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**M. S. Rubtsov², L. E. Shukevich¹, A. N. Kotelnikov¹,
E. F. Malyugin, E. I. Tutolmin, A. A. Vorobiev**

A 20-YEAR EXPERIENCE OF RHABDOMYOLYSIS TREATMENT, COMPLICATED BY ACUTE RENAL FAILURE

*Detoxication Center FSIHC "Tomsk Regional Clinical Hospital",
Tomsk, Russian Federation,*

¹ FSIHC "Kemerovo Regional Clinical Hospital", Kemerovo, Russian Federation

*² Emergency States Laboratory FSI SRI CPCD SB RAMS,
Kemerovo, Russian Federation*

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М. С. Рубцов, Л. Е. Шукевич, А. Н. Котельников, Е. Ф. Малугин,
Е. И. Тутолмин, А. А. Воробьев

ДВАДЦАТИЛЕТНИЙ ОПЫТ ЛЕЧЕНИЯ РАБДОМИОЛИЗА, ОСЛОЖ- НЕННОГО ОСТРОЙ ПОЧЕЧНОЙ НЕДОСТАТОЧНОСТЬЮ

Цель — проанализировать эффективность неотложной помощи при рабдомиолизе с острой почечной недостаточностью.

Материалы и методы. В клиниках трех учреждений изучен двадцатилетний опыт интенсивной терапии по историям болезни 284 пациентов с синдромом позиционного сдавления и тромбозами магистральных сосудов, осложненным рабдомиолизом и сопровождавшимся острой почечной недостаточностью в олигурической и анурической стадиях. Проанализированы частота осложнений, количество и качество процедур экстракорпорального очищения крови, доступы, эффективность хирургических вмешательств, показатели летальности в десятилетнем интервале (1993–2002 и 2003–2012 гг.).

Результаты. За последнее десятилетие число больных остается стабильным, преобладают опиатные комы. Сокращение времени поступления, изменение технологии экстракорпоральных методов и их ранняя инициация, отказ от фасциотомии снизили частоту и тяжесть поздних осложнений. В структуре летальности эндотоксические шоки сменили поздние гнойно-септические осложнения, смертность снизилась на 58,5 %.

Заключение. Определен алгоритм дифференцированной помощи при олигоанурии и анурии.

Ключевые слова: рабдомиолиз, острая почечная недостаточность, экстракорпоральное очищение крови.

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M. S. Rubtsov, L. E. Shukevich, A. N. Kotelnikov, E. F. Malyugin, E. I. Tutolmin, A. A. Vorobiev

A 20-YEAR EXPERIENCE OF RHABDOMYOLYSIS TREATMENT, COMPLICATED BY ACUTE RENAL FAILURE

Aim. To analyze the efficacy of a 20-year experience of critical care of rhabdomyolysis with acute renal failure (ARF).

Materials. 284 medical records of patients with compartment syndrome and great vessel thrombosis with rhabdomyolysis, accompanied by oliguric and anuric ARF were retrospectively reviewed. Patients with rhabdomyolysis, caused by trauma as well as somatic pathologies, were excluded. The complication rate was assessed; the quality and quantity of extracorporeal blood purification techniques were estimated as well as the access sites, the effectiveness of surgical procedures, mortality rates and their structure in a 10-year follow-up period (1993–2002 and 2003–2012).

Results. Over the past decade, the number of patients remains stable; opiate coma is among common causes resulting in compartment syndrome. The reduction of time from the admission to the event development, improvement of extracorporeal blood purification technique and its early initiation as well as the refusal to perform fasciotomy have decreased the rate and severity of later complications. In the mortality structure endotoxic shocks have replaced later purulent-septic complications, the mortality rate decreased by 58.5%.

Conclusion. The efficient algorithm of intensive care for oliguria and anuria has been found.

Key words: rhabdomyolysis, acute renal failure, extracorporeal blood purification.

Background

Rhabdomyolysis (RM) in Russia in peacetime is commonly caused by soft tissue compression (STC) during coma development. It is typically observed in cases of alcohol and drug intoxication, psychotropic medications and carbon monoxide. Also, there is a number of rare pathological conditions and diseases, as well as drugs and chemical compounds provoking RM [1]. RM in patients with acute and chronic alcohol intoxication is associated with a combination of direct myotoxicity and agitation (delirium) or prolonged forced position (coma), hypokalemia and hypophosphatemia. This combination of etiological factors can also be observed in both patients receiving psychotropic medications and delirious patients requiring fixation, especially if extrapyramidal disorders, and / or muscular infections have been found [2]. Clinical variants of RM course vary from the asymptomatic, characterized with episodes of muscle weakness, dark urine, and a moderate increase of creatine kinase levels, to the acute one — fulminant shock, acute renal failure, disseminated intravascular coagulation (DIC), multiple organ dysfunction. Early mortality

is associated with shock and severe hyperkalemia. The severity of its course directly depends on the amount of damaged muscle fibers. The main problem in the early diagnosis and early initiation of the targeted therapy is associated with electrolyte disorders and ARF onset. If prior medical history includes traumatic injury caused by natural or man-made disaster, RM diagnosis is not difficult, but common clinical signs in the general practice (musculoskeletal symptoms: pain, weakness in the affected muscle groups, possible increase in the volume density to “woody” consistency — and non-specific symptoms: malaise, fever, tachycardia, nausea, and vomiting) are often ignored by patients or medical staff, or are considered to be the manifestations of the underlying disease, resulting in a late initiation of extracorporeal blood purification (EBP) and the formation of anuria.

Aim: to analyze the efficacy of changes in critical care strategies to treat rhabdomyolysis with acute renal failure.

Materials and Methods

There are 284 medical records of patients with rhabdomyolysis, accompanied by acute renal failure, admitted in three different hospitals in the period of 1993–2012, were retrospectively reviewed. Patient population included 258 (90.8 %) men and 26 (9.2%) women in the age of 39.1 ± 7.1 (min 18, max 72); 227 patients (79.9%) were of the working age (21–60 yrs). 255 (89.8%) patients had STC, and 29 (10.2%) — severe ischemia of lower limbs caused by arterial thrombosis. The most frequent causes of ARF were acute alcoholic intoxication — 126 (49.4%) and opiate coma — 55 (21.6%), the less frequent — psychotropic drugs poisoning — 6 (2.4%) and carbon monoxide — 5 (2%). Patients with RM caused by injury (crush syndrome) and somatic pathologies (myopathies, endocrine disorders) were excluded from the analysis, because in the first case, the severity of the condition can be characterized as multifactorial (including traumatic and hemorrhagic shock), while the second — the amount of muscle damage, as a rule, was insignificant. Anuric stage was diagnosed in 181 patients (63.7%) at a time of admission. Besides the standard clinical and laboratory tests performed in the presence of ARF, the dynamics of serum and urine myoglobin (before 1 day ICU admission), creatine kinase (CK-MM), in case of late admissions) were measured. The rate of complications was assessed in the early stage of muscle damage (through 12 hrs) as well as in the late stage (hypovolemic shock, hyperkalemia, development of arrhythmias, hypocalcemia, signs of hepatopathy, DIC, abdominal compartment syndrome (ACS), multiorgan dysfunction (MOD), sepsis). The quantity and quality of the EBP techniques, their modes and site access were estimated. An efficacy analysis of surgical interventions (fasciotomy, thrombectomy, reconstructive surgery) was performed. The structure and mortality rates in a 10-year follow-up period (1993–2002 and 2003–2012) were assessed.

Results and Discussion

Despite that the average rate of RM was 3.75 cases per year in 1ml population, a significantly large number of admissions in the first analyzed decade should be noted. In our opinion, it is associated with a great number of acute alcoholic intoxication (87 vs. 39, or 54% of total admissions). Thus, after 2003 the most frequent cause of RM was opiate coma (17 before 2002 vs. 38, or 31% of total admissions since 2003). The admission time since the disease onset ranged from 12 h (20.1%) to 7days (med 3.2) and was

associated with the diagnostic problems. We have faced the cases where patients were examined for two — three days to confirm different diagnosis at various hospitals, and, only after oligoanuria was found, they were transferred to the specialized department to perform renal replacement therapy. Other researchers reported that the presence of prolonged coma without the “classic triad” of symptoms in the prior medical history (muscle pain, general weakness, dark urine) can be considered as a major predictor of RM [3]. The average myoglobin levels at a time of admission in the early stages were (181 ± 54) mcg/l, where as CK-MM levels in the late admissions — (427 ± 111) U/l. Biochemical markers were used to verify the muscle damage; there were no clinical significance in their dynamics during the application of efficient detoxification methods. The incidence rate of early complications is comparable for both periods — in average 1.3 complication per case (Table 1).

After 2003 a significantly low rate of systemic complications was reported in the long-term period (1,3 vs. 1.0) that can be explained by the improvement of techniques and the time of EBP initiation. At the same time, a significant ($p=0.015$) increase of septic complications after 2003 was more likely determined by the change of the vascular access: before 2002 arteriovenous shunts were used in 100% of cases for dialysis, and after they were replaced with double-lumen venous catheters. Despite the extension of ABT spectrum, an increased rate of angiogenic catheter sepsis suggested that the refuse to use arteriovenous shunts for prolonged and repetitive EBP was untimely, although other researchers do not share our point of view [4].

Table 1
Incidence of early and late complications comparing two periods, n (%)

Complication	1993–2002 yrs, n=161	2003–2012 yrs., n=123
Early complications		
n	214	164
Hypovolemic shock	49 (30.4)	37 (30.1)
Hyperkalemia	73 (45.3)	58 (47.2)
Arrhythmias	36 (22.4)	24 (19.5)
Hypocalcemia	29 (18.0)	26 (21.1)
Hepatopathy	27 (16.8)	19 (15.4)
Late complications		
n	211	125
ACS	39 (24.2)	23 (18.7)*
DIC	51 (31.7)	21 (17.1)*
MOD	73 (45.3)	32 (26.0)*
Sepsis	48 (29.8)	49 (39.9)*

Note. * — the intergroup differences were considered reliable at $p < 0.05$; ACS — abdominal compartment syndrome; DIC — disseminated intravascular coagulation; MOD — multiple organ dysfunction

The need for EBP. The average number of EBP per case decreased from 2.75 (total 442) in 2002 to 2.3 (271) in 2012. Since 2003, there has been an increase in the number of patients with oligoanuric ARF due to the early admission (day 1) from the onset of symptoms (Table 2).

In this case, conservative therapy appeared to be effective, reducing the need for EBP generally in this group. At the same time, early initiation of EBP has significantly increased at any stage of ARF, which is primarily associated with the development of new technologies (particularly, continuous renal replacement therapy), and the possibility to use bicarbonate dialysis, allowing to perform EBP in hemodynamically unstable patients as well as in patients with shock. Such methods as hemosorption, ultraviolet irradiation of blood, acetate dialysis, widely used in the 90s, have been excluded from the clinical practice. The number of plasma exchange (PE) procedures have reduced significantly — 84 procedures (19% of total EBP techniques used during this period) were conducted

Table 2

Need to perform EBP depending on the time of admission and the ARF stage, n (%)

ARF stage/admission time	1993– 2002 yrs., n=161	2003– 2012 yrs., n=123	1993– 2002 yrs, n=161	2003– 2012 yrs., n=123
	Total	Total	EBP	EBP
Oligoanuria	53 (32.9)	50 (40.6)*	23 (43.4)	18 (36.0)*
<12 hrs	12 (22.6)	10 (20.0)	0	3 (10.0)*
1 day	27 (50.9)	35 (70.0)*	12 (44.4)	12 (34.4)*
3 days	11 (20.8)	4 (8.0)*	9 (81.8)	2 (50.0)*
>3 days	3 (5.7)	1 (2.0)*	2 (66.7)	1 (100)*
Anuria	108 (67.1)	73 (59.3)*	91 (84.3)	69 (94.5)*
<12 hrs	18 (16.7)	12 (16.4)	11 (61.1)	10 (83.3)*
1 day	24 (22.2)	27 (37.0)*	16 (66.7)	25 (92.6)*
3 days	31 (28.7)	21 (28.8)	29 (93.5)	21 (100)
>3 days	35 (32.4)	13 (17.8)*	35 (100)	13 (100)

Note: EBP — number of patients, who have undergone extracorporeal blood purification.

* — the intergroup differences were considered reliable at $p < 0.05$. “Total” bars — % of patients with this ARF stage admitted in this time period. “EBP” — % of patients who have undergone EBP of all admitted in this time period.

before 2002, whereas no more than 8% performed in the next decade (in case of DIC and severe hepatopathy). Existing opinions considering PE to be effective and safe procedure [2; 3] are justified in case of emergency care mainly for traumatic RM.

Surgical activity. Intramuscular pressure >50 mmHg is defined as the objective parameter to perform fasciotomy. However, several researchers supposed fasciotomy to provoke infectious complications, lead to a pronounced loss of plasma, hypoproteinemia, arrosive bleeding from wounds with the subsequent development of DIS (consumption coagulopathy), the progression of anemia, endotoxemia. Our results have confirmed their opinion in a certain way. Out of 32 fasciotomy, 29 patients (19.9%) reported complications (bleeding) preventing to perform continuous renal replacement therapy in the period 1993–2002, 8 patients (21.1% of total fasciotomy) developed secondary endotoxic shock. At the same time, thrombectomy, performed in 65.5% of cases with ischemic RM, resulted in a rapid reduction of symptoms and abortion of ARF in the oligoanuric stage under conservative therapy in 90% of those cases. There were no bleeding complications during RRT among 10 patients who have undergone reconstruction of the great vessels.

Mortality. The mortality rate was lower (18.3%; $n=52$) compared to the data provided by other researchers — 21–52%. Prior to 2002, 11 patients of 41, who have died, were admitted with decompensated refractory exo- and/or endotoxic shock, which did not allow to use extracorporeal blood detoxification methods. They mostly formed the group of patients who have died before 1 day of ICU admission — from 2 to 10 hrs (Table 3).

DIC and uncontrolled MOD affecting more than 3 organs were among the common causes of death in the mortality structure during that period. There was a significant increase in the treatment duration and, as a consequence, purulent septic complications were the main cause of patients' deaths after that period. The average bed stay for survi-

Table 3

Mortality rate depending on the time of admission, n (%)

	1993–2002 yrs., n=161	2003–2012 yrs., n=123
Total	41 (25.4)	11 (8.9)*
<1 Day	11 (26.8)	1 (9.1)*
<3 Days	7 (17.1)	2 (18.2)
<6 Days	10 (24.4)	0
<10 Days	10 (24.4)	0
>20 Days	3 (7.3)	8 (72.7)*

Note. * — the intergroup differences were considered reliable at $p < 0.05$

niques have changed in general, and, particularly, RRT; 3) the facts, mentioned above, have allowed to use such methods as high-volume hemodiafiltration or bicarbonate dialysis even in hemodynamically unstable patients.

Conclusion. The following algorithm to provide health care, which was suggested, developed and implemented in the critical care for patients with RM and ARF, is proposed to be used:

1. In case of oligoanuria and a small percentage of the damaged muscle tissues (up to 18% of the body surface area):

— Correction of hypovolemia and dehydration — volume of infusions ≥ 700 ml/kg — 1500 ml/kg (early rehydration with Na bicarbonate alkalinity and mannitol osmotic balance of 0.5 g/kg may prevent the development of anuric ARF)

— The use of plasma exchange is proved to be ineffective and life-threatening because of hemorrhagic complications

— Fasciotomy is contraindicated (decompression of muscle tissues increases blood flow in the compression zone, resulting in the release of myolysis products into the systemic circulation and a sharp development of anuric endotoxemia)

2. Anuric stage of ARF:

— Emergent bicarbonate hemodialysis in case of life-threatening hyperkalemia

— After hyperkalemia management — continuous RRT with the opportunity to use short-term, high volume venovenous hemodiafiltration

— Plasma exchange is indicated to treat DIC and severe hepatopathy

— To stabilize the patient's condition — daily intermittent hemodialysis to restore adequate renal function to filtrate and concentrate

— Immediate restoration of blood flow is indicated in case of thrombotic RM, followed by early initiation of EBP.

vors with anuric ARF was 28 b/t, for those who died — 8 b/t; 32 anuric patients with RM (out of 108) died during the period of 1993–2002 (the mortality rate was 29.6%), in comparison to 9 anuric patients with RM (out of 73) who have died during the period of 2002–2012 (the mortality rate was 12.3%). Thus, the mortality rate has decreased by more than 50% over the last decade. We suppose that it is associated with the following reasons: 1) despite the fact that the number of RM patients remains relatively stable, physicians from other departments have raised their awareness in the diagnosis of RM; physicians of other specialized health care institutions have gained the experience of EBP; 2) EBP tech-

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М. Н. Лебедева, Е. В. Терещенкова, А. М. Агеенко, А. А. Иванова

ПЕРВЫЙ ОПЫТ ПРИМЕНЕНИЯ МЕТОДА НИЗКОЧАСТОТНОЙ ПЬЕЗОТРОМБОЭЛАСТОГРАФИИ В ХИРУРГИИ СКОЛИОЗА

ФГБУ «Новосибирский научно-исследовательский институт травматологии и ортопедии имени Я. Л. Цивьяна» Министерства здравоохранения Российской Федерации, Новосибирск, Российская Федерация

УДК 616.711-007.55-089

М. Н. Лебедева, Е. В. Терещенкова, А. М. Агеенко, А. А. Иванова

ПЕРВЫЙ ОПЫТ ПРИМЕНЕНИЯ МЕТОДА НИЗКОЧАСТОТНОЙ ПЬЕЗОТРОМБОЭЛАСТОГРАФИИ В ХИРУРГИИ СКОЛИОЗА

Актуальность. Корректирующие операции по поводу сколиоза занимают особое место в хирургии деформаций позвоночника. Имеются лишь единичные сообщения об особенностях системы гемостаза у больных сколиозом и отсутствуют надежные прогностические критерии ожидаемого объема интраоперационной кровопотери.

Цель исследования — оценка возможностей метода низкочастотной пьезотромбоэластографии для прогнозирования ожидаемой интраоперационной кровопотери в хирургии сколиоза.

Материалы и методы. Для исследования гемостатического потенциала у 29 больных идиопатическим сколиозом на предоперационном этапе применена технология низкочастотной пьезотромбоэластографии. Динамика исследуемого процесса определялась изменениями агрегатного состояния крови и регистрировалась в виде интегрированной кривой линии низкочастотной пьезотромбоэластограммы.