

Congress Abstract

Prediction of the Outcome of Acute Renal Failure in Multiorgan Failure in Children: Risk Factors and Algorithm

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ABSTRACT

Introduction: Polyorgan failure syndrome (POYES) remains the most common cause of death after surgical interventions. It is also one of the most common causes of death in intensive care units and intensive care units. The pathogenesis of the syndrome remains incompletely understood, but is probably associated with a combination of dysregulation of the inflammatory response, microcirculatory dysfunction, hypoperfusion ischemia, and immune dysregulation.

Objectives: To improve the effectiveness of predicting the outcome of acute renal failure against the background of dysfunction of other organs and systems during renal replacement therapy.

Materials and methods of the study: From January 2022 to December 2025, a retrospective and prospective analysis of clinical and laboratory indicators and methods of renal replacement therapy in patients with acute renal failure accompanied by dysfunction of other organs and systems was conducted based on data from the intensive care unit of the Tashkent State University of Medical Sciences and the National Children's Medical Center (NCMC). 150 patients aged 1 to 17 years (8.17 ± 6.78) were included in the clinical study. The main contingent consisted of 130 (86.7%) (4-12 years old), of which 110 (73.3%) were boys and 40 (26.7%) were girls.

Research results: Based on the etiology of acute renal failure (ARF) and the associated dysfunction of other organ systems, the study cohort was categorized into five distinct groups:

- Group I (26 patients): Individuals suffering from diffuse atherosclerotic cardiosclerosis, those who underwent cardiovascular surgery, patients with bacterial endocarditis, and those presenting with acute cardiovascular pathology or cardiogenic shock.
- Group II (55 patients): Patients who underwent emergency thoracic or abdominal surgery, as well as those with traumatic brain injuries or polytrauma.
- Group III (18 patients): Patients diagnosed with hemorrhagic destructive pancreonecrosis complicated by diffuse enzymatic peritonitis.
- Group IV (25 patients): Patients suffering from acute poisoning.
- Group V (26 patients): Patients with generalized sepsis and bilateral septic pneumonia.

Beyond the primary diagnosis, the involvement of additional organ systems defined the criteria for Multiple Organ Dysfunction Syndrome (MODS). The most frequent clinical presentation involved the concurrent failure of the renal, respiratory, and cardiovascular systems, with central nervous system impairment occurring less frequently.

The distribution of organ failure within the groups was as follows:

- **Group I:** 11.6% (3 patients) had three systems involved, 50% (13 patients) had four, 34.6% (9 patients) had five, and 3.8% (1 patient) had six systems affected.
- **Group II:** The majority showed four or five-system involvement (27.3% and 32.7%, respectively). Three systems were involved in 23.6% (13 patients), six systems in 14.6% (8 patients), and two systems in 1.8% (1 patient).
- **Group III:** Four and five-system involvement occurred in 27.8% (5 patients each), three systems in 33.3% (6 patients), and two systems in 11.1% (2 patients).
- **Group IV:** Two-system involvement was most common at 44% (11 patients). Three and four-system involvement occurred in 20% each (5 patients each), five systems in 12% (3 patients), and six systems in 4% (1 patient).
- **Group V:** Three, four, and five-system involvement were each observed in 23.1% (6 patients each). Two systems were involved in 26.9% (7 patients), and six systems in 3.8% (1 patient).

Renal replacement therapy was administered as follows: 109 patients (72.7%) underwent hemodialysis, 25 (16.7%) received hemofiltration, and 16 (10.6%) were treated with a combination of both methods. Renal function recovery, marked by the transition to the polyuric phase of acute kidney injury (AKI), was observed in 81 patients (54%), while the remaining 69 (46%) failed to regain kidney function.

Mortality rates varied by clinical condition: 76.9% (20 patients) among those with cardiovascular pathology, 76.4% (42 patients) in the group undergoing emergency abdominal surgery or suffering from polytrauma, and 77.8% (14 patients) in cases of destructive hemorrhagic pancreonecrosis. Mortality for patients with acute poisoning and disseminated sepsis stood at 48% (12 patients) and 69.2% (18 patients), respectively. The overall mortality rate reached 70.7% (106 patients), with acute cardiovascular failure identified as the primary cause of death in 96% of cases (144 patients). Notably, among the 81 patients who showed renal recovery, 37 still succumbed to their condition.

Our analysis indicates that the prognosis for survival is influenced by several factors, including the number of failing organ systems, the severity of the patient's condition, hemodynamic stability, level of consciousness, and the success of renal recovery. Consequently, we conducted further research to evaluate how specific clinical and laboratory markers impact AKI outcomes. These criteria were categorized into three groups: general clinical indicators, clinical-biochemical parameters, and urinalysis/daily diuresis data.

The findings demonstrate that the outcome of AKI is significantly affected by the number of affected organ systems—particularly the involvement of the cardiovascular and central nervous systems—as well as the duration of the oligoanuric phase, the timing of renal replacement therapy initiation, and specific laboratory values such as plasma sodium, platelet count, fibrinogen levels, and proteinuria. While individual markers hold some prognostic value, the accuracy of predicting AKI outcomes is substantially higher when utilizing a combination of these clinical and laboratory indicators.

Conclusions: The development of acute kidney injury (AKI) in the context of multi-organ dysfunction syndrome (MODS) is primarily triggered by cardiovascular diseases, post-cardiac surgery states, bacterial endocarditis, acute vascular events, major thoracic or abdominal surgeries, traumatic brain injuries, polytrauma, severe enzymatic peritonitis, acute poisoning, and systemic sepsis. In cases of MODS involving AKI, the involvement of four or five organ systems is most frequent (29.4% and 27.3%, respectively), while the involvement of three systems occurs in 22% of cases, two systems in 14%, and six systems in 7.3%. Renal function recovery is observed in 54% of patients. The prognosis for recovery is most favorable when only two or three systems are affected, with success rates of 66.7% and 78.8%, respectively.

Conversely, recovery rates drop to 45.5% for four affected systems, 43.5% for five, and 27.3% for six. For patients undergoing renal replacement therapy, survival probability can be predicted with 86% accuracy using a mathematical-statistical model. This model incorporates critical clinical and laboratory parameters, including the number of failing organs, Glasgow Coma Scale scores, the need for inotropic hemodynamic support, mechanical ventilation requirements, and serum levels of bilirubin, urea, and creatinine. Similarly, the likelihood of renal function recovery can be forecasted with 85.3% accuracy using a separate statistical model. This model accounts for key prognostic factors such as the presence of cardiovascular failure, the depth of coma, the total number of impaired systems, platelet and fibrinogen counts, plasma sodium levels, proteinuria, and the duration of the oligoanuric phase.

Keywords: Renal; Risk Factors; Algorithm