Coma: pathophysiology and classification

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Coma is a state of unconsciousness; the word is derived from Greek and means a sleep-like state. Modern neurology understands coma as a symptom and not as a syndrome. The terms acute coma, profound coma, coma depassé and coma vigil still used routinely but also in the literature do not meet the requirements of modern diagnostics. The coma must be seen as main symptom of the various "coma syndromes" and they must be named specifically according to the different accompanying symptoms and their development. Simplifying we could use the term "acute coma" to describe neurological diseases with transitory unconsciousness, while conditions in which unconsciousness persists over weeks, months or until death could be called "chronified coma", thus avoiding the neurologically vague terms semi-coma and pre-coma which are frequently found in the literature. The onset of unconsciousness and accompanying symptoms and their development as well as the pathophysiological fact that unconsciousness - coma - is caused by failure of all cerebral functions. must be taken into account for a correct attribution of the symptom coma to a neurological syndrome

The acute coma

Failure of all cerebral functions may be due to a sudden disintegration of all cerebral functions, as it happens in epileptic seizures or electro convulsion (E.C.), and may be followed soon by complete recovery after reintegration of the cerebral functions.

Acute coma is further caused by functional failure of certain brain regions such as the frontal lobe (after brain injury etc.), by lesions of larger brain areas, such as the parietal lobe (infarction, intracerebral haemorrhage encephalitis etc.), but also by lesions of the brain stem (hypoperfusion, inflammation, haemorrhages, progressive tumour). Modern neurological terminology does not use the term coma for such conditions with attack-like or rapidly improving unconsciousness and they will therefore not be discussed within the framework of the present paper.

The acute midbrain syndrome and the acute bulbar brain syndrome

In modern literature the term coma describes a prolonged state of unconsciousness regardless of accompanying symptoms, which have a uniform combination. We differentiate between "progressive coma" and "chronified coma", which can again be subdivided into "persisting coma"

and "coma depassé". Typical examples of acute coma with prolonged unconsciousness are the acute midbrain syndrome and the acute bulbar brain syndrome.

The acute midbrain syndrome may be a primary condition caused by an acute lesion in the upper brain stem (local haemorrhage, encephalitis etc.), or a secondary condition due to compression (tentorial herniation), or a tertiary condition as a consequence of a diffuse damage of the whole cerebrum with a decline of brain functions to the midbrain level (hypoxia, panencephalitis, endotoxic metabolic damage [hepatic, nephrogenic], exotoxic damage [CO-, drug intoxication]).

Failure of the brain stem due to diffuse brain stem damage or foraminal pressure and loss of cerebral and brain stem functions lead to the bulbar brain syndrome. If no reintegration occurs, brain death is the consequence. Remission is possible in primary, secondary and tertiary acute midbrain syndrome and in rare cases also in secondary acute bulbar brain syndrome. Without remission a "chronified coma", the apallic syndrome, evolves.

Secondary and tertiary acute midbrain syndrome develop by stepwise disintegration of cerebral functions with simultaneous disinhibiton of the midbrain centres for eye and body motor systems and of autonomic functions, while the level of consciousness decreases gradually. The primary acute midbrain syndrome normally occurs without stepwise disintegration in accordance with the local lesion (haemorrhage, brain stem encephalitis etc.) The step-wise development may also be absent in tertiary acute midbrain syndrome. Remission with full recovery is more likely in secondary and tertiary midbrain syndrome than in primary.

The acute bulbar brain syndrome occurs as secondary condition as a result of an increase in volume of the cerebrum and subsequently of the brain stem with mass displacement and foraminal herniation when the lower brain stem is compressed, or may be caused by a local lesion in the medulla oblongata.

The secondary acute midbrain syndrome develops in five stages. The level of consciousness decreases gradually resulting in coma. Motor symptoms, which are due to a disinhibiton of the nigro-~~olivary~~ rubral centres, begin with massive movements followed by an extended position of all limbs with extension spasms (decerebrate rigidity), exaggerated reflexes, increase in tonicity and pyramid signs. At the same time the eye motor system fails and autonomic functions are disinhibited.

In acute secondary midbrain syndrome, unilateral compression of the brain stem may lead to a lateralisation of symptoms with disintegration of the mesodiencephalic regulatory centres of eye and body movement and autonomic functions as well as deterioration of the level of consciousness. We distinguish two separate stages which turn into the third and fourth stage of the acute secondary midbrain syndrome. A lateralisation of acute midbrain symptoms may be seen in some patients with focal damage of the upper brain stem.

The a cute secondary bulbar brain syndrome has also two stages; gradually motor and autonomic regulatory centres of the brain stem fail. Without remission, phase two of the acute primary and secondary bulbar brain syndrome will result in brain death with all signs of complete failure of cerebral and brain stem functions.

The acute primary, secondary and tertiary midbrain syndrome may change from stage three into a protracted midbrain syndrome during which individual symptoms improve with a delay and a temporarily an apallic syndrome may develop.

The apallic syndrome

The apallic syndrome is occasionally still called persistent vegetative state, a term not corresponding to the symptoms of the condition, which are not limited to a disturbance of autonomic (i.e. vegetative) functions. The fully developed apallic syndrome is characterised by coma vigil, the typical state of altered consciousness with circadian regulation of the sleep-wake rhythm, typical posture of the body, rigid spasticity, hyperreflexia, pyramid signs, impairment of eye movements, primitive motor patterns and primitive emotional reactions. The term persistent vegetative state is also unacceptable because it signals that rehabilitation programmes will be unsuccessful. The English custom to call such patients "vegetables" must be rejected as being unethical.

The apallic syndrome must be differentiated from the locked-in syndrome. These patients are completely immobile apart from vertical eye movements; in advanced stages the limbs are held in a flexed position and primitive motor patterns may be seen.

The apallic syndromes evolves out of the mid brain syndrome in three stages. The fully developed apallic syndrome is reversible in a high percentage of patients (70 - 80 %). Regression occurs in eight stages including the Klüver-Bucy syndrome consisting of three sub-stages; afterwards further

improvement may be expected. After the remission stages, patients may be left with a more or less severe neurological deficit, however complete recovery has also been reported.

The fully developed apallic syndrome may again change into the acute midbrain syndrome, usually due to complications such as gastrointestinal bleeding, sepsis etc. On the other hand, an irreversible failure of all brain functions, i.e. brain death may occur.

An acute brain disease is not the only possible pathogenesis of an apallic syndrome, it may also be caused by progressive degeneration of all cerebral functions, which is a terminal stage. Conditions which may lead to this terminal stage include Huntington's chorea, Alzheimer's disease and various progressive diffuse brain diseases, Creutzfeldt-Jacob's disease, Kuru disease and chronic panencephalitis.

Since the term coma describes only a symptom, neurological conditions with unconsciousness should be identified according to the underlying disease. The terms acute midbrain syndrome, bulbar brain syndrome and apallic syndrome correspond much better to the neurological disorders which are accompanied by coma.

UPDATES IN CLINICAL NEUROLOGY

Scientific Director
G. Comi

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September 19th, 1996

Dear Prof. Gerstenbrand,

following the invitation by Prof. Bramanti, and on behalf of the organization of the Courses "Updates in Clinical Neurology" to be held in Messina during October 1996, we thank you very much for your confirmation to partecipate in.

Your lecture on "Physiopatology and Classification" is appointed on Saturday October 12th 1996, at Teatro Vittorio Emanuele as indicated in the programme here attached. It will be held in English language with oversound simultaneous translation into Italian and should last about 45 minutes.

As far as your journey and stay in Italy are concerned, we wish to inform you that they will be entirely covered by Farmades; here attached you will find your flight ticket.

For your hotel accomodation we have reserved a room for the night of October 11th at the "Jolly Hotel", Via Garibaldi, 126 Tel. 0039-90-363860. Should you wish to shroten or prolong your stay, please let us know at your earliest convenience.

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