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Original article

EVOLUTION AND REHABILITATION IN ISCHEMIC STROKE OF LEFT INTERNAL CAROTID ARTERY

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Abstract

Objective. Decompressive hemicraniectomy was proposed as a “rescue” solution that should be taken into consideration for young patients with clinical degeneration due to extended cerebral infarction resisting medical treatment. Still, the selection criteria of the patients and the moment of the operation decision remain as debated as the moment of starting rehabilitation with survivors.

Methods. The research represents a case study of a 28-years-old female patient admitted to hospital with the diagnosis of malignant ischemic stroke of left ICA, operated and motor rehabilitated after a 6 months passive and active kinetics therapy program. The motor evolution of the patient is outstanding, Table 1 points out the motor progress recorded over 6 months. The Barthel Index shows the evolution of the patient as she recorded a 70 points progress after 6 months of kinetics therapy program.

Conclusions. The motor postoperative recovery activity started immediately after the surgical intervention, is defining in regarding the motor evolution of the patient. The passive rehabilitation, which included kinetic therapy, massage, passive gymnastics, respiratory gymnastics, was started in the first days. The active rehabilitation was strictly individualized. The rehabilitation treatment (passive kinetics therapy) was started in the first 11 days since the debut, success depending on the precocity of the recovery treatment.

Keywords: malignant stroke, hemicraniectomy, motor recovery, young.

Introduction

Cerebral ischemia represents the functional and/or anatomic failure of the cerebral tissue determined by the interruption or diminution of the arterial perfusion to the cerebral territories. The consequence of cerebral ischemia is localized necrosis of the tissue (stroke) induced by a cellular metabolic deficit related to the decrease of the cerebral blood flow.

The stroke for young adults under 45 is a reality and a “sad privilege”, considering its biologic, psychic and socio-professional integration consequences. The systemic disease, the disseminated lupus erythematosus can produce large strokes and it is thought that they can appear through inflammatory arteritis, clotting anomalies and heart embolism.

The “malignant” stroke in the middle cerebral artery is recognized (Werner Hacke et al, 1996) as having a high mortality rate in the absence of adequate treatment. Despite medical management, the rise of intracranial pressure, bulging and death arise with 78% of the patients within the first five days. The cerebral edema (Eric Jüttler et al, 2007) appearing in the first few days after the massive cerebral infarction determines the neurological degeneration of the patient and threatens survival. It occurs, most often, in the total infarction in the territory of the middle cerebral artery. The clinical degeneration occurs in a few days after the stroke (usually in the third day, sometimes later), but may evolve even more rapidly, in a few hours from the debut. Decompressive hemicraniectomy was proposed as a “rescue” solution that should be taken into consideration for young patients with clinical degeneration due to extended cerebral infarction

resisting medical treatment. Still, the selection criteria of the patients and the moment of the operation decision remain as debated as the moment of starting rehabilitation with survivors.

Case study: Material and method

The 28-years-old patient had an eight-year known history of SLE with cutaneous, articular and hematological determinations. In the personal record there was mention of four spontaneous abortions with ages between a few weeks and four months. She was under chronic treatment with Metilprednisolonum 8 mg/day, Hydroxychloroquine 200 mg/day. She was admitted to hospital two hours after the brutal apparition of right hemiplegia and aphasia. She suffered from an endometritis process with metrorrhagia that had started seven days previously. The hereditary collateral antecedents mentioned the mother's sister and the grandmother with SLE. The clinical examination revealed at hospitalization a BP of 130/70cm Hg, a regulate pulse of 60 bpm, a lax right hemiplegia, mixed aphasia, sphincter incontinence, metrorrhagia, deglutition is possible. Under the antiedematous cerebral treatment with Osmofundinum 100 mg/6 h i.v. in bolus, Metilprednisolonum, antibiotic protection, water-electrolytic balancing solutions, neuro-protectors and vitamins, the evolution over the first 48 hours was stationary. The gynecological examination revealed endometritis.

Results

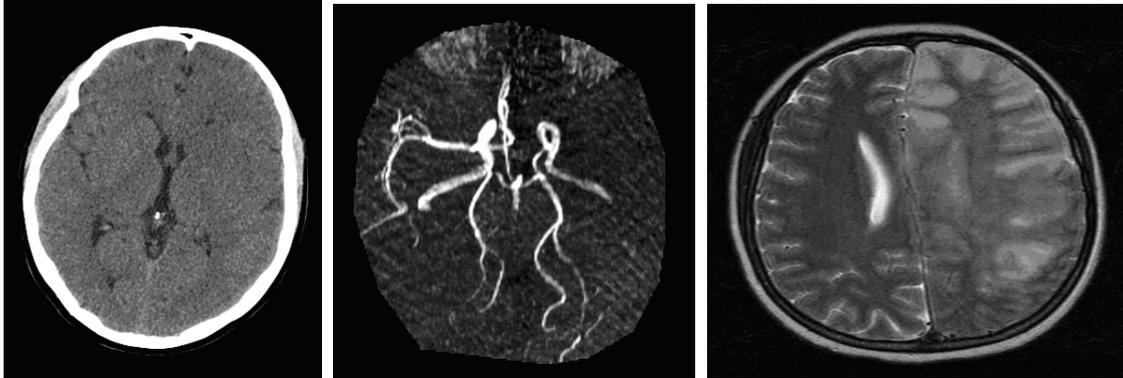
The first brain CT made at admission (2 hours after the clinical debut) was normal.

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1.

1. Normal cerebral CT

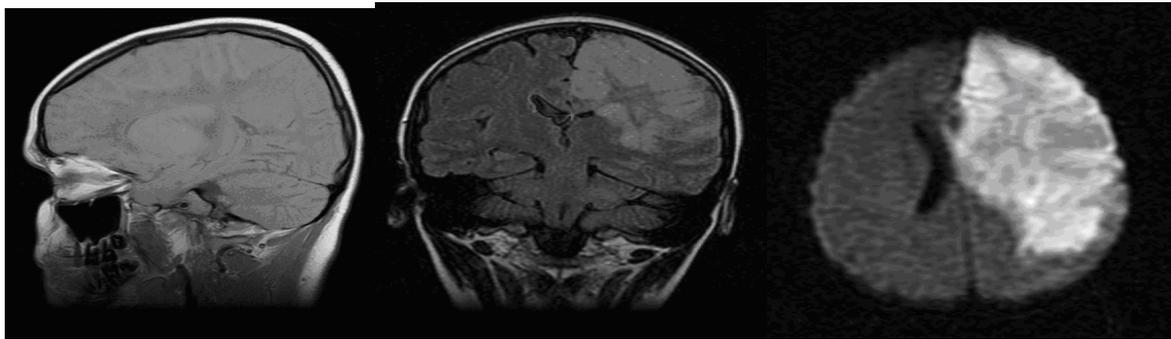
2. Angio-IMR made 24 h after clinical debut showed the absence of left MCA and ACA

3. Cerebral IMR showed the infarction of the left ICA with a right-deviation of 7-8 mm.

2.

T2 – intraaxial-supratentorial, with the emphasis of the left F-T-P-O lobe, showed a large inhomogeneous, hyper-intense T2 range. The edematous range determines a mass effect over the left VL comprising it, and over the falx cerebri, with a right-deviation of 7-8 mm.

3.



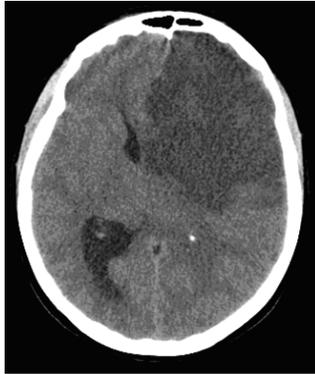
1. T2 sagittal image: intraaxial-supratentorial, with the emphasis of the left F-T-P-O lobe, showed a large inhomogeneous, hyper-intense T2 range

2. Coronary FLAIR: intraaxial-supratentorial, with the emphasis of the left F-T-P-O lobe, showed a large inhomogeneous, hyper-intense FLAIR range

3. DWI diffusion sequence: intraaxial-supratentorial, with the emphasis of the left F-T-P-O lobe, showed a large inhomogeneous, franc hyper-intense range in the diffusion sequences.

The DWI diffusion sequence, intraaxial-supratentorial, with the emphasis of the left F-T-P-O lobe, showed a large inhomogeneous, franc hyper-intense range in the diffusion sequences that extended towards the head and body of the caudate nucleus and the homolateral lentiform nucleus. The edematous range determined a mass effect over the left LV, which it compressed, and over the falx cerebri, with a 7-8 mm right-deviation. The inflammatory tests that were run had the following values: blood sedimentation test = 90

div/h, fibrinogen = 980 mg/dl, C3c complement = 111 mg/dl (normal value = 90-180 mg/dl), the doubly catenarian anti-DNA antibodies = 5.3 (negative), lupus anticoagulant: positive, anticardiolipin: negative, plaque = 138 000/mm. The clinic evolution was stable until the third day when there was psycho-motor unrest followed, a few hours later, by a rapidly progressive towards aggravation comatose state, thus on the fourth day, she was in a Glasgow 5 coma (motor 3, verbal 1, ocular 1), with a fixed left mydriasis, with head and eyeballs deviated to the right, photo-motor and corneal reflexes bilaterally sketched; on minor pain stimuli, or spontaneously, she presented decerebration crises intricated with decortication crises (upper limbs in flexion, lower limbs in extension or flexion). Babinski bilaterally positive, t = 37.8 °C. The cerebral CT is repeated and there showed a largely extended ischemic stroke on the left F-T-P lobe, with an emphasized mass effect over the lateral ventricles and the middle-sagittal structures, with the compression of the left LV and their movement to the right by 16 mm.



4.

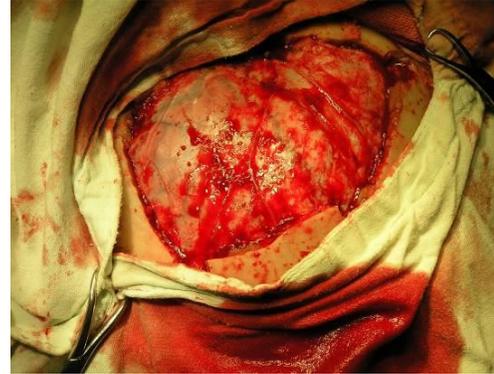
4. Cerebral CT showed a largely extended ischemic stroke on the left F-T-P lobe, with an emphasized mass effect over the lateral ventricles and the middle-sagittal structures, with the compression of the left LV



5.

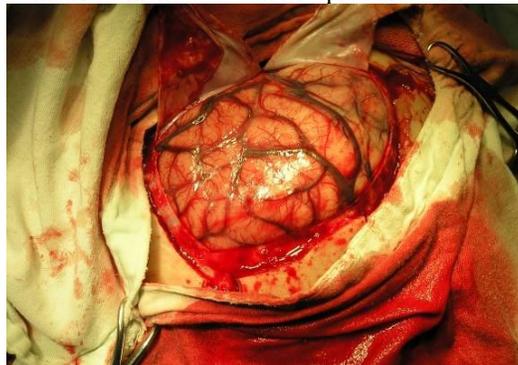
5. Cerebral CT showed a largely extended ischemic stroke on the left F-T-P lobe, with an emphasized mass effect over the lateral ventricles and the middle-sagittal structures, with the compression of the left LV and their movement to the right by 16 mm.

It is decided to initiate the neurosurgical intervention, by making a decompressive slot on the left F-T-P. There is made a curved incision as a reversed question mark; the soft layers are peeled off, there is made a temporal-parietal slot in 6 holes which lifted off without incidents. There is called attention on the dura mater which was under pressure. The



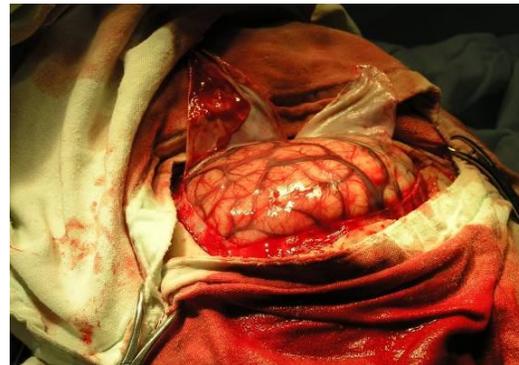
6.

pressured dura was initially incised curvedly with a temporal base, later it was opened in a star shape according to the adjacent tissues. The malignant cerebral edema was pointed out as it was swollen at the level of the surgical incision and the cerebral convolutions were smoothed and the veins were congested. The brain did not pulsate and it was extremely pale in the anterior half of the exposed area (the ACA territory) and had a small sub-arachnoidal hemorrhagic zone in the posterior half. The brain was washed with lukewarm saline solution, the dura was suspended here and there, and therefore the dura was left open. The bone slot was removed and preserved in order to be put back into place several months later; there were made sutures in the anatomic layers. The postoperative evolution was favorable.



7.

7. The incision of the dura and revelation of the malignant cerebral edema



8.

8. The incision of the dura and revelation of the malignant cerebral edema

After 36 hours, the patient was able to follow with the gaze, to perform simple commands and regained deglutition. On the 4th day she was transferred back to the Neurology Clinic. There was attached a plastered splint on the lower right limb, but after four days, the patient no longer accepted it. The last stitches were removed on the 18th day. There was initiated an

early motor and speech rehabilitation. For the motor evaluation there was used the Barthel index, which was 0 on the first day. On the 11th postoperative day, the cerebral CT was repeated and showed the extended left tempo – parietal craniotomy, the inhomogeneous hypodense mass with edema and intra-axial dilacerations at the level of the left cerebral hemisphere with a protrusion through the craniotomy orifice. For a month there was a kinetics therapy program: passive (starting in the 11th day) and active (starting in the 18th day), the patient is now able to move using a waling frame.



9. The cerebral CT showing the extended left tempo – parietal craniotomy, the inhomogeneous hypodense mass with edema and intra-axial dilacerations at the level of the left cerebral hemisphere with a protrusion through the craniotomy orifice

10. The cerebral CT showing the extended left tempo – parietal craniotomy, the inhomogeneous hypodense mass with edema and intra-axial dilacerations at the level of the left cerebral hemisphere with a protrusion through the craniotomy orifice.

Experiment protocol

The case study begun on February 2014 and ended after the Barthel Index evaluation six months after the operation. The 28- years-old patient had a 6 months passive and active kinetics therapy program for her motor rehabilitation, presented below.

Passive and active kinetics therapy program

I. The initial phase, immediately after the surgery:

-in the early stages of the disease, the total or partial paralysis of the limbs is lax;

-the objective of the rehabilitation is the maintenance of the articular mobility in complete amplitudes and the prevention of muscular contractions;

-the correct posture of the limbs in functioning position;

-the upper limb is to be kept with the shoulder in abduction (a pillow in the axilla), the forearm in slight flexion on the arm or in extension, semisupination, the fist in slight extension, the finger in semi-flexion and the thumb in abduction;

-the lower limb is to be kept in extension, not allowing for any degree of flexion or rotation of the hip;

-the knee is to be kept in extension, and the lower foot at a right angle with the lower leg with the aid of a posterior splint, well cushioned in order to avoid compression or skin injuries.

II. The functional recovery of the hemiplegic upper limb

The rehabilitation of the hemiplegic fist and arm is the most difficult problem for the rehabilitator.

The rehabilitation of the upper limb started early, in our case – on the 18th day since the debut of the neuromuscular deficit. It is the period of flaccidity when, first of all, we must proceed to correctly posture the entire upper limb:

-the arm in 45° abduction, the elbow in slight flexion or extension, the fist in extension, the fingers in slight flexion, the thumb in abduction (it is repeated every 5' with 30" breaks after each minute of maintenance);

-gradual tactile and proprioceptive stimulation, from facilitating positions; (sensory stimulation is used in the direction of increasing the desired responses and inhibiting the unwanted ones);

-muscle tapotement associated with light pressure, joint light compression, in rapid alternation (5-6' with 30" breaks).

-from the seated position, we use the normal reactions of stability and equilibrium, which we challenge through light pushes of the upper body so as to unbalance the patient who, trying to maintain balance, initiates muscle contractions in the upper limb (5' with 30" breaks after each minute).

Methodic indications: the rehabilitation therapy develops in two phases:

A. In the initial phase, when the proximal extremity of the upper limb is taken care of, there must be voluntary control of the shoulder and elbow, if possible, in different plans; all movements should be as far away as possible from the sinkinetic schemes. In the beginning, there is recommended to accentuate the spasticity of the hand to any movement of the upper limb root. Therefore, during the active mobilization of the proximal extremity, the hand shall be kept in an inhibition position, that is: total extension of the fingers and of the fist with the thumb in abduction.

-the passive mobilization of all of the joints of the affected limb is done gently, but it must be insisted in order to carry on the full amplitude of the movement. Every joint should be separately mobilized, holding at the extremities of the mobilized segments (a joint is not passively mobilized through another joint);

-the training of the body symmetry is made through bilateral activities, then alternative unilateral ones, and finally through reciprocal activities;



-when the overall condition allowed it, (on the 30th day since the debut), the Kabat technique is applied, the diagonals for the upper limb; once the spasticity is installed, the new conditions of the neuromuscular deficit forced the adjustment of the therapeutic tactics;

-the traction exercised by the upper fascicles of the trapezius and the sternocleidomastoid flexes the head on the affected side and rotates it on the healthy side.

-the body has a lateral inflexion on the hemiplegic part, with lifting and retraction of the basin with the descent and retrusion of the humeroscapular belt due to the traction exercised by the broadest muscle of the back.

--the entire hemiplegic part is rotated backwards; in order to inhibit or reduce the spasticity that generates this attitude, as well as to correct the abnormal tonic reflexes, the change of the key points: the neck, the spine, the scapular belt and the pelvic belt, the fingers and toes: these reflex positions should be localized with every patient and correct every time it is necessary; at the same time there should be attempted to reduce the spasticity through the methods described in the general part;

-it is important to know that with some hemiplegics there may reside a lack of usage of the hand, although motility is recovered. This is explained by the profound sensory disorders due to the involvement of the upward sensory paths which are very close on the pyramidal path, at the level of the cortex and the inner capsule.

The prognosis of the functional rehabilitation of the hand is linked to many aspects, among which we mention some references to the etiology and topography of the lesion:

-the most serious, from a functional point of view, and, unfortunately, the most frequent, are the cortical or capsular lesions following an ischemia, such as is our case in the ICA territory. If at the debut of the illness, the functional prognosis cannot be determined, two months later it may be known according to: the topography of the lesion, the importance of the sensory and motility disorders.

-the functional prognosis is initially mediocre, and its primarily purpose is that of preventing the elbow-shoulder syndrome and learning how to use the arm as a basic helper, as well as the preservation of the future, in case the rehabilitation should occur (after a year), which is sometimes the case.

The functional rehabilitation was proximally started, then distally.

B. Afterwards, the evolution was the following. During hospitalization, the patient went through:

1. Initially, the hand had no voluntary command or can only flex through stereotype movement.

2. At release, she can actively flex her fingers and thumb, but she cannot extend them except in one

position; we explain that it is required to have precision in movement, and not force and execution speed.

The rehabilitator tries the "awakening" of the extensor muscles, with the help of the facilitating techniques, especially those that use the position shifts (Bobath). We used the following:

- vertical rising or at a certain angle of the upper limb;
- passive forced abduction of the thumb (several successive repetitions)
- in ventral decubitus, resting the hand on the lumbar region (*the unlocking reflex* described by T. Fay)
- the flexion of the fist (several successive repetitions).

We have noted the extension of only one finger (on the 25th day) – the fifth finger (in the second month).

As we record the progress, we reduce facilitation in order to obtain, if possible, the extension of the finger regardless of the upper limb position.

The simultaneous extension of the fingers and of the fist always remains difficult because of the deficit in the extensors muscles, the spasticity of the flexors and the paralysis of the intrinsic ones.

Prehension in such cases can only remain basic and it is realized through the fingers and palm hold. The lack of force and of opening of the hand does not allow for light and small objects to be held. At prehension, the entire limb is risen so that, due to the fist flexion, the extension of the fingers and the slight abduction of the thumb to be possible after the termination of the voluntary contraction.

The best work technique is the alternation of the antagonists and rhythmic stabilization. The pivot joint should permanently be changed. After the global labor of the upper limb, there should be strived to realize the analytical movements, such as:

-close the fist, open and extend the thumb, open the fist and extend the index, open and extend the thumb and index; (10 series x 10-15 repetitions, passive break of 1' between the series);

III. The functional rehabilitation of the lower hemiplegic limb and walking

The major objective of the lower limb rehabilitation is thus defined: obtaining a balanced command on different antagonist groups and eliminating the sinkinetics in order to recover a walking as close to normal as possible. Most statistics give percentages between 85 and 95 of recovering walking for hemiplegics.

Methodic indications: in order to prevent the typical flexion stiffness and the external rotation of the hip, knee flexion and equinovarus, we install the patient so as to have the basin flat on the bed, with no flexion of the hip and knee, the lower limb totally coupled so as to avoid its fall in external rotation, the feet is maintained at 90° on the lower leg.



Spasticity is announced through the exaggeration of the deep reflexes and usually begins with the abductors of the thighs and the quadriceps, in our case, on the 30th day.

For a good rehabilitation of the walk, it is necessary to make a thorough analysis of the muscular deficit, of the repartition and intensity of the spasticity, of the intensity of the sin-kinetics, to sum up, it is necessary to make a functional evaluation of the patient.

The muscular deficit is mostly recorded (the general scheme of hemiplegia) on the following muscles: psoas, abductors and internal rotators of the hip, the knee flexors, and the leg dorso-flexors. The ischio-tibial muscles are partially respected.

During the evolution, the deficit is modified; the first muscles to recover voluntary contraction capacity are the abductors, the quadriceps and then gluteus maximus.

The muscles that remain most often, deficient, are the common extensor of the fingers, the peroneals, and the middle and small gluteus.

Bearing this in mind, the importance of the correct positioning during the flaccidity period is thoroughly justified.

The analysis of walk in hemiplegics

In order to rehabilitate walk, it is absolutely necessary the recovery of verticality and balance. The sense of verticality is recovered in time, and its training is very important. Concerning balance, it must be progressively trained from decubitus to semi-sitting with adequate lateral support, thus stimulating labyrinthine reflexes, and therefore, the contraction of the neck muscles which hold the head in a correct position. (Gudrun, 2009)

In order to decrease the motor deficit, we must use the Kabath technique, the diagonals for the lower

limbs. Sinkinetic are a negative element in recovering correct walk and must be eliminated as early as possible.

In order to eliminate sinkinetic contraction of the long peroneal during the active contraction of the quadriceps, there must be done the following kinetic program for 30" and it must be repeated twice a day:

1. the patient is laid on the kinetics table, the lower leg is freely hanging, and must contract the quadriceps and palpate its increased tonus. Te patient is instructed to notice the sin-kinetic contraction of the long peroneal and should try to voluntarily eliminate it.
2. the knee is extended, and the hock is held by the therapist; the patient must actively mobilize the patella upwards and downwards. At the same time, she should try to relax the long peroneal as much as possible.
3. the knee should be extended without support and hold the leg as free as possible
4. the knee should be actively extended, the therapist should palpate the long peroneal and, the moment he feels the sinkinetic contraction, he should ask the patient to regain the start position and repeat the extended movement of the knee.
5. the knee should be actively extended, the therapist should apply his hand on the planta, the tension of the long peroneal has as a result the modification of the position of the leg and the patient should feel this through the amplification of the pressure that the therapist is applying on the planta.

The patient of the present study stopped at the second stage after a month and at the third stage after the 6 months evaluation.

After 6 months of motor recovery, the patient obtains 70 points, 30 more than after the accumulated rehabilitation after one month of kinetic therapy. (Table no 1).

Activity	Date			Activity	Date		
	0 day	1 month	6 months		0 day	1 month	6 months
1.Feeding 0= unable 5=needs help cutting, spreading butter 10=independent	0	5	5	7.Toilet use 0=dependent 5=needs some help 10=independent	0	5	10
2.Bathing 0=dependent 5= independent (or in shower)	0	0	0	8.Transfer (bed to chair and back 0=unable, no sitting balance 5=major help 10=minor help, verbal or physic 15=independent	0	5	10
3.Grooming 0=needs help but can do about half unaided 5= independent face/hair/teeth/shaving	0	0	5	9.Mobility (on level surfaces) 0=immobile or <50yards 5=wheelchair independent, including corners, >50 yards 10=walks with help of one person >50 yards 15=independent	0	5	10
4.Dressing 0=dependent 5=needs help but can do about half unaided	0	0	5	10.Stairs 0=unable 5=needs help (verbal, physical, carrying aid) 10 independent	0	0	5
5.Bowels 0=incontinent 5=occasional accident 10=continent	0	10	10				
6.Bladder							



0=dependent	0		
5=needs some help, but can do something alone		<i>TOTAL (points)</i>	0 40 70
10=independent	10 10		

Discussions

Among the rare causes of stroke, there lies the inflammatory arteritis of collagenosis, in our case, the systemic lupus erythematosus (SLE) [Kitagawa,1990, Kushner M,1989]

In the first days after the massive brain damage, the cerebral edema of the necrotic tissue can threaten life. It most frequently appears in the complete infraction of the middle cerebral artery (MCA) [Werner Hacke, 1996]. The additional infraction in the territory of the anterior cerebral artery (ACA) only makes the situation worse. The clinical deterioration occurs in the following days after the stroke, most frequently on the third day, just as in the case presented above. The clinical signs of the aggravation are represented by sleepiness, fixed pupil, but not necessarily mydriasis, bilateral Babinski. Controlled hyperventilation may be useful in order to delay the neurosurgical intervention, but not in all cases of malignant infraction of MCA or ICA. Another useful help is i.v. osmofundin 1g/kg, then 50 g every 2-3 hours. Still, in the vast majority of these cases of comatose patients, the hemicraniotomy is necessary, otherwise, they die. The hemicraniotomy, together with the free dura, reduces the mass effect and intracranial pressure in these cases where the patient progresses from stupor to coma and the cerebral imagistic reveal the mass effect increase [Werner Hacke, 1996].

The earliest the kinetic therapy starts, the more effectively and efficiently it may be acted against static and motor disorders [Diedler,2009]. Treatment individualization represents an essential condition of recovery initiation; the patient must meet some essential requirements: stable clinical state, no speech impairments, no sphincter disorders, and no psychic or behavior disorders. The rehabilitating treatment in ischemic stroke is usually started in the first 3-4 days since the debut, its success depends on its precocity, but in the case of the malignant stroke, the recovery is started after stabilizing the patient – in our case, on the 11th day. In the first 6-8 months since the debut of the stroke, there must be continuous rehabilitation. On the Barthel Index, that was 0 in the beginning (on the 18th day), evolved to 40 after a month, and to 70 after six months of rehabilitation, which means that the patient became independent, with minimal help, a fact which points out the importance of the early start of rehabilitation, even for the patients with malignant stroke. The passive rehabilitation, which includes kinetic therapy, massage, passive and respiratory gymnastics, must be started right from the first days. Active rehabilitation is strictly individual and depends on the character of the cerebral infraction. The patient started therapy on the 18th day, but started walking only on the 27th day with a walking frame, making 2-3 steps progress, and after 6 months she still uses a walking

frame, but she is able to manage her physical necessities (urinate, defecate) all by herself. The distances covered every day grew from 20-30 steps on release, to 50-60 steps on the walking frame after 6 months (Table no 1).

Conclusions

The motor postoperative recovery activity started immediately after the surgical intervention, is defining in regarding the motor evolution of the patient. We have presented the case of a 28-years-old patient, with a 8 years history of SLE with cutaneous, articular and hematological determinations and who was admitted to hospital with sudden debut right hemiplegia and mixed aphasia on the endometritis process with metrorrhagia that had started seven days previously. The evolution was stationary until the 3rd day when the general state rapidly deteriorated and the patient entered a coma. The repeated cerebral CT revealed a malignant infraction of the left internal cerebral artery and the neurosurgical intervention that consisted of a decompressive left fronto-temporo-parietal slot, saved the life of this young woman.

Moreover, the rehabilitation measures had a very important role, and they were taken as early as possible after the stabilization of the patient. The passive rehabilitation, which included kinetic therapy, massage, passive gymnastics, respiratory gymnastics, was started in the first days. The active rehabilitation was strictly individualized. The rehabilitation treatment (passive kinetics therapy) was started in the first 11 days since the debut, success depending on the precocity of the recovery treatment. In the first 6 months since the debut of the stroke, it is necessary to make continuous rehabilitation. By analyzing the motor performances over the hospitalization period and afterwards, there is a clear significant improvement (Table no 1).

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