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INCIDENCE OF ACUTE KIDNEY INJURY IN PATIENTS FOLLOWING CARDIAC SURGERY

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A retrospective cohort study of 200 patients after cardiac surgery was conducted to identify the incidence and severity of acute kidney injury (AKI) and to study the cardiopulmonary bypass effect on this pathology occurrence. It was found that the AKI after operations «on pump» was observed in 27% of patients and after cardiac surgery «off pump» in 33%.

***Keywords**: acute kidney injury, cardiac surgery, RIFLE.*

Acute kidney injury (AKI) is sudden and persistent reduction of renal function resulting in the impossibility to hold water-electrolytic and acid-base balance [1]. According to the data presented in the publications the occurrence of kidney injury following various surgical interventions may be up 30%, after operations with cardiopulmonary bypass (CPB) - up to 35%, the degree of its severity is correlated with mortality [2,3,4].

The problem of kidney injury in cardiac surgery is especially actual as even imperceptible changes of their functions make the in-patient treatment longer, increase treatment costs, morbidity and mortality [5]. Mortality of the developed AKI following cardiac surgery varies from 7% to 38% [6]. In some clinics the incidence of such complication has the tendency to increase. It is connected with the increase of the middle age of operated patients and the severity of the associated pathology [7,8].

Traditionally the development of AKI following cardiac surgery is associated with CPB [9]. But it's also connected with other factors taking place in the postoperative period. That's why their detection, search of markers of early diagnostics of kidneys injury and adequate preventive measures remain the actual problem of modern cardio-anesthesiology.

Purpose: To estimate the incidence of AKI at patients following cardiac surgery as well as to study the CPB effect on its development.

Materials and methods.

A retrospective cohort study of 200 patients operated in the department of cardiac surgery of "University Clinic" in 2011-2013 was held. All patients were divided into 2 groups: the first group (n=100) – operations "on pump", the second group (n=100) – operations "off pump".

The patients are compared to one another according to sex, age, state under ASA, points under EuroSCORE II.

Operations were performed by one and the same surgical and anesthetic team that provided standard technique of surgical and anesthetic aid. The following operations "on pump" were performed: isolated CABG – 14%, valves replacement - 56%, combined operations – 30%. Operations "off pump" included isolated CABG – 100%.

RIFLE criteria were used to examine the development of AKI in the postoperative period [1].

Kidney function and basal creatinine were estimated under MDRD formula (Modification of Diet in Renal Disease) [Levey AS and co-authors, 2000]:

$$\text{GRF, (ml/min/1,73м}^2\text{)} = 186 \times (\text{Scr, mg/dl})^{-1,154} \times (\text{age, years})^{-0,203},$$

where GRF is 75 ml/min/м² (by Bouman) [1,10];

result received for women ×0,742.

The estimation was done before the operation (1st phase), after 24 hours (the 2nd phase), on 2-4 day (the 3rd phase) and 5-7th day (the 4th phase).

Statistica 8.0. program was used for statistical processing of data. Pirson criterion x^2 was used to estimate incidence of AKI development in the groups of patients. Differences were considered to be significant under $p< 0,05$.

Results and discussion.

After operations "on pump" the incidence of AKI increases considerably (Table 1).

Table 1. Incidence of AKI in the group with operation "on pump" (%)

	1 phase	2 phase	3 phase	4 phase
R	10	13	13	16
I	0	11	10	10
F	0	0	1	1
L	0	0	0	0
E	0	0	0	0
In all	10	24*	24*	27*

Note: * – $p<0,01$ compared to the 1st phase

The present table shows that 10 % of patients were supposed to have the development of kidney injury (R-criterion) in the preoperative period taking into account the anamnesis and criteria of RIFLE scale. In postoperative period 11% of patients had kidney injury (I, F), and a number of patients having risk of AKI increased to 16%. It was found out that maximum AKI incidence is observed on the 5-7th day of postoperative period increasing gradually and becoming more severe with every next day. On the 4th day the severity of kidney injury at one patient increased up to F stage. General number of patients with the symptoms of AKI development made 27% - 2,7 times as much as compared to the level before the operation.

In the group of patients after operations "off pump" (the 2nd group) considerable increase of AKI incidence was also observed in postoperative period (Table 2).

Table 2. Incidence of AKI in the group with operation off-pump (%)

	1 phase	2 phase	3 phase	4 phase
R	6	15	12	24
I	0	8	9	7
F	0	0	2	2
L	0	0	0	0
E	0	0	0	0
In all:	6	23*	23*	33*

Note: * – $p < 0,01$ compared to the 1st phase

As in the group with operation "on pump" a number of patients with AKI increased on the 5-7th day of postoperative period. A number of patients also increased at R stage and amounted to 24%; AKI incidence increased from 6% detected before operation to 33% in postoperative period, i.e. 5,5 times.

When comparing AKI incidence in groups between each other it was found out that there were no statistically significant differences at all phases of the study (Figure 1). In both groups a number of patients having AKI symptoms gradually increased with equal frequency and reached its maximum on the 5-7th day of the postoperative period ($p<0,01$).

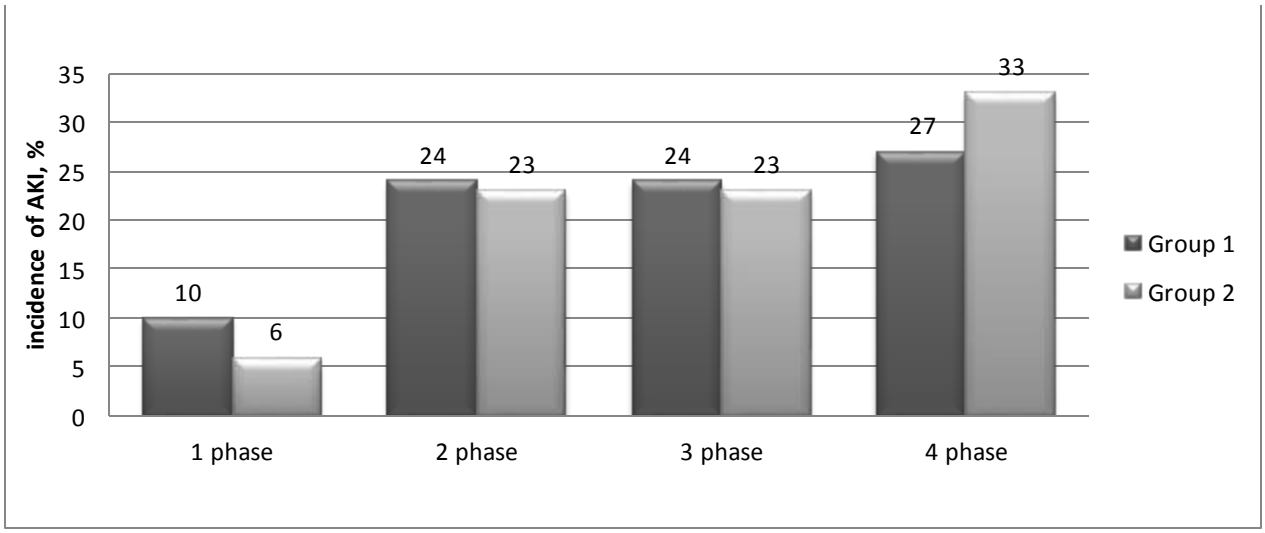

Figure 1. Incidence of AKI in groups on phases of the study

Analysis of data received shows that the use of CPB is not the key factor of AKI development after cardiac surgery. Swelling of epithelium, vasospasm, reduction of

renal blood flow, ischemia that may appear during operations “off pump”, precede acute injury.

RIFLE scale criteria fail to show risk in full as they are based on these serum creatinine that are considered to be the late markers of kidney injury that delay early replacement renal therapy. Preoperative preparation with the purpose of protection (therapy correction, choice of infusion medium, use of NO donators?) would be possible for the patients in the preoperative period.

So, the results of the present study showed again that the problem of AKI development at cardio-surgical patients is being actual. They also testify that its development is not connected only with the use of cardiopulmonary bypass. The development of early detection of AKI as well as the development of integrated measures for its correction and prevention can be the prospective tendency of the decrease of this complication incidence.

Conclusions

1. The development of AKI remains the actual problem of the modern cardiac anaesthesiology as the incidence of this complication in the postoperative period increases 2,7-5,5 times ($p<0,01$) and may be connected with the deterioration of the results of the treatment.
2. The use of cardiopulmonary bypass is not the key factor of AKI pathogenesis because its incidence in the groups of patients operated “on pump” and “off pump” didn’t differ much statistically and made 27% and 33% respectively.
3. It is necessary to continue the search of reliable predictors of the early detection of AKI at patients following cardiac surgery as well as integrated measures of prevention and treatment of this complication in the postoperative period.

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ЧАСТОТА РОЗВИТКУ ГОСТРОГО УШКОДЖЕННЯ НИРОК У ХВОРИХ ПІСЛЯ КАРДІОХІРУРГІЧНИХ ОПЕРАЦІЙ

Чумаченко В.Н., Потапов А.Л., Бабанін А.А., Різк Г.Е., Овчаров Р.С.

Виконано ретроспективне когортне дослідження 200 пацієнтів після кардіохірургічних операцій з метою виявлення частоти і тяжкості розвитку гострого ушкодження нирок (ГУН), а також вивчено вплив штучного кровообігу (ШК) на розвиток даної патології. В результаті проведеного дослідження було виявлено, що після операцій з використанням ШК частота розвитку ГУН становила 27%, а після кардіохірургічних операцій без ШК – 33%.

Ключові слова: *гостре ушкодження нирок, кардіохірургія, критерії RIFLE.*

ЧАСТОТА РАЗВИТИЯ ОСТРОГО ПОВРЕЖДЕНИЯ ПОЧЕК У БОЛЬНЫХ ПОСЛЕ КАРДИОХИРУРГИЧЕСКИХ ОПЕРАЦИЙ

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Выполнено ретроспективное когортное исследование 200 пациентов после кардиохирургических операций с целью определения частоты и тяжести развития острого повреждения почек (ОПП), а также изучено влияние искусственного кровообращения (ИК) на появление данной патологии. В результате проведенного анализа было выявлено, что после операций с использованием ИК частота развития ОПП составила 27%, а после кардиохирургических операций без применения ИК – 33%.

Ключевые слова: *острое повреждение почек, кардиохирургия, критерии RIFLE.*