pupillary size and reactivity, limb movements, and Babinski responses are assessed. As soon as vital functions permit and cervical spine x-rays and a CT scan have been obtained, the patient should be transported to a critical care unit. Hypoxia should be reversed, and normal saline used as the resuscitation fluid in preference to albumin. The finding of an epidural or subdural hematoma or large intracerebral hemorrhage is usually an indication for prompt surgery and intracranial decompression in an otherwise salvageable patient. Measurement of ICP with a ventricular catheter or fiberoptic device in order to guide treatment has been favored by many units but has not improved outcome. Hyperosmolar intravenous solutions are used in various regimens to limit intracranial pressure. The inherently appealing approach of removing portions of the skull in order to decompress the intracranial contents, as has been successful for brain swelling after cerebral infarction, has so far not proven effective for traumatic brain injury. The use of prophylactic antiepileptic medications has been recommended, but there is little supportive data. **Management of raised ICP, a frequent feature of severe head injury, is discussed in Chap. 330.**

GRADING AND PROGNOSIS

In severe head injury, the clinical features of eye opening, motor responses of the limbs, and verbal output have been found to be generally predictive of outcome. These three responses are assessed by the Glasgow Coma Scale; a score between 3 and 15 is assigned **(Table 457e-1)**. Over 85% of patients with aggregate scores of <5 die within 24 h. However, a number of patients with slightly higher scores, including a few without pupillary light responses, survive, suggesting that an initially aggressive approach is justified in most patients. Patients <20 years old, particularly children, may make remarkable recoveries after having grave early neurologic signs. In one large study of severe head injury, 55% of children had a good outcome at 1 year, compared with 21% of adults. Older age, increased ICP, early hypoxia or hypotension, compression of the brainstem on CT or MRI, and a delay in the evacuation of large intracranial hemorrhages are indicators of a poor prognosis.

POSTCONCUSSION SYNDROME

The *postconcussion syndrome* refers to a state following minor head injury consisting of combinations of fatigue, dizziness, headache, and difficulty in concentration. The syndrome simulates asthenia and anxious depression. Based on experimental models, it has been proposed that subtle axonal shearing lesions or as yet undefined biochemical alterations account for the cognitive symptoms. In moderate and severe trauma, neuropsychological changes such as difficulty with attention and memory and other cognitive deficits are undoubtedly present, sometimes severe, but many problems identified by formal testing do not affect daily functioning. Test scores tend to improve rapidly during the first 6 months after injury and then more slowly for years.

Management of the postconcussive syndrome requires the identification and treatment of each separate element of depression, sleeplessness, anxiety, persistent headache, and dizziness. A clear explanation of the problems that may follow concussion has been shown to reduce subsequent complaints. Care is taken to avoid prolonged use of drugs that produce dependence. Headache may initially be treated with acetaminophen and small doses of amitriptyline. Vestibular exercises **(Chap. 28)** and small doses of vestibular suppressants such as promethazine (Phenergan) may be helpful when dizziness is the main problem. Patients who after minor or moderate injury have difficulty with memory or with complex cognitive tasks at work may be reassured that these problems usually improve over 6–12 months, and workload may be reduced in the interim. It is sometimes helpful to obtain serial and quantified neuropsychological testing in order to adjust the work environment to the patient's abilities and to document improvement over time. Whether cognitive exercises are useful in contrast to rest and a reduction in mental challenges is uncertain. Previously energetic and resilient individuals usually have the best recoveries. In patients with persistent symptoms, the possibility exists of malingering or prolongation as a result of litigation.

TABLE 457e-1 GLASGOW COMA SCALE FOR HEAD INJURY

Eye Opening (E)		Verbal Response (V)	
Spontaneous	4	Oriented	5
To loud voice	3	Confused, disoriented	4
To pain	2	Inappropriate words	3
Nil	1	Incomprehensible sounds	2
		Nil	1
Best Motor Response (M)			
Obeys	6		
Localizes	5		
Withdraws (flexion)	4		
Abnormal flexion posturing	3		
Extension posturing	2		
Nil	1		

Note: Coma score = E + M + V. Patients scoring 3 or 4 have an 85% chance of dying or remaining vegetative, whereas scores >11 indicate only a 5–10% likelihood of death or vegetative state and 85% chance of moderate disability or good recovery. Intermediate scores correlate with proportional chances of recovery.