and guidance of ventilator therapy in ARDS patients, but emphasized the necessity of standardized training [7].

Point of care ultrasound can be used to quickly estimate basic cardiac function, further to evaluation after good training of key indicators such as LVEF and LAP, and improve the diagnostic accuracy of ALI or ARDS, realize cardiopulmonary overall assessment and reflect cardiopulmonary interaction [8].

## Conclusion

Point of care ultrasound has developed rapidly in the past 20 years generate multiple clinical critical care protocols and has been widely used in critical care or emergency department [9-12]. Severe trauma and abdominal infection can lead to sepsis and even septic shock. Surgery is targeted at the etiology [13]. Perioperative management of these patients is the challenge of anesthesia. The patient's condition is critical and transportation is difficult, requiring bedside tools to provide valuable clinical information. Point of care ultrasound has the advantages of dynamic, real-time and repeatable [14,15], and is

a perioperative visualization tool. Combined use of cardiopulmonary ultrasound can achieve rapid assessment of patients with septic shock and achieve precision medicine.

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## Availability of Data and Materials

The datasets availability from the corresponding author on reasonable request.

## Contributions

Zheng Xin, Su Yang collected the data, Xiong Ying, Yang Haitao, designed the study, Su Yang and Luo Wei wrote the paper.

## Ethics Approval and Consent to Participate

Ethics approval number: dy2y/2021071. As the study is a retrospective one and emergency, the need for patient consent was waived.

## Consent for Publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

## Competing Interests

The authors declare that they have no competing interests.

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