Ventricular tachycardia at critical conditions

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Among malignant arrhythmia we fix focus attention on ventricular tachycardia: problems of prevention, diagnosis and treatment at critical conditions.

There are a lot of unknown forms of the ventricular tachycardia and at the various electrical versions of the given pathology cardiohemodynamics till the present time is not investigated.

We present private clinical and experimental data.

Key words: cardiohemodynamics, arrhythmia, tachycardia.

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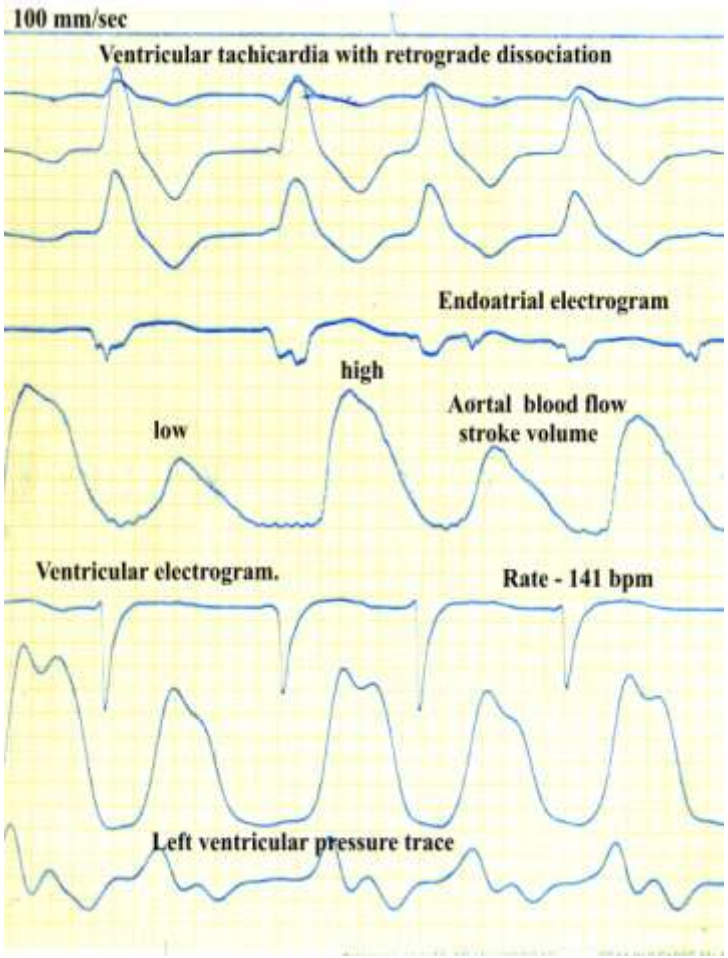
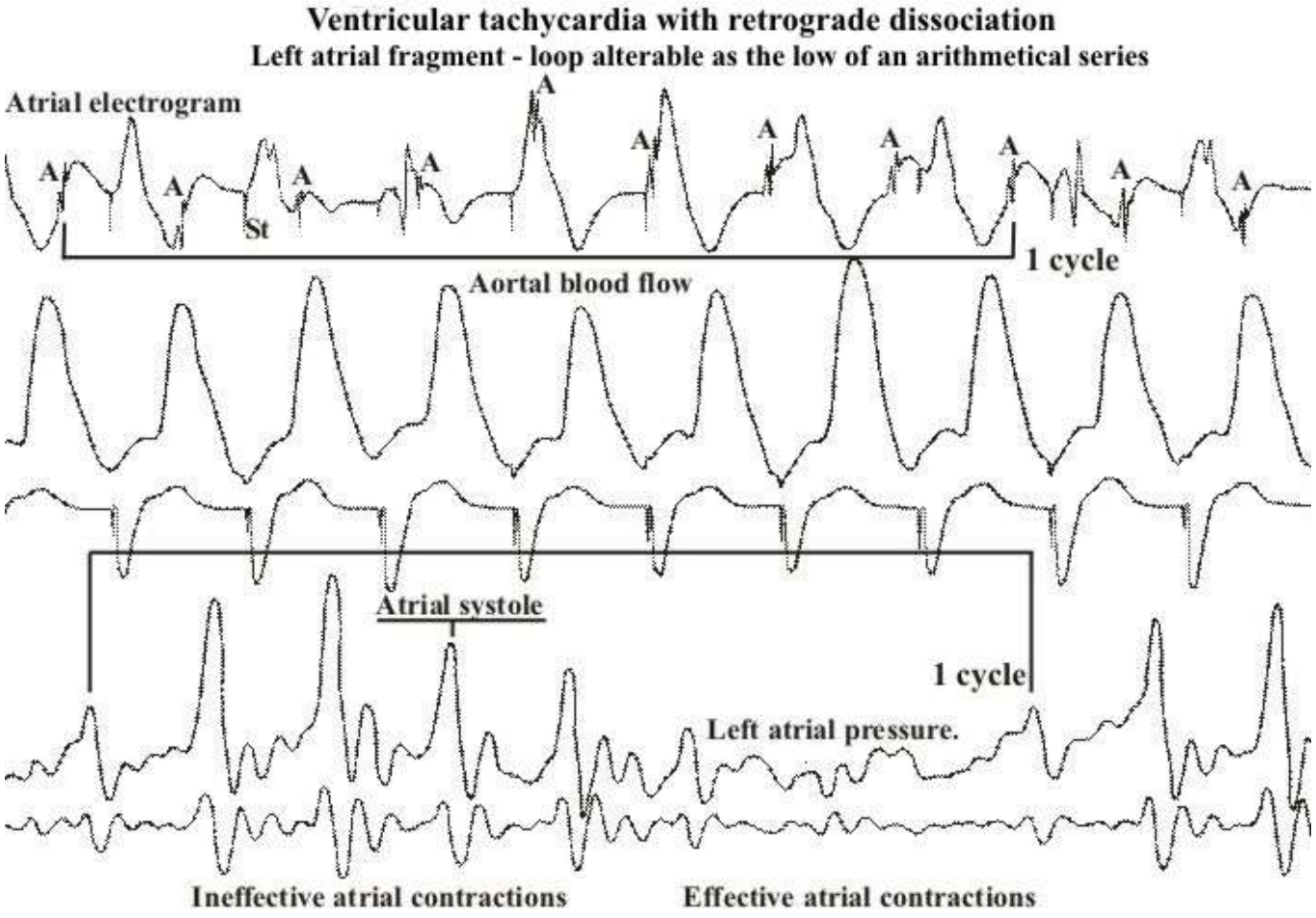


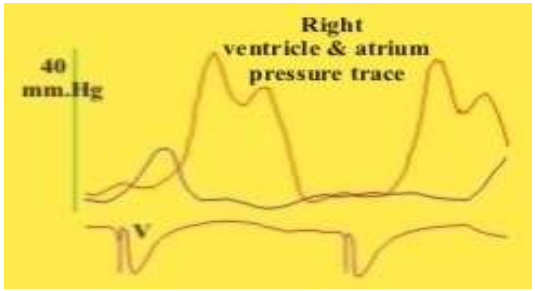
At ventricular tachycardia accompanied with retrograde dissociation there were registered noticeable decreasing of inotropic activity, stroke and minute volume, stroke work and peak systolic pressure of the left ventricle and reduction of the average pressure in aorta. The ventricular rhythm with retrograde dissociation inverted a physiological sequence of depolarization and contraction of various chambers of heart,caused by fragmentation of an electrical field of heart on two independent parts - atrial and ventricular, resulting to complete asynchronous in their functioning. Quantity of hemodynamically effective atrial systoles were sizeably less in comparison with absolute number of ventricular contractions. Ventricular cycle was not always commenced by atrial contraction or supplied by “personal” atrial systole. For this reason the basic hemodynamical parameters, characterized levels of preloading on ventricles, varied from a cycle to a cycle, that radically influenced on inotropic state of ventricles and the magnitude of the stroke volume. Position of atrial cycle in common cardiocycle does not appear as "ventricle-depending".Configuration of the functionally linked ventricular and attended to it atrial cycles was defined by duration of their cardiocycles, i.e. - frequency of their rhythm. The given formula entirely modeling the hemodynamical version of every ventricle-atrial complexes and all subsequent unphysiological mechanics of myocardium - all spectrum of mechanisms of compensations directed to supplying ventricles by volume.


Ventricular tachycardia with retrograde dissociation
Left atrial fragment - loop alterable as the low of an arithmetical series
Atrial electrogram
A
A
A
St
A
A
A
A
A
A
A
A
1 cycle
Aortal blood flow
Atrial systole
1 cycle
Left atrial pressure.
Ineffective atrial contractions
Effective atrial contractions

1. It was revealed, that atrium shows well-defined “flexibility” and depending on of definite hemodynamical conditions. It changes the duration of an own cycle, inotropic activity, configuration of pressure trace, magnitude of intraatrial pressure etc.

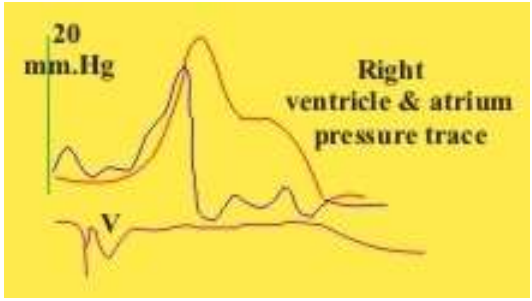
2. In most cases sinus node generated impulses with an error within the limits of 30-60 msec., but during monitoring of intraatrial pressure traces the pieces with identical duration of their cycles were registered (it was one alterable loop), in the course of which the order of coincidence of the phases of the atrial and ventricular cycles varied in the certain sequence, in particular, according to the law of an arithmetical series. It was determined, that certain distance of atrial contraction from a beginning of a ventricular systole was equaled to a difference of cycles A-A and V_1- V_1. In elementary mathematics such difference is denoted as a step of arithmetical progression. Any member of an arithmetic progression, i.e. distance of a beginning of atrial contraction from ventricular, is possible to calculate by the well-known formula: an = a1 + d (n-1). With the purpose of simplification of process of the analysis we conditionally accepted those atrial and ventricular complexes, contraction of which were formed simultaneously, so,from a zero point of readout. So, at ventricular tachycardia accompanied by ventriculo-atrial dissociation it was formed not asynchronous of atrial and ventricular contractions, but certain sequence of coincidence of phases of atrial and ventricular cycles controllable by a difference of atrial and ventricular cycles [(A - A) - (V_1 - V_1)], i.e. by a step of arithmetical progression. The frequency of repeatability of coincidence of phases of atrial and ventricular cycles in the unit of time, i.e. the duration of a line of an arithmetical progression, was supervised by the rhythm – by the general least common multiple number of the duration of atrial and ventricular cycles.

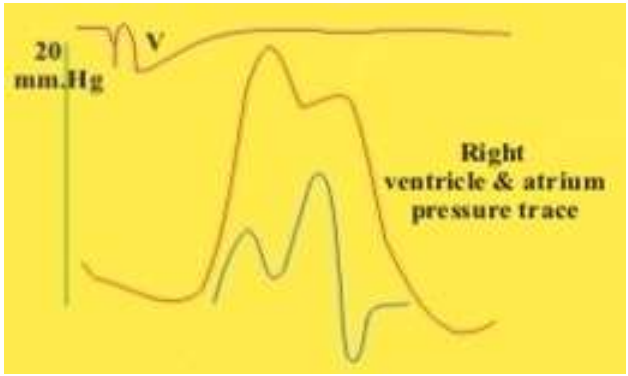
At ventricular tachycardia with retrograde dissociation due to "asynchronous" in contractions of ventricles and atriums, variants of a coincidence of the phases of their cycles were allocated as follows: atrial contraction took place during of any phase of ventricle. So, the concept of hemodynamically effective or noneffective atrial contractions at ventricular tachycardia accompanied by retrograde dissociation has wider significance, as it is defined by the concrete version of coincidence of phases of atrial and ventricular cycles and indicates at the presence of close hemodynamical connection between atrial and ventricular cycles. This sort of "haemodynamically linked " ventriculo-atrial complex at ventricular tachycardia with retrograde dissociation is highly multifarious: the right and left parts of heart behave ambiguously as belong to the zone of high and low pressure.



At this version of the atrio-ventricular cycles ratio one atrial cycle serves two ventricular complexes. If the atrial cycle duration more than twice surpasses in ventricular, its systolic phase can take place in a physiological order and adequately loads 1-st on sequence ventricular diastole. As the diastole phases of the given atrial and subsequent ventricular cycles completely coincide, the end diastolic and stroke volume of the second ventricular cycle are smaller in comparison with first ventricular cycle. And vice versa: if two atrial cycles serve one ventricular diastolic phase the first on sequence atrial systole also has the greater hemodynamic meaning.So, order of complectation is important.

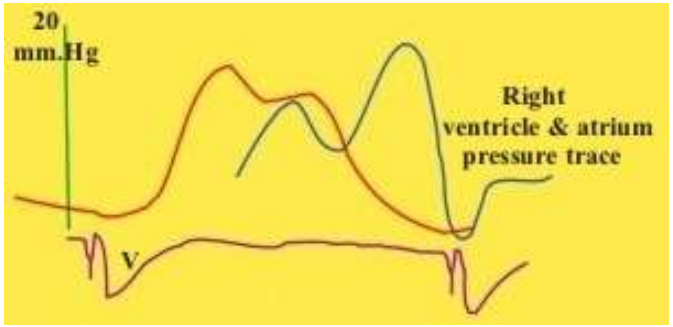
At this version of the atrio-ventricular cycles ratio the atrial systole is formed in late diastole, after opening of the atrio-ventricular valves, more or less sufficiently charges subsequent ventricular cycle and is completely or partially hemodynamically effective. In a case of displacement such physiological atrial systole to the right (to the next ventricular cycle) for 80 – 120 msec it easily will turn into the hemodynamically inefficient atrial contraction. At the given version of the atrio-ventricular cycles ratio "multistage atrial contraction phenomenon" is observed: on an ascending branch of the atrial systolic pressure trace the saw-teeth sweeps and about 20-30 msec durations plateaux are formed that indicate on unreadiness of the atrial contractile system, so finally the atrium takes Solomon's decision while running enlarges own ejection period. It is one of the compensating hemodynamic mechanism, and there are a lot of such objects, and at various forms of ventricular tachycardia they should gradually be opened. At asynchronous atrial hemodynamic indexes always are changeable. So, (1) at the presence of series of variable hemodynamic deformations the atrium always reproduces variable answer as the adaptive-tuning system and (2) in running order optimizes electrical and mechanical reply. So,the reproducibility of the myocardial tissue response is an intricate problem.



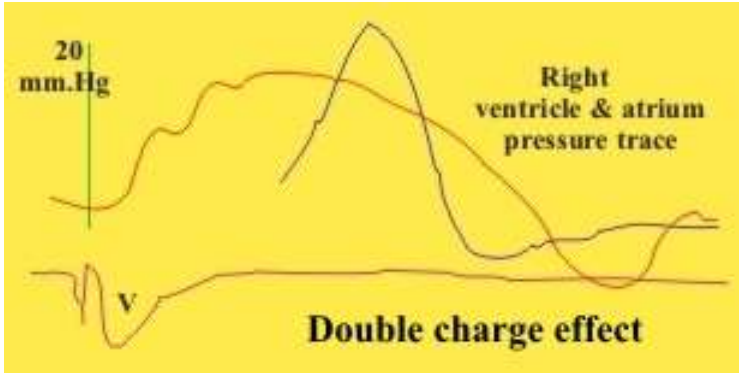


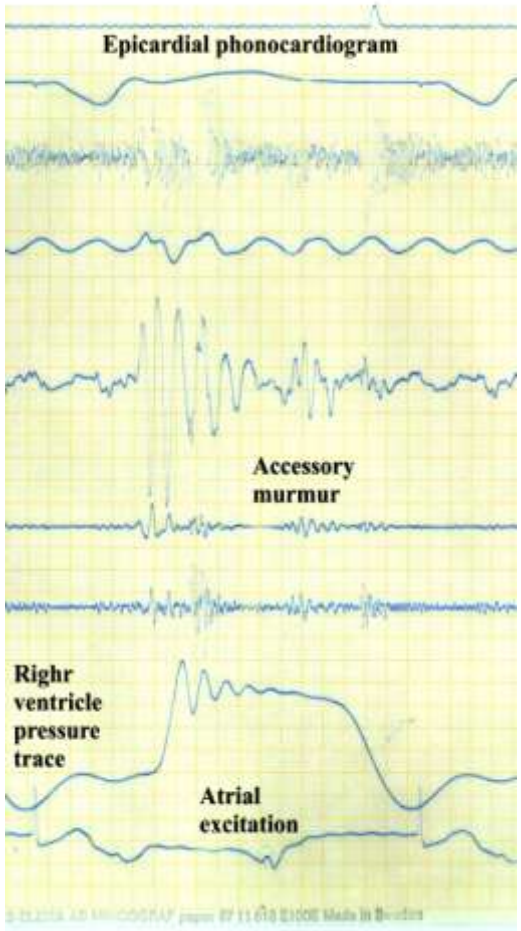
At this version of the atrio-ventricular cycles ratio the left and right atrial systoles are formed from a beginning of a phase of an isometric contraction practically up to a protodiastole. The atrium cotracts at closed atrio-ventricular valve and can't open it, as the amplitude of intraatrial systolic pressure is less than intraventricular. Such atrial contraction is hemodynamically inefficient independently of a durations of atrial and ventricular cycles. At the given period “active” volume loading of the ventricle is absent. After the myocardial relaxation the antegrade diastolic blood flow charges ventricle, but it is underloaded , as the duration and magnitude of the perfusion pressure is significally less in comparison with control level.

At this version of the atrio-ventricular cycles ratio atrial contraction is formed after protodiastole and promotes to early formation of the antegrade atrio-ventricular pressure gradient. High atrial systolic pressure breaks into the ventricular diastole and at once considerably changes the left ventricular diastolic X-ray geometry. Such right atrial systole is hemodynamically completely effective, but the left atrial contraction is partially effective.



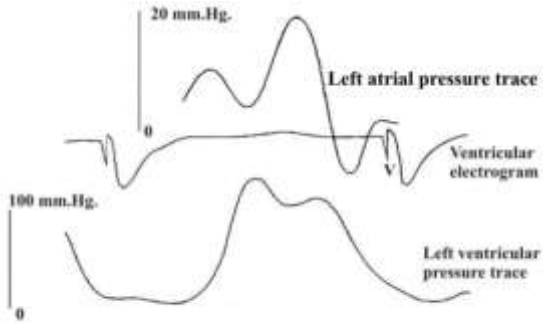
At this version of the atrio-ventricular cycles ratio atrial and ventricular systoles are formed practically simultaneously. Such atrial contraction due to high systolic pressure additionally charges the ventricle during ejection phase and at once substantially changes ventricular systolic X-ray geometry. It considerably violates the process of ventricular contraction, but hemodynamically is effective. Finally it ensued “double charged effect” – first in systole and second – in diastole.



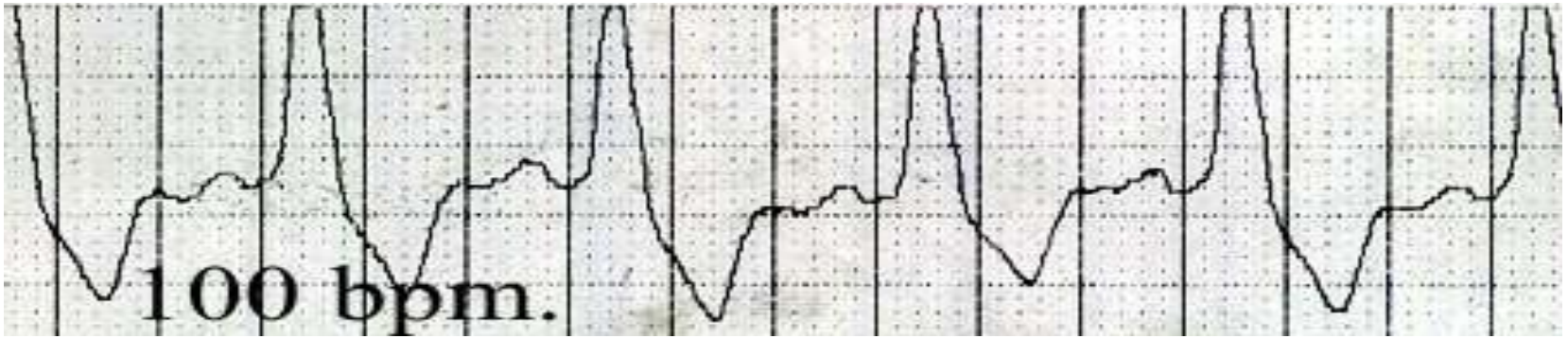


Anomalous atrial contractions also induce variable diastolic or systolic murmurs over atrio-ventricular valves. At asynchronous there were registered multiform transient cardiac murmurs over the mitral or tricuspid valves. They were formed at any point of the common cardiocycle - during systole or diastole,etc, and changed dislocation, magnitude, duration and intensivity of the temporary murmur from cycle to cycle-it changed while running. As a rule, audiologic characteristics of such provisional cardiac murmurs at retrograde dissociation fully were depended on concrete version of a ratio of atrial and ventricular cycles and were defined by duration, polarity, amplitude of ante- and retrograde trans-atrio-ventricular pressure gradients, velocity and volume of left and right trans-atrio-ventricular flow. It is variable phonofunction because of unstability of electrical and hemodynamical conditions at ventricular tachycardia with retrograde dissociation.

At the ventricular tachycardia with a short V-A interval atrial systole was not haemodynamically effective.Transmitral bloodflow at the given period was absent as the contraction of the left atrium basically coincided with a phase of ejection of the left ventricle and had happened at a closed mitral valve. This fact was confirmed by the presence of an inverse and high left ventriculo-atrial pressure gradient at the end of the left atrial systole. In addition to there was no X-ray "wash off symptom " at left ventriculograms in the area of the mitral valve,corroborated its opening synchronously with pathological left atrial contraction.At contraction of the left atrium in condition of the closed mitral valve always increased its inotropic activity and magnitude of the intraatrial systolic,diastolic and mean pressure. At that had formed a contrary left-atrial-pulmonary-vein pressure gradient which generated the reverse blood flow from left atrium to adjacent large-scale pulmonary veins. After the relaxation of the left atrium the mentioned pathological pressure gradient became extint and antegrade blood flow was formed repeatedly.



Ventricular tachycardia with retrograde atrial excitation diagram
Hemodynamically ineffective atrial contraction



Ventricular tachycardia with retrograde atrial excitation has lot of electrocal and hemodynamical versions. For example: the given pathology proceeding with retrograde block of the first degree on usual ECG practically does not differ from sinus tachycardia at complete left bundle branch block, as the given forms of electrical infringements stereogically are face to face turned on 180 degrees mirror reflection in all three spatial planes. They have appropriate hemodynamical status.

At ventricular tachycardia hemodynamical disturbances is determined by frequency of a rhythm of atriums and ventricles and by the sequence of coincidence of various phases of atrial and ventricular cycles, i.e. by functional state of retrograde conduction system.

By West authors the frequency of ventricular rhythm at ventricular tachycardia changes within the limits of 180-250 bpm. At active ventricular rhythm the frequency is more 140 bpm. Some authors have defined frequency 140-160 bpm.

By our data at critical patients the frequency of ventricular rate is equal to 131,16±4,3 bpm,dispertion – min – 105, max – 155 bpm.

We fix the given frequency zone as one of a diagnostic marker of the ventricular tachycardia.
In the given range, in particular above this zone, the frequency of a rhythm is inversely proportional to ventricular performance.

The diagnostic importance has sharp initiation of the ventricular tachycardia and its termination after infusion of the antiarhythmic drugs. There are vertions with heat up and recooling phenomena.

Experts of Georgian Critical Medicine Institute propose
the following definition of the ventricular tachycardia for discussion.

ventricular tachycardia is an acute electrical disturbance with primary focus of excitation in ventricular histostructure and inversion of the order of atial and ventricular cycles, originated by multivariable pathophysiological mechanisms on a base of widely distributed and/or local miocardiocital metabolic inerference, that, depending on frequency of the ventricular rhythm and functional state of the retrograde conduction, determines lifethreatening hemodinamical and different violations and in this connection is under the urgent therapy.

Georgian Critical Medicine Institute thoroughly will study opinions of all experts on the given question.

Laus Deo, there is no mandatory unified classification of the ventricylar tachycardia suitable for the clinical purposes in critical medicine. Direct diagnosis of any pathology in critical medicine should be carried out quickly and simply. The history of diagnostics of former USSR hypertonic disease ' model evidently has proved it. Western medicine has refused superfluous diagnostic procedures and expenses. This pathology now has one clinical marker: a level of pressure in brachial artery. At presence time a doctor bedside diagnosis arterial hypertension.

We should think, that for practical purposes of critical medicine is quite acceptable:

1. Diagnosis: Ventricular tachycardia.

Diagnostic markers and therapy algorithm of the given pathology are well-known.

Such approach will simplify process of diagnostics, will increase efficiency of the medical personnel and will warn many legal problems.

Georgian Critical Medicine Institute uses one of the AHA (USA) ventricular tachycardia treatment algorithm having the legal right.

The algorithm:

1 stage
Lidocainum

II stage
Novocainamidum

III stage
Ornidum

IV stage
Cardioversion

Georgian Critical Medicine Institute ventricular tachycardia therapy algorithm examines as flexible pattern. The deviations from algorithm are possible in view of specificity of a pathology, alternative and resources.

At invalid diagnosis of ventricular tachycardia it is recomended to use 1 stage of an algorythm and then so - called " passing stage " - ATPH - 10-20 mg i.v.

Acute efficacy of AAD on steady retrograde conduction.
Own data

Medication	Effect
Disopyramidum	has not
Mexitil	has not
Pyromecainum	has not
Lidocainum	transitory retrograde block of I-II degree in 20%
Novocainamidum	transitory retrograde block of IV degree in 33%
Etmozin and Etacizin	transitory retrograde block of IV degree in 19%
Inderal	transitory retrograde block of IV degree in 19%
Amiodaron	steady retrograde block of IV degree in 33%
Verapamilum	steady retrograde block of IV degree in 20%.

Efficacy of bifocal overdrive A-V pacing at ventricular tachycardia was equal to 14,3 %.

Testing and program cardiac pacing at ventricular tachycardia had no urgent effect.

Treatment of ventricular tachycardia by cardioversion at critical patients with stroke and coma, brain oedema and unresponsive circulating shock had no steady effect.

პარკუჭოვანი ტაქიკარდია კრიტიკულ პაციენტებში რამაზ შონია (თბილისი საქართველო)

შესწავლილია პარკუჭოვანი ტაქიკარდიების სხვადასხვა ელექტრული ვერსიების გავლენა კარდიოჰემოდინამიკაზე.