Prognosis of Stroke Patients Requiring Mechanical Ventilation in a Neurological Critical Care Unit

Rasha Al-Aubaidi

ABSTRACT:

BACKGROUND:

Intubation and mechanical ventilation are sometimes necessary during treatment of acute stroke. Indications include neurological deterioration, pulmonary complications, and elective intubation for procedures and surgery.

OBJECTIVE:

This study was performed at neurosciences hospital for the period 2013 - 2014 to prospectively assess the prognosis of stroke patients who require ventilation in a neurological intensive care unit and to determine factors that may influence outcome.

METHODS:

Analysis was made of 124 consecutive stroke patients,who required mechanical ventilation over a 2-year period. We determined the survival rate at 1 year after admission.

RESULTS:

The 1-year survival rate was 33.1%. Sixty-five patients (52%) died in the neurological intensive care unit. Among 17 variables analyzed, seven were found to significantly influence 2-month fatality in the univariate analysis: age greater than 65 years, atrial fibrillation, bilateral absence of pupillary light reflex, bilateral absence of corneal reflex, bilateral Babinski's sign, infratentorial stroke, and Glasgow Coma Scale (GCS) score less than 10. Independent predictors of death at 2 months were age greater than 65 years, GCS score less than 10, and intubation performed because of coma or acute respiratory failure.

CONCLUSION:

Intubation and mechanical ventilation of severe stroke patients should be performed in a timely manner.older patients comatose on admission requiring mechanical ventilation have very poor prognosis. Fatality rate in our patients was high, but one third were still alive at 1 year after admission. Patients electively intubated in our study had a better prognosis independent from other factors, including age and GCS score.The probability of death at 2 months was more than 2.5 times greater in patients who were intubated because of neurological or respiratory deterioration than in those electively intubated for angiography or surgical intervention.

KEY WORDES: strok, ETT,controled ventilation ,prognosis.

INTRODUCTION:

Neurological intensive care units (NICUs) tend to deal largely with a different population of patients. Such units are primarily concerned with the management of primary encephalopathic patients, the control of raised intracranial pressure (ICP), the management of ventilatory, autonomic, and bulbar insufficiency, and the consequences of profound neuromuscular weakness. patients with primary neurological diseases such as stroke, ischemic or haemorrhagic, have a better outcome than those patients with secondary neurological disease .The lack of effective therapy to reduce the neuronal damage associated with stroke has led to controversy about the benefit of stroke units. Some studies have shown no benefit of stroke ICUs in reducing mortality or morbidity [1,2,3]. Other studies have shown that patients with stroke acutely treated in nonintensive stroke units have at least a better long-term outcome, probably related to reduction in secondary complications and intensive and early rehabilitation.[4,5,6].Patients with stroke who are comatose on admission and those requiring mechanical ventilation have a very poor prognosis despite intensive care treatment.[7,8,9]. Early

Specialist Anesthesia and Intensive Care Unit.

thrombolytic therapy in acute ischemic stroke have generated more interest in optimizing medical management of brain ischemia.[10,11,12,13]. The prognosis of patients with stroke may be strongly influenced by medical measures that improve cerebral perfusion in the “ischemic penumbra.”[14]. This includes close monitoring of arterial pressure and electrolyte balance, and management of increased intracranial pressure with antiedema agents, hyperventilation, or decompressive surgery. Neuroprotective agents and hypothermia may also be valuable to extend the narrow therapeutic window for thrombolysis.[15,16].

METHODS:

Patient Characteristics_The patient group consisted of 80 men (64.5%) and 44 women (35.5%). Mean±SD age was 61.4±12.8 years, and mean GCS score on admission was 10.1. Of these patients, 116 (93.6%) were admitted to the NICU within 24 hours after onset of symptoms (mean, 10.1 hours) and were intubated the same day (mean, 11.9 hours). Diagnosis of stroke was confirmed in all patients. Eighty-four patients (67.7%) presented with ischemic stroke, and 40 (32.3%) presented with spontaneous hemorrhage. Ages and GCS scores on admission according to subtypes of strokes are listed in Table 6:

General principles of intensive care: There are general principles of intensive care management common to all units, whatever their specialization:

•These include meticulous nursing and medical care and, physiotherapy. Early and aggressive physiotherapy intervention (including frequent alterations of limb positioning, passive limb movements, and appropriate splinting) helps to maintain joint mobility and prevents limb contractures and pain while awaiting neurological improvement.

•Other aspects of general ICU care include the management of agitation and pain, maintenance of an adequate airway and ventilation, cardiovascular stability, nutrition, anticoagulation, thrombolysis, raised ICP and psychological therapy.

•INDICATIONS FOR ADMISSION to NICU : The primary role of the NICU is that of the management of acute neurological emergencies. This involves
control of airway, respiratory, bulbar, and haemodynamic compromise. It also entails the provision of specific treatments and the prevention and management of the secondary complications.
neurological indications for mechanical ventilation [17,18,19]

- impaired level of consciousness e.g brain swelling with depressed level of consciousness (Glasgow coma score < 9)
- impaired airway protection
- Progressive respiratory impairment or the need for mechanical ventilation. Impending neuromuscular respiratory failure (forced vital capacity < 20 ml/kg, tachypnoea, dyspnoea at rest, use of accessory muscles, staccato speech). Respiratory failure must be anticipated before the emergence of hypoxia and/or hypercapnia. Thus the threshold for intubation is lower in the context of rapidly progressive neuromuscular weakness.
- seizures
- clinical or computed tomographic (CT) evidence of raised ICP caused by a space occupying lesion, cerebral oedema or haemorrhagic conversion of a cerebral infarct
- general medical complications (for example, hyper/hypotension, aspiration pneumonia, sepsis, cardiac arrhythmias, pulmonary emboli)
- monitoring (for example, level of consciousness, respiratory function, ICP, continuous electroencephalography (EEG))
- specific treatments (for example, neurosurgical intervention, intravenous or arterial thrombolysis
- Failure of central regulation of respiration (apnoea, ataxic or cluster breathing)

The central and peripheral causes in ventilatory insufficiency or failure which may require admission to the NICU are listed in tables 1 and 2.

Table 1: Central causes of ventilatory insufficiency or failure which may require admission to the NICU.

▸ Cortical	Epilepsy
	Vascular
	Tumour
▸ Brainstem	Congenital (Ondine's curse)—primary alveolar hypoventilation
	Tumour
	Vascular
	Multiple sclerosis and acute disseminated encephalomyelitis
	Motor neurone disease
	Infection: Borrelia
	Listeria
	Post-varicella encephalomyelitis
	Poliomyelitis
	Encephalitis lethargica
	Western equine encephalitis
	Paraneoplastic
	Leigh's disease
	Reye's syndrome
	Hypoxaemia
▸ Formen magnum and upper cervical cord	
	Arnold Chiari malformation – cerebellar ectopia
	Achondroplasia, osteogenesis imperfecta
	Rheumatoid arthritis—odontoid peg compression
	Trauma
	Vascular
▸ Disorders of the spinal cord	
	Acute epidural compression due to neoplasm or infection
	Acute transverse myelitis
	Cord infarction
	Other myelopathies (including traumatic)
	Tetanus
▸ Autonomic	Multi system atrophy
▸ Extrapyramidal	Status dystonicus

Table 2: Peripheral causes of ventilatory insufficiency or failure which may require admission to NICU.

▸ Anterior horn cell	Motor neurone disease
	Poliomyelitis or post-polio syndromes
	Rabies
▸ Multiple radiculopathies	Carcinomatous meningitis
	AIDS polyradiculitis
▸ Polyneuropathy	Acute inflammatory demyelinating polyneuropathy (AIDP)
	Acute motor and sensory axonal neuropathy (AMSAN)
	Acute motor axonal neuropathy (AMAN)
	Critical illness polyneuropathy

	Other polyneuropathies:
	Hereditary motor-sensory
	Acute porphyria
	Organophosphate poisoning
	Herpes zoster/varicella
	Neuralgic amyotrophy
▸ Neuromuscular transmission defects	Myasthenia gravis
	Lambert-Eaton myasthenic syndrome
	Neuromuscular blocking agents
	Other: Botulism
	Toxins
	Hypermagnesaemia
	Organophosphate poisoning
▸ Muscle	Dystrophy—Duchenne, Becker, limb girdle, Emery Dryfuss
	Inflammatory
	Myotonic dystrophy
	Metabolic:
	Acid maltase deficiency
	Mitochondrial myopathies
	Myopathies associated with neuromuscular blocking agents and steroids
	Acute quadriplegic myopathy
	Myopathy and sepsis
	Cachectic myopathy
	HIV related myopathy
	Sarcoid myopathy
	Hypokalaemic myopathy
	Rhabdomyolysis
	Periodic paralysis

Treatment and Follow-up

The data were prospectively recorded on admission:

A. History of hypertension or diabetes mellitus, previous stroke, atrial fibrillation, or coronary artery disease.

B. Clinical data clinical assessment and resuscitation included non-neurological assessment and neurological assessment with GCS (GCS scores <10 were defined as coma).

The principles of non-neurological assessment and resuscitation from acute stroke are similar regardless of the underlying cause and include:

- Airway management—tracheal intubation is indicated when there is:
- Impaired level of consciousness (for example, Glasgow coma score < 9)
- Progressive respiratory impairment or respiratory failure
- Impaired cough and airway clearance
- Pulmonary oedema/aspiration.
- Intubation may also be required before diagnostic or therapeutic procedures such as magnetic resonance imaging (MRI) or thrombolysis
- Maintenance of adequate arterial blood pressure/cerebral perfusion pressure

- Intravenous fluid management
- Temperature control
- Control of seizures
- Institution of enteral nutrition
- ICP management
- Medical treatment of complications (for example, sepsis)

Medical treatment; included osmotic agents (THAM or tromethamine), hyperventilation, and pulse therapy with thiopental to control acute increases of intracranial pressure. Rehabilitation was started within the first 24 hours after admission. Patients were treated according to standardized treatment protocols. Patients with symptoms of acute ischemic stroke of <6 hours in duration received systemic thrombolysis following an open institutional protocol. Intravenous heparin was given to all patients with acute ischemic stroke unless contraindicated.22

Surgical treatment: Other management related to the underlying cause (for example, evacuation of haematoma, clipping and coiling of intracerebral aneurysms). Patients with large supratentorial or infratentorial hemorrhages and clinical and electrophysiological evidence of brain-stem dysfunction underwent surgical evacuation or decompressive craniectomy. An external ventricular drainage was placed in patients with secondary hydrocephalus due to intraventricular bleeding or SAH. Decompressive craniectomy was performed in some patients with complete infarction of the middle cerebral artery territory and risk of transtentorial herniation and in patients with large cerebellar infarction and signs of brain-stem compression.21

Neurological Assessment in the ICU: 20

1. Assess mental status/higher function:

A. Conscious patient:

1) Talk to patient and ask questions that avoid yes/no answers if possible.

•Evaluate orientation, attention, coherence, comprehension, memory/recall

•Screen for delirium

•Identify symptoms such as headache, nausea or visual problems

2) Determine Glasgow Coma Scale (GCS)

B. Altered patient:

1) Assess for response to:

a) Normal voice

b) Loud voice

c) Light touch

d) Central pain Differentiate between higher function of “awareness” (e.g., purposeful movement, recognition of family) versus arousability (grimacing to pain only).(chart of sensary assessment).

2) Determine Glasgow Coma Scale (GCS)

2. Consider whether seizures could be present

Look for evidence of seizures (non-convulsive seizures should be considered in patients with unexplained decrease in level of consciousness or failure to awaken, especially after TBI or stroke).

3. Test Cranial Nerves and brainstem testing

In rapid neurologic examination, pupil assessment is the primary CN examination. Loss of reactivity to direct and consensual light with pupillary dilation suggests compression of CN III (top of brainstem). Fixed and pinpoint pupils suggests lower brainstem dysfunction in the area of the pons.

4. Assess motor function (look for asymmetry) Table3 ,Table4 .

Evaluate movement in conscious and sedative patient in response to command, with and without resistance if possible. Observe spontaneous movement or response to pain if unable to obey.

5. Assess sensory function (look for asymmetry) " look at chart sensary assessment".

Test response to pin and light tough; patient must be able to obey; important part of spinal cord testing for at risk patients (trauma with uncleared C Spine, ASCI, thoracic aneurysm).

6. Assess cerebellar function

Patient must be able to obey; cerebellum responsible for ipsilateral coordination of movement.Tests of rapid alternating movement can be performed in ICU. Examples:

1) examiner holds finger up and asks patient to touch his/her own nose, then the examiner’s finger.

2) Have patient touch each finger tip to thumb tip in succession.

Table3:23

Motor Scoring Scale	
5	Able to overcome strong resistance (normal strength)
4	Able to overcome mild resistance (mild weakness)
3	Supports limb against gravity but not resistance
2	Moves but not against gravity
1	Muscle flicker but no movement
0	No muscle movement
/5	Score

Chart .Sensory Assessment/Spinal Cord Testing 23 Test sensation twice, once for pin and once for light touch . Use a wisp of tissue for light touch and blunt end needle for pain/pin. Record the highest level of sensation using the dermatome chart below.

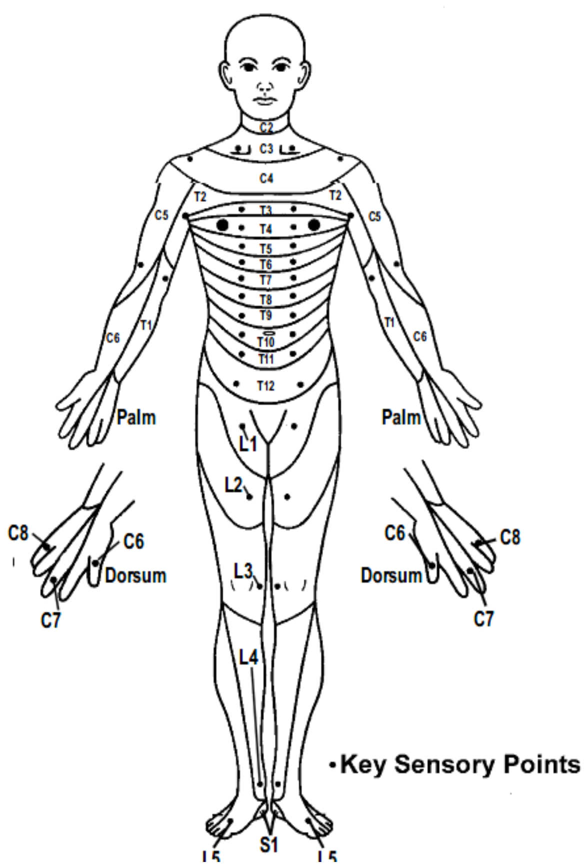

Table 4: Sedation Assessment 23.

VAMASSVentilator Adjusted: Motor Assessment Scoring Scale (if not ventilated, determineMASS only)			
MASSScore	Description of MASS	VA Score	Description of VA
0	Unresponsive to pain	A	Minimal coughing; few alarms;tolerates movement
1	Opens eyes and/or moves to pain only	B	Coughing, frequent alarms when stimulated; settles with voice or removal of stimulus
2	Opens eyes and/or moves to voice	C	Distressed,frequent coughing or alarms; high RR with normal/ low PaCO2
3	Calm and cooperative	D	Unable to control ventilation; difficulty delivering volumes; prolonged coughing
4		Restless but cooperative; follows commands	
5		Agitated; attempts to get out of bed; may stop behaviour when requested but reverts back	
6		Dangerously agitated; pulling at tubes or lines, thrashing about; does not obey commands	

Table 5: Age and GCS Scores on Admission and Survival at 1 Year According to Stroke Subtypes in 124 Ventilated Patients.

	Survival at 1 Year	GCS, Mean		Age, y		Patients	
%	n		SD	Mean	%	n	Stroke Subtype
31.0	26	10.3	13.3	61.5	67.7	84	Ischemic
42.5	17	12.1	15.0	56.4	32.3	40	Carotid
20.5	9	8.7	9.5	66.1	35.4	44	Vertebrobasilar
37.5	15	9.7	12.0	61.3	32.3	40	Hemorrhagic
							Parenchymal
18.2	2	10.6	11.5	63.9	8.9	11	Supratentorial
16.7	1	6.5	7.8	61.9	4.8	6	Infratentorial
46.2	6	9.8	9.0	63.2	10.5	13	With ventricular bleeding
60.0	6	10.4	17.2	56.0	8.1	10	SAH

RESULTS:

Analysis was made of 124 consecutive stroke patients :

•Ninety-two patients (74.2%) were intubated because of clinical deterioration,

57 (46.0%) for neurological reasons (coma, severe brain-stem dysfunction, loss of brain-stem reflexes)

35 (28.2%) for respiratory failure (aspiration, pulmonary embolism, or pneumonia).

The remaining 32 patients (25.8%) were intubated electively for angiographic procedure or surgery (aneurysm clipping, hematoma evacuation, ventricular drainage, decompressive surgery), or angiographic procedures.

•Thrombolytic therapy was given to 24 patients (19.4%), including 9 patients with carotid territory infarction and 15 patients with vertebrobasilar territory infarction.

• Surgical procedures were performed in 44 patients (35.5%).

1. Twenty-three patients underwent decompressive craniectomy because of space-occupying infarction and brain-stem compression (14 patients with hemispheric infarction and 9 patients with cerebellar infarction).

2. External ventricular drainage was performed in 13 patients with spontaneous hemorrhage.

3. Surgical hematoma evacuation was performed in 6 patients with supratentorial parenchymal hemorrhage. In 10 patients with SAH, four-vessel angiography showed an intracranial aneurysm in only 3. One patient with basilar artery aneurysm was not a candidate for surgical therapy.

4.Aneurysm clipping was performed in the remaining 2 patients.

•Fifty-six patients (45.1%) received neither thrombolytic therapy nor surgery and were managed according to the general institutional guidelines described in “Subjects and Methods.”

Table 6: Mean Survival Time 24 (was defined as the interval from admission to death) According to Indication for Intubation in 83 Ventilated Patients With Stroke Deceased at 1 Year After Admission.

Cause of Intubation	n	Mean Survival Time, d
Elective	15	21.3
Coma	42	15.9
Acute respiratory failure	26	9.7
Total	83	15.0

Causes of death were classified clinically as neurological (brain death due to herniation), nonneurological (eg, cardiac, pulmonary embolism, sepsis), and undetermined.

Table 7: Cause of Deaths in 83 Ventilated Patients With Stroke Deceased at 1 Year According to Subgroup of Stroke and Indication for Intubation.

		Subtype of Stroke, n (%)				Indication for Intubation, n (%)	
		Ischemic		Hemorrhagic		Elective	Coma/Acute Respiratory Failure
Cause of Death	All, n (%)	Carotid	Vertebrobasilar	Parenchymal	SAH		
Neurological	66 (79.5)	18 (78.3)	29 (82.9)	16 (76.2)	3 (75.0)	13 (86.6)	53 (77.9)
Nonneurological	6 (7.2)	1 (4.3)	2 (5.7)	2 (9.5)	1 (25.0)	1 (6.7)	5 (7.4)
Undetermined	11 (13.3)	4 (17.4)	4 (11.4)	3 (14.3)	0	1 (6.7)	10 (14.7)
Total	83 (100.0)	23 (100.0)	35 (100.0)	21 (100.0)	4 (100.0)	15 (100.0)	

Factors Influencing 2-Month Survival :The 2-month fatality rate was significantly influenced by the following eight variables through univariate analysis (Table 8): age >65 years, atrial fibrillation, bilateral absence of pupillary light reflex, bilateral absence of corneal reflex, bilateral Babinski's sign, infra-tentorial stroke, GCS score <10, and intubation because of coma or acute respiratory failure.

Table 8: Univariate Association of Initial Factors and Risk of Death at 2 Months After Admission in 124 Ventilated Patients With Stroke.

Factor	n	%
Male sex	52	41.9
Age >65 y	40	32.3
Diabetes	14	11.3
Hypertension	34	27.4
Atrial fibrillation	20	16.1
Previous stroke	8	6.5
Anisocoria	20	16.1
Unilateral absence of pupillary light reflex	5	4.0
Bilateral absence of pupillary light reflex	20	16.1
Unilateral absence of corneal reflex	18	14.5
Bilateral absence of corneal reflex	16	12.9
Unilateral Babinski's sign	32	25.8
Bilateral Babinski's sign	20	16.1
Ischemic stroke (0, hemorrhagic; 1, ischemic)	56	45.2
Infratentorial stroke (0, supratentorial; 1, infratentorial)	40	32.3
GCS score <10	37	29.8
Indication for intubation (0, elective; 1, coma/acute respiratory failure)	66	53.2

Multiple logistic regression was performed for 17 factors; the following three were found to be independent predictors of death at 2 months:
(1)Age >65 years
(2)GCS <10
(3)Intubation because of coma or acute respiratory failure

DISCUSSION:

The accurate prediction of survival is important for the appropriate management of patients with stroke and has major consequences for the organization of medical resources. Many studies have tried to determine factors that influence prognosis, but few have looked for predictors of death in patients with severe stroke. Most of these studies concluded that the fatality rate of patients with stroke who are comatose on admission is very high and that intensive care treatment does not affect prognosis to any great extent. Therefore, we studied the 1-year fatality rate of 124 patients with severe stroke admitted to our NICU who required mechanical ventilation. Additionally, we defined the relationship of several independent variables and the risk of death at 2 months. In general, early death has been shown to be higher in patients with hemorrhagic stroke than in those with ischemic stroke. In our patients, the type of stroke did not influence survival, probably because severe ischemic strokes were over represented. Despite successful thrombolytic therapy in some patients with ischemic stroke, infratentorial stroke was significantly associated with death in the univariate analysis. This difference disappeared after multivariate analysis and is attributable to the lower GCS score on admission in the group of patients with infratentorial stroke. In the final model derived by multiple logistic regression, only three variables were found to be independent predictors of death at 2 months: age >65 years, GCS score on admission <10, and need for intubation because of coma or acute respiratory failure. Age >65 years was also independently associated with death at 2 months. Several other studies, including general population-based studies of stroke have also found older patients with stroke to have a poorer prognosis, not only those mechanically ventilated.GCS scores of <10 had the greatest predictive value and the highest odds ratio. Indeed, loss of consciousness is the most recognized prognostic determinant of death in acute stroke and is directly related to the severity of the neurological damage. Additional effects of specific therapy may have also favorably influenced the clinical course in our patients, as suggested by several studies of novel treatment modalities for well-defined stroke types.Unfortunately, statistical analysis of the influence of specific treatments was not feasible in this study because treatments differed considerably in patients with ischemic and hemorrhagic stroke. Moreover, additional analyses of subgroups would have compromised statistical validity. Symptomatic management of stroke will be even more important in the future as new therapies are being developed. Mechanical ventilation should be considered as an additional measure to control intracranial hypertension in severe stroke. Moreover, other ancillary therapies such as barbiturates can only be given to ventilated patients in ICUs.Overall prognosis of ventilated patients with severe stroke is better than previously reported but in our study shows that most ventilated patients with stroke still die within the first few weeks after admission. Most surviving patients (59.5%), however, have only slight or no long-term disability.

CONCLUSION:

1. Most ventilated patients with stroke still die within the first few weeks after admission.We conclude that intubation and mechanical ventilation of severe stroke patients should be performed in a timely manner, before irreversible damage occurs.
2.Older patients comatose on admission who need to be intubated and requiring mechanical ventilation have very poor prognosis .
3.Fatality rate in our patients was high, but one third were still alive at 1 year after admission.Patients with severe stroke, most of them died within the first 2 to 3 weeks. This indicates that baseline variables probably have a direct influence on early death; therefore, for prognostic factor analysis, we included death at 2 months as an outcome variable.
4.Patients with primary neurological diseases in NICU such as stroke have a better outcome than those patients with secondary neurological disease seen on general ICUs.
5. Patients electively intubated in our study had a better prognosis independent from other factors, including age and GCS score.The probability of death at 2 months was more than 2.5 times greater in patients who were intubated because of neurological or respiratory deterioration than in those electively intubated for angiography or surgical intervention.
6. In our patients, the type of stroke did not influence survival, probably because severe ischemic strokes were over represented.

Recommendations:

1. We believe that neurological intensive care treatment of patients with stroke will help to reduce the fatality rate in the future. If mechanical ventilation is valuable in optimizing treatment, as well as preventing further deterioration, then intubation should be performed in a timely manner, before irreversible damage occurs. Other lifesaving measures should also be started early after the patient is stabilized and before first signs of brain-stem damage occur.

2. Mechanical ventilation should be considered as an additional measure to control intracranial hypertension in severe stroke patients.

3.Not all stroke sufferers can be admitted to a specialist ICU and the level of care will depend on the availability of local stroke units and the condition and prognosis of the patient.

4.Older patients comatose on admission who need to be intubated because of neurological or respiratory deterioration and requiring mechanical ventilation have very poor prognosis. However, such patients remain dependent on ICU support for very much longer periods of time useless.

Selected Abbreviations and Acronyms

DSA	=	digital subtraction angiography
GCS	=	Glasgow Coma Scale
NICU	=	(neurological) intensive care unit
SAH	=	subarachnoid hemorrhage
SD		standard deviation

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