

**Peculiarities of EEG changes in critical situations****M.Khaburzania, Z.Kheladze, N.Ninua, Zv.Kheladze, M.Beridze, N.Kajaia****Georgian Critical Care Medicine Institute. Tbilisi, Georgia.**

In research were involved 194 comatose patients caused by different etiology. Of these 152 patients were consistent with the criteria. Age of patients ranged from 18-76, woman – 63, men – 89.

Coma was caused by following: skull and brain trauma – 35, hypoxic damage of brain – 21, ischemic stroke – 28, hemorrhagic – 24, subarachnoidal parenchymal hemorrhage – 20, diabetic coma – 7, hepatic coma – 5, intoxicative coma – 12. On the base of dominative rhythms following types of coma were allocated: alpha, beta, theta and delta.

Results allow to discuss progression of disease using electroencephalographic changes and to choose treatment options.

**Key words: EEG, Coma, Alpha, Beta, Theta, Delta.**

**Actuality:**

Coma is the most common state of disorder of consciousness which is stated in 4% of all patients in resuscitation and intensive therapy departments.

By registration of bioelectric brain activity it is to define a localization of motor and sensorial sphere pathological process, changeability of behavioral reactions, and the level of consciousness. EEG allows us to evaluate thalamus-cortical disorders of patients in coma state which is impossible clinically, account of EEG patterns which are relation with the process and result of the disease.

Despite a wide range of abilities of the modern visual methods, EEG remains as one of the significant methods in stating of the brain death and evaluating the functional state of brain in terminal situation.

Development of such branches of medicine as neurosurgery, transplantology and resuscitation, supported the prolongation and maintenance of patients life. From this point, changing of brain function activity is of particular interest. Registration bioelectric activity of its changes into account the peculiarities of its changes make possible to the dynamics of a disease, correct the process, prognosis due to result.

**The target of the study:**

Is defining of peculiarities of EEG changes aroused during the critical state according to a type, frequency, amplitude, distribution gradients, mapping of their frequency and amplitude, according to their percentage extension and stating the links to the prognosis and result of the disease.

**Materials and methods:**

The study was carried out on 194 patients with coma of various etiologies. Among 152 patients satisfy all the research criteria. The age of patients varies from 18 to 76; 63 women and 89 men.

In case the brain death was stated EEG was carried out twice in 24 hours. The definition of brain bioelectric activity by EEG was conducted, according to international demands and a 16- channel computer EEG was used with ICA software.

Electrodes were distributed due to International system 10-20% and 2 ear electrodes, between electrodes is minimum 100ohm and maximum 10kohm, a distance between them is 10cm and record on channels was carried out using constant time, minimum 0.3 seconds, and intensification minimum 2mcv/mm. The top level of frequency permeability minimum 30 hz. EEG responsiveness was estimated on light, sound stimulus and pain. Duration of stimulus impact was minimum 10 min, the frequency of light source varied from 1 to 30 hertz, the frequency of sound stimulus 10 dB.

Electric silence i.e. isoelectric line corresponds to such activity when amplitude from peak to peak is not more 2 mc.v.

EEG was recorded on 1, 3, 5 days and in dynamics from developing of coma.

To estimate the dominated frequency and amplitude we took for each case 5 age with duration 30 seconds and the average indices of obtained results we calculated, by frequency and amplitude mapping the spectral indices of rhythms density distribution. Coma state was estimated by Glasgow coma scale. Coma was caused by the following nosologies: brain trauma-35, brain hypoxic damage-21, ischemic insult-28, hemorrhagic insult-24, subarachnoid- hemorrhage insult-20, diabetic coma-7, hepatic coma-5, intoxication coma-12.

**Results and discussion:**

27 patients were in terminal i.e. 3 points coma. The coma in patients was caused by the following nosologies: brain trauma-7 cases, brain hypoxic damage-6, ischemic insult-5, hemorrhagic insult-6, subarachnoid- hemorrhage insult-4.

Coma was estimated by Glasgow scale as 3 point. After objective examination, the neurologist admitted the death of the brain, EEG stated nonreactive responses to light, sound and pain stimulus. Slow –wave delta rhythm of 0, 5-3 Hz. Frequency and amplitude with 2-70mc.v range dominated on EEG record.

On the first day from the development of coma EEG states electric silence in 64%. In 36% delta rhythm varied 1-2 Hz. and amplitude range variation 10-70 mc.v. In 57% - range accentuation of delta rhythm in frontal-central areas and in 43% - frontal areas.

On the third day from the development of coma the research was quitted by 2 patients because of their death. From those who left (36%) electric silence appeared in 23% while in 13% was stated an average variation of delta rhythm frequency 0,5-1,5hz. and amplitude range variation, range accentuation of delta rhythm was stated in frontal areas in 86% and in frontal-central areas in 12%. On the 5-th day 4 more patients passed away. Electric silence was stated in 12% and a range of delta rhythm more than 2mc.v –in 1%.

Electric activity induces of delta rhythm frequency as well as amplitude, were decreasing alongside the time passing in the cases where the brain death was objectively stated. The density of delta rhythm was changing from frontal- central areas to frontal areas. It was followed by ceasing of areal differentiation and was substituted by electric silence.

On the basis of our data, while stating a diagnosis of brain death, EEG gave 99% specification on the 5-th day of the development of coma.

According to Luders classification (Philadelphia 2006) on the basis of dominated rhythms the following types of coma were singled out: alpha, beta, theta and delta.

Alpha coma, alpha activity in this case differs from alpha rhythm by its frequency 7,5-9 hz, amplitude 40-70 mc.v and gradient, i.e. the maximum amplitude of alpha rhythm reveal instead of occipital areas in frontal - central areas is mono rhythmic, diffuse and as a rule nonreactive.

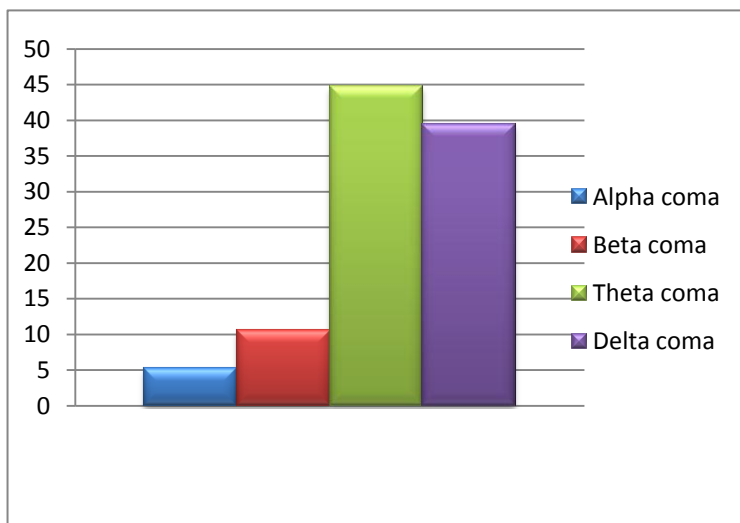
Beta coma- frequency 15-22 Hz or more; amplitude 30-55mc.v.

Theta coma- frequency 4-7 Hz; amplitude varies 10-70 mc.v.

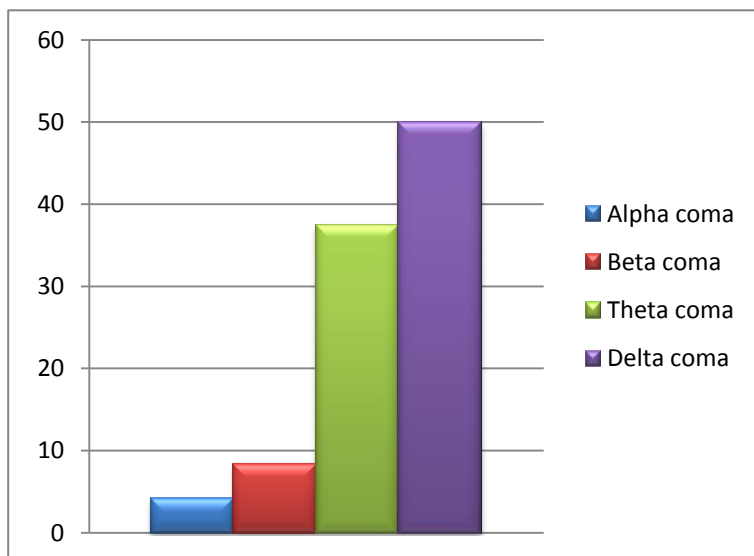
Delta coma- frequency 0, 5- 3 Hz; amplitude varies 5-90 mc.v.

Besides, we estimated the peculiarities of EEG changes: bilateral epileptic form activity, periodical lateralization epileptic form activity, three-phase waves, burst-suppression pattern; spindle coma; focal epilepsy activity; generalized epilepsy activity; nonconvulsive epistatus, percentage of their expansion and connectivity to the result.

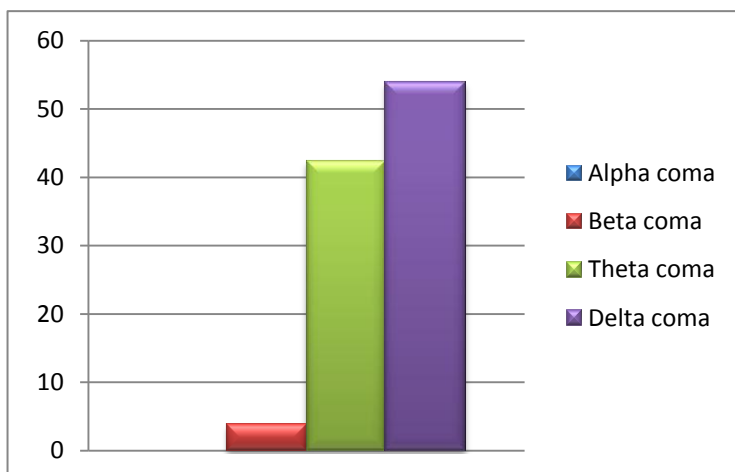
4-number coma was recorded in 38 patients; the data due to etiological factors of coma state see in Table 1;



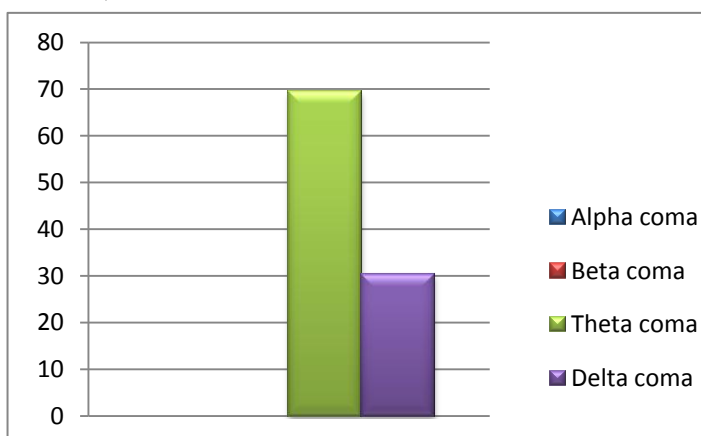
5-number coma was recorded in 24 patients; the data due to etiological factors of coma state see in Table 2;



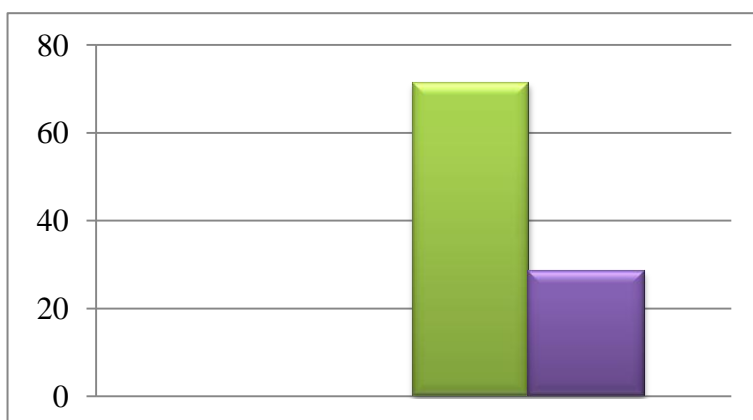
6-number coma was recorded in 26 patients; the data due to etiological factors of coma state see in Table 3;



7-number coma was recorded in 23 patients; the data due to etiological factors of coma state see in Table 4;

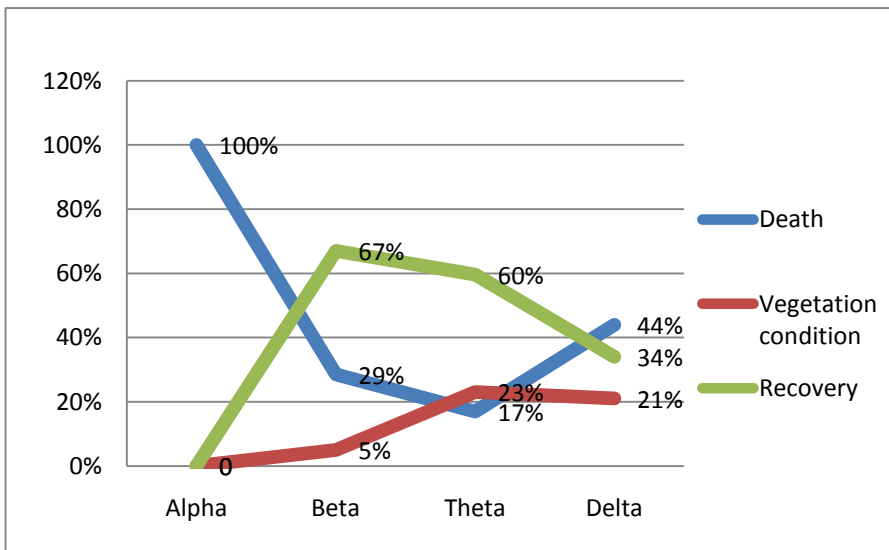
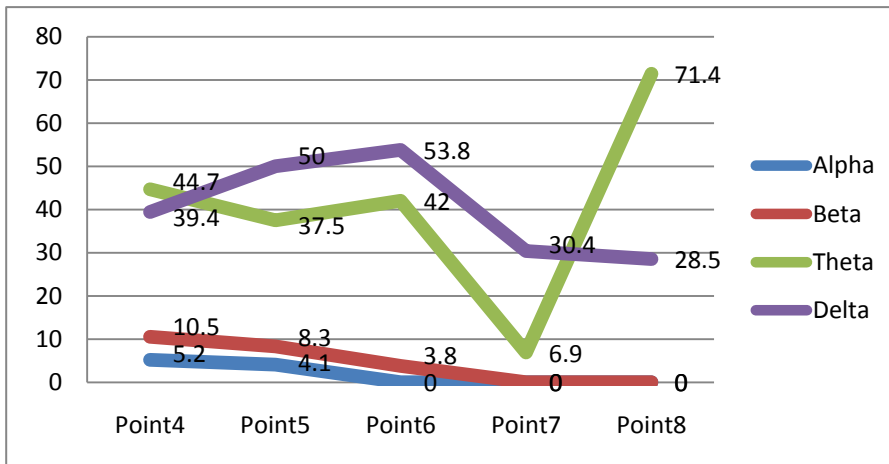


8-number coma was recorded in 14 patients; the data due to etiological factors of coma state see in Table 5;



According to Glasgow scale, the average data of frequency and amplitude dendense in

Alpha, beta, theta and delta pattern comas is evaluated in table (6), while the attitude to the result in table (7).



Spindle coma in 23%;

Periodical lateralization epileptiform activity in 12%;

Bilateral epileptiform activity in 7%;

Three-phase waves in 9%;

Burst-suppression pattern in 10%;

Focal epilepsy activity in 53%;

Generalized epilepsy activity in 28%;

Nonconvulsive epistatus in 6%;

Considering the EEG data of the patients in coma (4-8coma), the following criteria were distinguished:

- 1) Indices of unfavorable(lethal) forecast;
  - 2) Predictors of transferring into a vegetative state;
  - 3) Indices of favorable forecast;
- 1) The indices of unfavorable(lethal) forecast are:
    - a) Non reactivity of EEG on external irritations;
    - b) Straightening of focal slow-wave activity;
    - c) Non-existence of regional differences on EEG;
    - d) Tendency of forming cortex characterizing stated rhythm;
    - e) Existence of generalized epilepsy activity and generalized rhythmic theta activity-5Hz;
    - f) Decreasing amplitude;
    - g) Forming of burst-suppression patterns;
  - 2) Predictors of transferring into a vegetative state are:
    - a) Resistant slow-wave activity;
    - b) Stability of EEG frequency and amplitude indices;
    - c) Suppression of resistant alpha rhythm;
    - d) Existence of disorganized polymorphic bioactivity;
  - 3) Indices of favorable forecast are:
    - a) Reactivity of EEG on the external irritations;
    - b) Existence on EEG of regional differences;
    - c) Skewness between hemispheres or existence of focal changes in damaged area;
    - d) Instability of EEG;
    - e) Changeability of rhythm distribution gradients towards occipital areas;
    - f) Formation of sleeping characterizing phenomenon on EEG; in particular maximal amplitude waves frontal-central areas and formation of alpha rhythm “spindles” in the same areas with frequency 12-14Hz and formation of theta rhythm with frequency 7Hz;
- Alpha coma gives 100% specification of lethal results; Beta coma gives favorable forecast in 67% and vegetative state in 4%; Theta coma produces vegetative state in 23% and is lethal in 17%; Delta coma gives lethal results in 44,2% and vegetative state in 21,2%.

On the whole, the results of the conducted studies allow us to evaluate the forecast of the disease according to the changes on EEG data as well as to work out the right approach in treatment.

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ელექტროენცეფალოგრაფიულ ცვლილებათა თავისებურებანი კრიტიკულ მდგომარეობათა დროს  
მ.ხაბურზანია, ზ.ხელაძე, ნ.ნინუა, ზ.ხელაძემბერიძე, ნ.ქაჯაია,  
საქართველოს კრიტიკული მედიცინის ინსტიტუტი. (თბილისი, საქართველო.)

კვლევაში ჩართული იყო სხვადასხვა ეტიოლოგიით გამოწვეული კომაში მყოფი 194 პაციენტი. ამათგან კვლევის კრიტერიუმებს შეესაბამებოდა 152 პაციენტი. პაციენტების ასაკი მერყეობდა შუალედში 18-76 წელი. ქალი – 63, მამაკაცი 89.

კომა გამოწვეული იყო შემდეგი ნოზოლოგიებით: ქალა-ტვინის ტრავმა - 35, თავისტვინის ჰიპოქსიური დაზიანება - 21, იშემიური ინსულტი - 28, ჰემორაგიული - 24, სუბარაქნოიდულ-პარენქიმული სისხლჩაქცევა - 20, დიბეტური კომა - 7, ღვიძლიმიერი კომა - 5, ინტოქსიკაციური კომა - 12. ომინირებადი რითმების საფუძველზე გამოიყო კომის შემდეგი სახეები: ალფა, ბეტა, თეტა და დელტა. შედეგები საშუალებას იძლევა ვიმსჯელოთ ელექტროენცეფალოგრაფიული ცვლილებების მიხედვით დაავადების მიმდინარეობის პროგნოზზე და შევარჩიოთ მკურნალობის ტაქტიკა.

გასაღები სიტყვები: ეკგ, ალფა, ბეტა, თეტა, დელტა.