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Acute Kidney Failure as A Complication of Individual Diagnostic and Therapeutic Procedures

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ABSTRACT

This article discusses the possibility of acute kidney failure (AKF) as a result of various diagnostic and therapeutic procedures. In particular, the possibility of developing contrast nephropathy with the use of X-ray contrast agents and the possibility of developing AKF as a result of the use of nonsteroidal anti-inflammatory drugs is being studied. The authors investigate the main causes of acute kidney failure associated with diagnostic and therapeutic procedures, and give recommendations for the prevention of these complications. In particular, precautions are discussed when using contrast agents and the use of nonsteroidal anti-inflammatory drugs. The article also discusses various methods of diagnosis of acute kidney failure and methods of treatment of this condition. The authors emphasize that early detection and treatment of AKF can significantly reduce the risk of complications and improve the prognosis for patients. In addition, the article also emphasizes the importance of preventing acute kidney failure, especially in patients at increased risk of developing this condition, such as the elderly, patients with diabetic nephropathy and patients with concomitant diseases. The paper also discusses the need for further research to better understand the causes and mechanisms of the development of acute kidney failure during various diagnostic and therapeutic procedures. In general, the article provides an overview of the problem of acute kidney failure as a complication of diagnostic and therapeutic procedures, and also offers practical recommendations to reduce the risk of this complication.

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INTRODUCTION

Acute kidney failure (ARF) is a condition when the kidneys cannot perform their functions sufficiently to support life. AKF can occur as a result of various reasons, including as a result of diagnostic and therapeutic procedures. Contrast nephropathy associated with the use of X-ray contrast agents and AKF caused by the use of nonsteroidal anti-inflammatory drugs are the two most common forms of AKF associated with medical procedures [1].

These complications can affect the patient's prognosis and require additional treatment; therefore, prevention of acute kidney failure and timely detection and treatment of this condition are extremely important for saving the patient's life and preventing possible complications. In this regard, understanding the causes and mechanisms of the development of acute kidney failure during diagnostic and therapeutic procedures, as well as the development of methods for its prevention and treatment, are topical issues in medical practice.

Other causes of acute kidney failure associated with medical procedures are the use of antibiotics, chemotherapeutic drugs and immune serums. These drugs can cause damage to the kidney tissues and decrease their function. In addition, mechanical damage to the kidneys, such as trauma or kidney surgery, can lead to the development of acute kidney failure.

To prevent the development of AKF as a result of diagnostic and therapeutic procedures, doctors and medical personnel should take precautions, such as assessing the risk of developing AKF in patients, conducting appropriate training and choosing alternative methods of diagnosis and treatment, if possible. It is also necessary to ensure careful monitoring of patients after medical procedures in order to detect possible signs of acute kidney failure and prevent further deterioration of the patient's condition [2].

In general, acute kidney failure as a complication of individual diagnostic and therapeutic procedures is a serious medical issue that requires more careful study and understanding. It is necessary to improve the methods of prevention, diagnosis and treatment of acute respiratory infections associated with medical procedures in order to reduce the risk of this condition and improve the prognosis of patients.

MATERIALS AND METHODS

When writing this study, literary sources were analysed, the authors of which were specialists in the field of medicine, the data were systematized and generalized through the use of comparative and analytical research methods.

RESULTS

Acute kidney failure (AKF) is a condition in which kidney function decreases sharply as a result of various causes. The mechanism of the occurrence of AKF may be associated with various factors, including:

- insufficient blood flow in the kidneys. This factor can be caused by various reasons, such as a decrease in blood pressure, dehydration of the body, a decrease in the volume of circulating blood as a result of injury or surgery;

- damage to renal tissues. Kidney damage can be caused by various factors, such as infection, toxins, medications, radiation, mechanical effects and other causes;

- metabolic disorders. Some diseases and conditions, such as diabetes, hypercalcemia, hyperuricemia, can lead to the development of acute renal failure due to metabolic disorders in the body;

- the presence of certain diseases. AKF may be associated with diseases such as acute glomerulonephritis, severe bladder infection, myeloma, and others [3].

In addition, AKF can be caused by other factors, such as hypothermia, infection, allergic reaction and other causes. If an acute kidney injury occurs, it is important to determine its cause as soon as possible and begin appropriate treatment. Depending on the cause, the AKF can be reversible or irreversible.

The causes of AKF may vary depending on the type of procedures that are performed. Some diagnostic and therapeutic procedures may increase the risk of developing AKF in patients. One of the most common causes of acute kidney injury is contrast enhancement during X-ray examinations, such as computed tomography (CT) or magnetic resonance imaging (MRI). The contrast agent used in these procedures can lead to impaired renal function, especially in patients with a predisposition to AKF [4].

Another reason for AKF is the use of nonsteroidal anti-inflammatory drugs (NSAIDs) and analgesics. Long-term use of NSAIDs and analgesics can cause impaired kidney function and lead to the development of acute renal failure.

Also, the risk of developing AKF increases during surgical interventions, especially in patients with pre-existing kidney problems. This may be due to blood loss during surgery, the use of anaesthesia, as well as the use of medications that can have a toxic effect on the kidneys [5].

AKF may also occur during infusion therapy, especially if medications are used that may negatively affect kidney function. In this case, it is important to carefully choose medications and monitor the condition of the patient's kidneys.

In general, AKF is a serious complication that can occur as a result of various diagnostic and therapeutic procedures. Therefore, it is important to take into account the possible risk of developing AKF during these procedures and take appropriate measures to reduce this risk.

Acute kidney failure may occur as a result of certain diagnostic procedures. One of the most common causes of acute kidney injury is contrast enhancement during X-ray examinations, such as computed tomography (CT) or magnetic resonance imaging (MRI) [6].

The contrast agent used in these procedures can lead to the development of acute kidney failure in patients, especially those who already have kidney problems or who are taking medications that can damage the kidneys. In addition, an increased risk of developing AKF may be associated with the use of high doses of contrast agent, increased pressure in the renal arteries and the presence of other risk factors.

AKF may also occur during other diagnostic procedures, such as ultrasound with contrast agents or kidney biopsy, respectively, before performing any diagnostic procedure, the doctor should take into account the possible risk of developing AKF and take appropriate measures to reduce this risk.

In order to reduce the risk of acute kidney injury during diagnostic procedures, the doctor may suggest that the patient conduct additional studies to assess kidney function before starting the procedure. Smaller doses of contrast agent or safer alternative diagnostic methods may also be used. It is also important to monitor the condition of the patient's kidneys after the procedure and take appropriate measures if any

changes are detected [7].

The main mechanism for the development of acute kidney failure during diagnostic procedures is the toxic effect of a contrast agent on the kidneys. Contrast agent, which is used in X-ray studies, contains components that can damage kidney tissue. Ionic contrast agents, which contain a high concentration of iodine, are considered especially dangerous. Iodine entering the kidneys can cause cell damage and disrupt kidney function [8].

In addition, the contrast agent can lead to the development of oxidative stress, a process in which free radicals are formed in tissues that damage cells. Free radicals formed as a result of exposure to a contrast agent can damage kidney tissues, cause inflammation and narrowing of capillaries, which leads to impaired blood flow and deterioration of kidney function.

The risk of developing AKF during diagnostic procedures may also be associated with other factors, such as the presence of concomitant diseases (for example, diabetic nephropathy or hypertension), high pressure in the renal arteries, long-term use of nonsteroidal anti-inflammatory drugs, etc. It is important to note that not all patients are at risk of developing AKF during diagnostic procedures. However, the doctor should assess the risk in each patient and take measures to reduce this risk. In case of symptoms of acute kidney failure, such as lack of urination, swelling and elevated creatinine in the blood, you should immediately consult a doctor.

The risk of developing acute kidney failure (ARF) during surgical interventions may be associated with several factors. One of the main factors is hypotension, that is, a decrease in blood pressure during surgery. Hypotension can lead to impaired blood flow in the kidneys and insufficient supply of oxygen and nutrients to the kidney cells, which can cause their damage and the development of acute renal failure [9].

In addition, the risk of AKF during surgical interventions may be associated with the use of anaesthetic drugs and the use of contrast agents during surgery.

Also, an important risk factor is the condition of the patient's kidneys before surgery. If the patient has already had impaired renal function, the risk of developing acute renal failure during surgery increases significantly. In addition, other factors may play a role, such as age, the presence of concomitant diseases (for example, diabetic nephropathy or hypertension), the use of nonsteroidal anti-inflammatory drugs, etc. [10].

To reduce the risk of developing acute kidney failure during surgical interventions, it is necessary to conduct a thorough assessment of the kidney condition before surgery and take measures to optimize kidney function in the preoperative period. In addition, it is important to control blood pressure during surgery and minimize the use of anaesthetic drugs and contrast agents, if possible.

The mechanism of development of acute kidney failure (AKF) during surgical interventions may be associated with several factors. One of the main mechanisms is hypovolemia, that is, a decrease in the volume of circulating blood. Hypovolemia can occur with large blood losses during surgery, heavy sweating, hardening of blood vessels when using epinephrine and other adrenoceptor agonists. Hypovolemia leads to a decrease in blood flow in the kidneys and insufficient supply of oxygen and nutrients to the kidney cells. This can cause damage to kidney tissue and impairment of their function, which can lead to the development of acute renal failure [11].

Another mechanism for the development of AKF during surgical interventions is obstruction of the urinary tract. Obstruction can occur with bleeding, blood clots, tumours and other causes. This can lead to a violation of the outflow of urine from the kidneys and an increase in pressure in the urinary tract. Increased pressure can cause damage to kidney tissue and impaired kidney function [12].

Also, an important factor may be the use of neuromuscular blockers during surgery, which can cause a violation of urination and lead to the development of acute renal failure. To reduce the risk of developing AKF during surgical interventions, it is necessary to carefully monitor the volume of circulating blood, prevent urinary tract obstruction, limit the use of neuromuscular blockers and timely identify and treat complications. In addition, it is important to monitor kidney function in the postoperative period and to intervene in case of violations in a timely manner.

Infusion therapy, including the introduction of various solutions, can cause the development of acute renal failure (AKF), especially in patients with pre-existing kidney problems. The risk of acute kidney failure during infusion therapy depends on various factors, including the characteristics of the patient, the type and dose of the injected solutions, as well as the duration of the infusion.

One of the most common mechanisms of the occurrence of acute renal failure during infusion therapy is hypervolemia - a strong increase in the volume of fluid in the circulatory system, which can lead to a decrease in the concentration of red blood cells and proteins in the blood and an increase in the total volume of blood in the kidneys. This can cause impaired renal function and, ultimately, lead to acute kidney failure [13].

Another mechanism may be direct damage to the kidneys by toxic substances that may be contained in some infusion solutions, for example, in some antibiotics or contrast agents. These substances can cause damage to kidney cells and lead to deterioration of their function. In addition, some patients may be more susceptible to the development of acute renal failure with infusion therapy, for example, patients with chronic renal failure, the elderly or those who take certain medications.

To reduce the risk of acute renal failure during infusion therapy, it is necessary to conduct a thorough assessment of the patient's kidney condition before starting the infusion, choose the safest solutions and doses, monitor the volume of injected solutions and monitor kidney function during infusion therapy. In addition, it is necessary to timely identify and treat any complications that may lead to the development of acute kidney failure [14].

The use of nonsteroidal anti-inflammatory drugs (NSAIDs) and

analgesics may also increase the risk of acute kidney failure (AKF). These medications can cause a violation of the hemodynamic of the kidneys, which leads to a decrease in blood flow in them and deterioration of kidney function. In addition, NSAIDs and analgesics can cause the development of toxic effects on the kidneys, such as interstitial nephritis, renal akinesia and tubular cell necrosis.

According to studies, the risk of developing AKF when using NSAIDs and analgesics increases in the elderly, patients with diabetes mellitus, hypertension, heart failure and other diseases accompanied by impaired renal function. Also, the risk of developing AKF increases with the simultaneous use of several drugs from the group of NSAIDs and analgesics, as well as with prolonged use of these drugs [15].

When prescribing NSAIDs and analgesics, it is important to take into account indications and contraindications, as well as to observe the correct dosage and duration of treatment. In the presence of risk factors, it is necessary to conduct regular monitoring of kidney function.

DISCUSSION

Reducing the risk of acute kidney failure (AKF) can be achieved by taking the following measures:

– examination and evaluation of kidney function before diagnostic and therapeutic procedures. This will help to identify possible violations of kidney function, which may be aggravated as a result of the procedures;

– rational prescription of medicines. It is necessary to take into account the possible side effects of drugs on the kidneys and choose the safest drugs, taking into account indications and contraindications;

– compliance with the correct dosage and duration of medication. Exceeding the recommended dose and prolonged use of medications can cause serious damage to kidney function;

– regular monitoring of kidney function. In the presence of risk factors, it is necessary to conduct regular monitoring of kidney function, including measurement of creatinine levels and other indicators;

– the use of precautions during surgical interventions and infusion therapy. It is necessary to comply with sanitary and hygienic requirements during the procedures and make sure that the infusion solutions do not contain components harmful to the kidneys;

– compliance with a healthy lifestyle by patients. A healthy lifestyle, including proper nutrition, regular exercise and quitting smoking, can help reduce the risk of developing acute kidney failure and other kidney diseases [16].

To identify the possible occurrence of acute kidney failure (AKF) during diagnostic and therapeutic procedures, the following methods can be used:

– assessment of kidney function before the procedure - this allows you to identify the presence of any problems with kidney function before the procedure. Creatinine clearance can be used to assess kidney function, which is determined by analysing the level of creatinine in the blood and urine;

– use of alternative diagnostic methods - as mentioned above, alternative diagnostic methods, such as ultrasound and kidney biopsy, can help avoid the use of contrast agents, which reduces the risk of developing AKF;

– use of safe contrast agents - some contrast agents may be less dangerous than others. For example, ionic contrast agents, such as iodine-containing ones, may be less safe than non-ionic contrast agents;

– monitoring of creatinine levels after the procedure - this will help to identify any changes in kidney function that may indicate the development of AKF;

– preventive use of drugs to protect the kidneys - some drugs, such as acetylcysteine and n-acetylglucosamine, can be used to protect the kidneys and reduce the risk of acute kidney injury during procedures involving the use of contrast agents [17].

It is important to note that the decision on which diagnostic method to use and what precautions to take to protect the kidneys should be made by a doctor based on the individual characteristics of the patient and the specific situation.

Biomarkers play an important role in the early detection of acute kidney failure (AKF) and assessment of its severity. Biomarkers are proteins, metabolites, or other molecules that can be measured in blood, urine, or other biological materials and that reflect the state of the body.

There are various biomarkers that can be useful in assessing kidney function and identifying the risk of acute kidney injury. For example, creatinine is the most common biomarker used to determine the level of kidney function. However, creatinine is not always a sensitive and specific indicator of early acute kidney failure [18].

Other biomarkers, such as cystatin C, natriuretic peptide (NT-proBNP), microalbuminuria, interleukin-18, etc., may be more sensitive and specific indicators of renal dysfunction and risk of acute kidney failure. Their use together with other clinical and laboratory parameters can help in early detection of the risk of developing acute kidney failure and taking appropriate measures to prevent its development.

However, it should be noted that the use of biomarkers is not an exclusive method of diagnosis of acute kidney failure. They can be useful additional tools in combination with other diagnostic methods, such as ultrasound, measurement of creatinine levels in the blood, etc. [19].

Modern methods of artificial intelligence (AI) can be used for early detection of acute respiratory infections. One of these methods is machine learning, which can be used to analyse large amounts of medical data and identify hidden patterns and links between various risk factors and the development of

acute kidney failure. For example, AI algorithms can be trained to analyse data on the level of creatinine, urea, electrolytes and other biomarkers to identify patients who are at risk of developing AKF. Intelligent systems can also be used to monitor patients after surgery or taking certain medications in order to detect the possible development of AKF at the early stages.

It is important to note that the use of AI in medicine requires a high degree of accuracy and reliability, since errors can lead to unpredictable consequences for the health of patients. Therefore, the development and implementation of innovative methods based on AI should be carried out in close cooperation with medical specialists and in compliance with strict norms and standards.

In addition to machine learning, other AI methods have been developed in recent years that can be used for early detection of AKF. For example, deep learning can be used to analyse images obtained using various medical equipment, such as computed tomography, magnetic resonance imaging and ultrasound diagnostics [20].

AI methods can also be used to analyse large amounts of data collected from various sources, such as electronic medical records, laboratory results, monitoring data, etc. These data can be used to create models that can predict the likelihood of AKF in patients depending on various risk factors [21].

The use of AI in medicine can significantly improve the effectiveness of diagnosis and treatment of various diseases, including acute respiratory infections. However, it is necessary to conduct additional research to determine optimal methods and algorithms, as well as to train AI systems on large amounts of data in order to increase the accuracy and reliability of the results [22].

In general, early detection of AKF is critically important for the timely and effective treatment of this complication. The use of innovative AI-based methods can help improve the diagnosis and management of the risk of developing AKF in patients. However, such methods cannot replace professional medical intervention and should be used only in close cooperation with qualified medical specialists.

CONCLUSION

Acute kidney failure (AKF) can be a complication of various diagnostic and therapeutic procedures. The risk of its development increases significantly with the use of contrast agents for X-ray examinations, surgical interventions, the use of infusion therapy, as well as with the use of nonsteroidal anti-inflammatory drugs and analgesics. Reducing the risk of developing AKF can be achieved through the use of alternative diagnostic methods, the use of fewer contrast agents, the use of safer analgesics and NSAIDs, as well as more thorough monitoring of the kidney condition in patients undergoing risky procedures.

Biomarkers such as creatinine, cystatin C, NGAL, etc. can play an important role in the early detection of AKF. They can help in the diagnosis of acute kidney injury at an early stage and taking the necessary measures to prevent its progression. Also, innovative methods based on artificial intelligence have been actively developing recently, which allow you to automatically analyse medical data and identify the risks of developing AKF at an early stage.

In general, early detection and prevention of acute kidney injury is an extremely important aspect of preserving the health of patients undergoing risky diagnostic and therapeutic procedures. Careful monitoring of the kidney condition, the use of safe methods and modern diagnostic technologies will help reduce the risk of developing acute kidney failure and improve the prognosis of the disease.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors contributed in reviewing the final version of this paper

REFERENCES

1. Bielecka-Dabrowa A, Godoy B, Schefold JC, Koziolek M, Banach M, von Haehling S. Decompensated heart failure and renal failure: what is the current evidence? Curr Heart Fail Rep 2018; 15: 224–238
2. Bucholz EM, Whitlock RP, Zappitelli M, Devarajan P, Eikelboom J, Garg AX, et al.TRIBE-AKI Consortium Cardiac biomarkers and acute kidney injury after cardiac surgery. [2019 Apr 27];Pediatrics. 2015 135(4):e945–e956.
3. Cardinale D, Cosentino N, Moltrasio M, et al.. Acute kidney injury after lung cancer surgery: incidence and clinical relevance, predictors, and role of N-terminal pro B-type natriuretic peptide. Lung Cancer 2018;123:155–9
4. Chang C.-H. Fu C.-M. Fan P.-C. Chen S.-W. Chang S.-W. Mao C.-T. et al. Acute kidney injury in patients with pulmonary embolism: a population-based cohort study. Medicine (Baltimore). 2017; 96: e5822
5. Damman K, Testani JM. The kidney in heart failure: an update. Eur Heart J 2015;36:1437–44; Goussot S, Mousson C, Guenancia C, et al.. N-Terminal fragment of pro B-type natriuretic peptide as a marker of contrast-induced nephropathy after primary percutaneous coronary intervention for ST-segment elevation myocardial infarction. Am J Cardiol 2015;116:865–71
6. Fiaccadori E, Maggiore U, Clima B, Melfa L, Rotelli C, Borghetti a. Incidence, risk factors, and prognosis of gastrointestinal hemorrhage complicating acute renal failure. Kidney Int. 2001;59(4):1510–9.
7. Firth JD, Rain AE, Ledingham JG.. Elevated venous pressure. The direct cause of sodium retention by the kidneys in edema?, Lancet, 1988, vol. 1 (pp. 1033-1035)
8. Fu Q, Colgan S.P., Shelley S.S. Hypoxia: the driving force of chronic kidney disease. Klin ed Res. 2016; 14(1): 15-39
9. G. Liu , Z. Zhao , S.Yu Cui , etc . Endovascular treatment of extensive acute deep vein thrombosis of the lower extremities with rheolytic thrombectomy AngioJet plus catheter-directed thrombolysis from contralateral femoral access Phlebology : J Venous Dis , 34 (2018) , pp. 257-265 .
10. Han WK, Waikar SS, Johnson A, Betensky RA, Dent CL, Devarajan

P, et al. Urinary biomarkers in the early diagnosis of acute kidney injury. Kidney Int. 2008;73(7):863–869

11. Harjola VP, Mebazaa A, Čelutkienė J, et al. Modern man- Age of acute right ventricular failure: statement Heart Failure Association and Lung Working Group Blood circulation and function of the right ventricle of the European Society of Cardiology. Heart failure Eur J. 2016; 18(3): 226-241,
12. Herget-Rosenthal S, Marggraf G, Hüsing J, et al.. Early detection of acute renal failure by serum cystatin C. Kidney Int 2004;66:1115–22.
13. Heringlake M, Charitos EI, Erber K, Berggreen AE, Heinze H, Paarmann H. Preoperative plasma growth-differentiation factor-15 for prediction of acute kidney injury in patients undergoing cardiac surgery. Crit Care. 2016;20(1):317–317.
14. I've had a CT scan. Academy of Emergency Medical Care. 2012; 19(6): 618-625
15. Liangos O, Perianayagam MC, Vaidya VS, Han WK, Wald R, Tighiouart H, et al. Urinary N-acetyl-ß-(D)-glucosaminidase activity and kidney injury molecule-1 level are associated with adverse outcomes in acute renal failure. J Am Soc Nephrol. 2007;18(3):904–912
16. Makris K, Spanou L. Acute kidney injury: definition, pathophysiology and clinical phenotypes. Clin Biochem Rev 2016; 37: 85–98
17. Marenzi G, Assanelli E, Campodonico J, De Metrio M, Lauri G, Marana I, et al. Acute kidney injury in ST-segment elevation acute myocardial infarction complicated by cardiogenic shock at admission. Crit Care Med 2010; 38:438–444
18. Ocak G, van Stralen KJ, Rosendaal FR, et al. Mortality from pulmonary embolism, myocardial infarction and stroke among patients on dialysis. Jay Tromb Chemost . 2012;10(12):2484–2493.
19. Parikh CR, Thiessen-Philbrook H, Garg AX, Kadiyala D, Shlipak MG, Koyner JL, et al.TRIBE-AKI Consortium Performance of kidney injury molecule-1 and liver fatty acid-binding protein and combined biomarkers of AKI after cardiac surgery. Clin J Am Soc Nephrol. 2013;8(7):1079–1088.
20. Fortrie G, de Geus HRH, Betjes MGH. The aftermath of acute kidney injury: a narrative review of long-term mortality and renal function. Crit Care 2019; 23: 24.
21. Kostrubets M., Plivachevskaya M., Jimenez D., etc. Forecast-the significance of renal function in acute pulmonary embolism central cohort study. Thrombus Chemost. 2019; 119(1): 140-148
22. Daft, L.A. Castellucci , M.A. Fergie Pulmonary embolism: Updated information on treatment and contradictions BM, 370 (2020) , pp.m2177-2188