Chapter 20
Approach to Oliguria in the ICU

20.1 Introduction

Oliguria, commonly defined as a urine output (UO) of less than 0.5 mL/kg/h over a period of 6 h, is a frequent clinical concern in the intensive care unit (ICU). However, recent evidence suggests that lower thresholds, such as UO less than 0.3 mL/kg/h, may be more predictive of acute kidney injury (AKI) in perioperative and critically ill patients. Oliguria can represent either a physiological response to various stimuli or a pathological process indicating decreased renal perfusion or injury. Distinguishing between physiological and pathological oliguria is essential to guide appropriate interventions and avoid potential harm from unnecessary treatments. This chapter provides a comprehensive approach to assessing and managing oliguria in the ICU, incorporating current guidelines and evidence-based practices [1] [Ref: Algorithm 20.1].

20.2 Initial Assessment

20.2.1 Confirm Oliguria and Assess Urine Output Trends

Rationale: Accurate diagnosis of oliguria requires confirmation of reduced urine output over a specific period. While traditionally defined as UO less than 0.5 mL/kg/h for 6 h, recent studies suggest that thresholds such as less than 0.3 mL/kg/h may be more reliable indicators of impending AKI in critically ill patients [1].

Clinical Considerations: Document urine output meticulously using an indwelling Foley catheter, ensuring consistent readings over the specified period. Evaluate trends in urine output rather than isolated measurements to identify persistent oliguria [2].

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20.2.2 Check for Mechanical Issues

Rationale: Mechanical problems associated with urinary catheters can falsely indicate oliguria.

Clinical Considerations: Inspect the catheter for kinks, obstructions, or dislodgement, and ensure proper placement.

20.2.3 Evaluate Hemodynamics and Renal Perfusion Pressure

Rationale: Hemodynamic instability, such as hypotension and tachycardia, can lead to decreased renal perfusion and oliguria.

Clinical Considerations: Measure mean arterial pressure (MAP) and heart rate, and assess for signs of poor perfusion like cool extremities or altered mental status. In cases of vasodilatory hypotension, vasopressors may be necessary to maintain adequate renal perfusion pressure.

Intervention: Administer isotonic fluids judiciously and simultaneously start vasopressors as needed to achieve target MAP (usually $\geq$65 mm Hg) and improve renal perfusion. Watch out for patients in fluid overload status. Monitor the response of urine output to fluid and vasopressor therapy, as improvements may indicate restoration of renal perfusion [3].

20.3 Diagnostic Work-Up

20.3.1 Distinguish Physiological from Pathological Oliguria

Rationale: Oliguria may be a physiological response to factors such as pain, stress, or the release of antidiuretic hormone (ADH), rather than an indicator of AKI or decreased renal perfusion.

Intervention: Address the underlying causes of physiological oliguria, such as providing adequate analgesia or adjusting medications. Avoid unnecessary fluid administration to prevent fluid overload [4].

20.3.2 Check Volume Status and Fluid Responsiveness

Rationale: Determining a patient's fluid status is critical for deciding appropriate interventions. Dynamic assessments can help identify whether a patient is likely to respond to fluid administration.

Clinical Considerations: Evaluate fluid balance over the last 24–72 h, check for signs of hypovolemia (e.g., dry mucous membranes, hypotension) or fluid overload (e.g., edema, jugular venous distension). Use tools such as the Venous Excess UltraSound (VExUS) score and lung ultrasound to assess volume status.

Diagnostic Tests: Perform dynamic assessments like passive leg raising (PLR) or administer a small-volume fluid challenge while monitoring hemodynamic parameters (e.g., stroke volume, cardiac output) to assess fluid responsiveness.

20.3.3 Consider Intra-abdominal Pressure

Rationale: Increased intra-abdominal pressure (IAP), as seen in conditions like abdominal compartment syndrome or after laparoscopic surgery, can reduce renal perfusion and lead to oliguria that is not responsive to fluid administration.

Clinical Considerations: Assess for risk factors of increased IAP, such as recent abdominal surgery, trauma, or ascites. Measure bladder pressure as a surrogate for IAP if increased pressure is suspected.

Intervention: Manage elevated IAP through decompression techniques, optimizing ventilator settings, or surgical intervention if necessary.

20.3.4 Consider Furosemide Stress Test (FST)

Rationale: The Furosemide Stress Test can assess tubular function and help predict progression to severe AKI in oliguric patients.

Clinical Considerations: In patients with suspected AKI, administer a single dose of furosemide (1.0 mg/kg for loop diuretic naïve patients and 1.5 mg/kg for those with prior loop diuretic exposure) intravenously and observe the urine output response over the next 2 h.

Diagnostic Implications: A poor diuretic response (urine output less than 200 ml over 2 h) may indicate severe tubular injury and a higher risk of progression to severe AKI, potentially prompting earlier intervention or renal replacement therapy.

20.4 Management Based on Volume Status

Hypovolemia: Administer isotonic fluids judiciously to restore intravascular volume and improve renal perfusion, guided by dynamic assessments of fluid responsiveness.

20.5 Euvolemia with Oliguria (Permissive Oliguria)

Rationale: In some hemodynamically stable patients who are not fluid responsive, tolerating lower urine outputs (permissive oliguria) may be safe and can prevent the risks associated with fluid overload.

Clinical Considerations: Consider the overall clinical context, and monitor for signs of worsening renal function or fluid overload. Recognize that aggressive fluid resuscitation to increase urine output may not improve outcomes and can be harmful.

Intervention: Avoid unnecessary fluid administration. Focus on optimizing hemodynamics and treating underlying conditions without overloading the patient with fluids.

20.6 Fluid Overload (Congestion)

Rationale: Fluid overload can cause oliguria due to increased venous pressures, leading to decreased renal perfusion and increased intra-abdominal pressure.

Clinical Considerations: Look for signs of fluid overload, such as peripheral edema, jugular venous distension, pulmonary crackles, and positive fluid balance.

Intervention: Use diuretics to remove excess fluid and reduce congestion. In cases where diuretics are ineffective, consider renal replacement therapy for fluid removal.

20.7 Monitoring and Follow-Up

20.7.1 Continuous Monitoring

Rationale: Ongoing assessment is crucial for detecting changes in renal function and response to therapy.

Clinical Considerations: Monitor urine output hourly, and regularly measure serum creatinine, blood urea nitrogen (BUN), fractional excretion of Sodium (FeNa), and electrolytes. Reassess hemodynamic parameters and volume status frequently.

20.7.2 Advanced Biomarkers for AKI

Rationale: Biomarkers such as neutrophil gelatinase-associated lipocalin (NGAL), cystatin C, and TIMP-2 × IGFBP7 can provide early detection of AKI and assist in risk stratification.

Clinical Considerations: Utilize these biomarkers in patients at high risk of AKI or when early detection is critical for management decisions.

Diagnostic Tests: Measure serum or urinary levels of NGAL, cystatin C, or TIMP-2 × IGFBP7 as adjuncts to traditional markers.

20.8 Medication Management

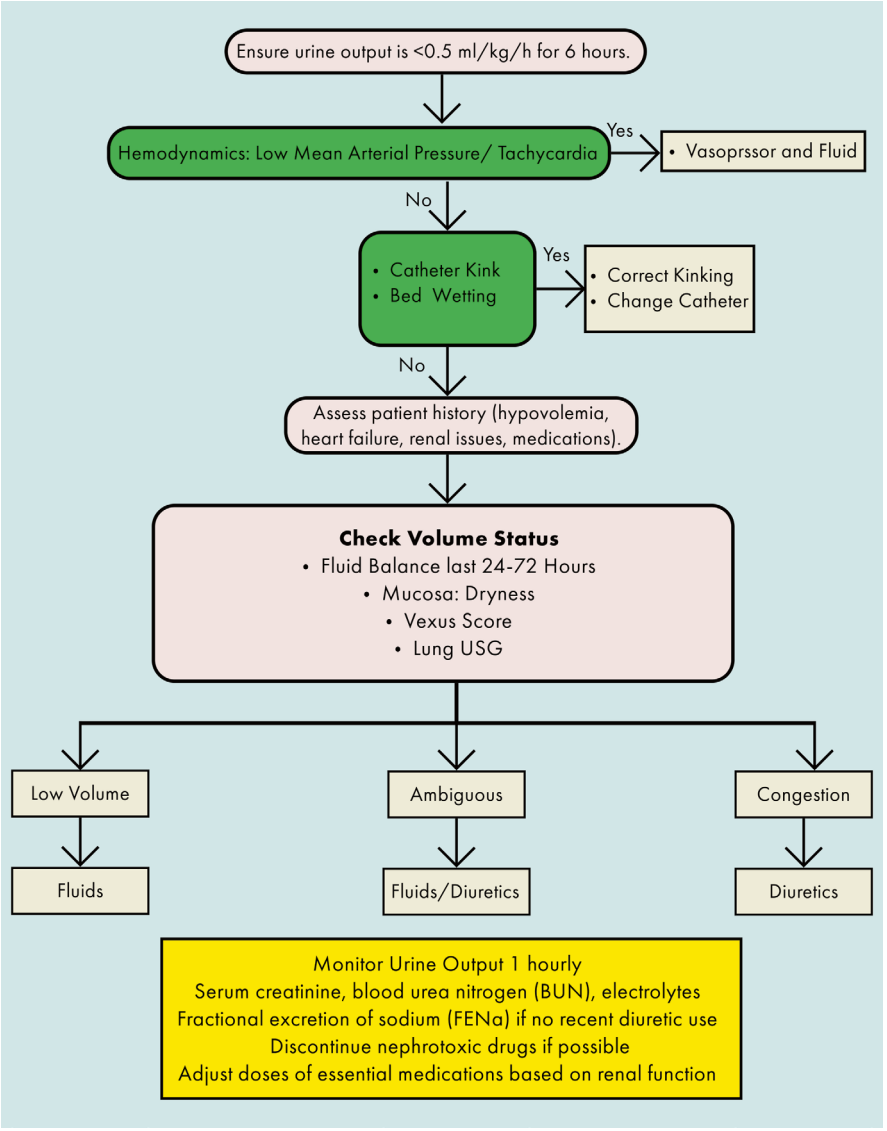
Rationale: Adjusting medication doses based on renal function is essential to avoid further renal impairment.

Clinical Considerations: Discontinue nephrotoxic drugs if possible, and adjust doses of essential medications. Consider the renal clearance of all medications prescribed.

20.9 Conclusion

Managing oliguria in the ICU requires a systematic and nuanced approach to distinguish between physiological and pathological causes. Early and accurate diagnosis, appropriate use of dynamic hemodynamic assessments, judicious fluid management—including the concept of permissive oliguria—and timely interventions are crucial for effective management. Monitoring advanced biomarkers can aid in early detection of AKI and guide therapeutic decisions. Continuous reassessment helps optimize treatment strategies and improve outcomes for critically ill patients.

Algorithm 20.1: Approach to oliguria in the ICU



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