

Mechanical ventilation in stroke: outcome and prognostic factors

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Abstract: In deciding whether to start, continue and terminate the mechanical ventilation. In ischemic cerebral-vascular accidents, due to the very serious prognosis, this disease is still considered to be an important clinical problem. Stroked patients under the mechanically ventilation, create a complex medical, ethical, economic, and medical examining problems for health care systems, health care teams and their relatives because of the very poor inherent prognosis of the disease and lack of definition of the prognostic factors. Determining the reasons of using mechanical ventilation, factors contributing in prognosis of mechanical ventilation and the outcome of ventilator contributing in stroke patients are among the primary objectives of this study. This work is a prospective descriptive study. We studied 55 patients who were hospitalized because of ischemic cerebral stroke between the years 2007 to 2011 in the neurological intensive care unit of Imam Khomeini and Imam Reza Hospitals of Tabriz city. They were subjected to the mechanical ventilation from the first days of hospitalization. For every patient, the disease risk factors, lesion location identified in the CT scan and, causes of mechanical ventilation, and the relationship of prognosis with sex, age, risk factors, ischemia location and causes of mechanical ventilation has been examined. Observations showed that, from 55 patients studied, 39 patients (70.9 %) have died. 9 patients (16.4 %) survived and were removed from the ventilator, and 7 patients (12.7 %) found chronic dependence to the mechanical ventilation. Among the factors that we have guessed to be associated with the prognosis of the disease, the presence or absence of risk factors related to the underlying disease (high age 82%, hypertension 65%, history of previous cerebral stroke 29%, diabetes 21%, atrial fibrillation 21%, smoking 16%, high blood fats 10%) were the only factors who had significant relationship with the prognosis of this disease. Sex, cerebral lesion location and the reasons of undergoing to mechanical ventilation were not significantly associated with the prognosis of the disease. Despite the high mortality (70%) and chronic dependence to ventilator (16%) in patients with acute ischemic cerebral stroke and respiratory failure, the use of mechanical ventilation still plays a major role in treating these patients. Planning to control the risk factors of this disease can play a major role in the treatment of this poor prognosis.

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1. Introduction

Stroke is a syndrome that will be detected by starting acute neurological symptoms in at least 24 hours. Neurological symptoms happen due to involvement of the central nervous system as a result of impaired blood flow to the brain (Garcia J., 1988).

In the clinical course of stroke, sometimes, neurological dysfunction disrupts the respiratory system which is more life-threatening than primary ischemic brain lesions. These secondary life-threatening lesions have very broad range and include serious complications such as neurogenic pulmonary edema, autonomic nervous system dysfunction; lung's ventilation movements' apraxia, hypothyroidism and hyperthyroidism syndromes, and chronic complications such as unilateral diaphragm paralysis and chronic diseases are neuro myopathy (Chambers B, Norris J, Shurvell B, 1987).

The first report on the outcome of mechanical ventilation in stroke began between 1976 and 1994 at Mayo clinic of Saint Mary hospital on 24 patients

with ischemic stroke. The results of this study, which was published in 1997, suggested that the prognosis of such patients is very frustrating and there is life expectancy and removing from ventilator when the indication of mechanical ventilation is seizures or cardiogenic pulmonary edema (Wijdicks E, Scott J., 1997). Later, various studies have been conducted by Berrouschot and Fanshawe et al. in different countries. The common point of the results of these studies only indicates the bad poor prognosis and high mortality (more than 80%) of these patients (Fanshawe M, Venkatesh B, Boots R., 2002; Berrouschot j, Rossler a, Koster J, Schneider D., 2000).

The authors' main motivation is the fact that, the advances in the intensive care units and neurological diseases have resulted in survival of patients who have, previously, died in the early stages of their diseases while, in the present era, most of the patients, despite severe and irreversible brain damage are kept alive through mechanical ventilation in the

neurological intensive care units. Under such circumstances, after period of time, many of relatives of the patients, while questioning about the fate of the patients want to decide about continuing mechanical ventilation. These patients, in addition to creating frustration for medical care teams, create intricate complex medical, ethical, economic, and medical examining problems for medical team and their families. In the all of the above-mentioned studies, in spite of very frustrating prognosis of patients with ischemic stroke, but it has been stressed that, the general principles of clinical decision about hospitalization location, the duration of mechanical ventilation, and the decision to discontinue the mechanical ventilation should be identified for doctors, patients, and their relatives (Needham d., 2004; Suarez J., 2004).

Due to the limitations and high costs of acute intensive care units in our country, and the need to develop chronic intensive care units authors suggest that, examining the prognosis of indications and outcomes of mechanical ventilation of these patients has considerable importance for both involved doctors and the relatives of patients.

The objectives of this study are investigate the following

- Common indications of mechanical ventilation in stroke patients
- Prognosis of mechanical ventilation in these patients
- Factors affecting the prognosis

2. Material and Methods

We studied 55 patients who were hospitalized because of ischemic cerebral stroke between the years 2007 to 2011 in the neurological intensive care unit of Imam Khomeini and Imam Reza Hospitals of Tabriz city. They were subjected to the mechanical ventilation from the first days of hospitalization. There was no age limit for selecting patients. All patients with a history of chronic obstructive pulmonary disease, congenital heart disease, and heart valve disease were excluded from the study. The authors had no role in the treatment course of the patients and all patients were within the normal course of treatment.

The outcomes of patients were identified as the following:

1. Dead
2. Live and removed from the ventilator
3. Chronic dependence to ventilator (mechanical ventilation for more than three weeks) (Laurent Brochard, Arnaud W. Thille, 2009; J-M, J. Bion, A Connors, 2007)

For all patients, according to their histories and clinical examinations, their diseases and common risk

factors of ischemic diseases of stroke have been identified.

Hypertension, diabetes, hyperlipidemia, AF rhythm, history of smoking, addiction to injection drugs, history of CVA, and the age more than 60 years were our risk factors in data collection.

All patients have been subjected to brain CT scans in the within the first our od admission to the emergency unit and according to the findings of CT scan, the patients were divided into the following 4 categories in terms of the location of ischemia.

1. Those with right hemisphere ischemia
2. Those with left hemisphere ischemia
3. Those with ischemia in both hemispheres
4. Those with no lesion report in the CT scan

Prognosis on any of the above cases is stated and compared separately.

After obtaining the initial data mentioned above (gender, age, CVA risk factors, ischemia location in CT scan, indication of mechanical ventilation of patients), their relationship with prognosis and outcome for each patient were evaluated.

The data obtained in this study were analyzed using SPSS software, version 15, descriptive statistics and Chi-square. Significance level, P value, has been considered less than 0.05.

3. Results

In this study, 55 patients have been studied. 30 patients (55%) were female and 25 patients (45%) were male. The average age was 70 years old. The minimum and maximum ages were 26 and 96 years old with 11.97% of standard deviation.

In this study, there was no significant relationship between gender, age and prognostic of disease ($P \leq 0.098$ and $P \leq 0.355$, respectively).

Indications of mechanical ventilation in patients, in the order of frequency, were as the following: respiratory distress syndrome in 24 patients (43%), pneumonia aspiration in 8 patients (14%), apnea in 8 patients (14%), tachypnea in 8 patients (14%), severe Cheyne–Stokes respiration in 5 patients (9%), and respiratory fatigue in 2 patients (3%). Observations showed that, there is no significant relationship between the indications of mechanical ventilation and the outcome of mechanical ventilation (average $p \leq 0.492$).

Frequency of risk factors for high age, hypertension, previous stroke, atrial fibrillation, diabetes, smoking, and high blood fat were 81%, 65%, 29%, 21%, 21%, 16% and 9%, respectively.

It should be noted that, in most cases, the patients had multiple risk factors simultaneously. For example, from the 36 people with high blood pressure, 33 patients had other risk factors such as diabetes and

so on. Among the 55 patients, there was no one without any risk factor.

The presence or absence of risk factors was the only case that had significant relationship with the outcome of artificial ventilation ($P \leq 0.033$).

The last objective of this study was to determine the prognosis of mechanical ventilation in patients with ischemic stroke based on the CT scan results.

CT scan results are presented in Table 1.

Table 1: Hemisphere involvement and outcome of patients

Ischemic hemisphere	Number of patients	Died	Ventilator-dependent	Removed from ventilator
Right hemisphere	18 (32.7%)	4 (22.2%)	10 (55.5%)	4 (22.2%)
left hemisphere	23 (41.8%)	18 (78.2%)	1 (4.3%)	4 (17.3%)
both hemispheres	7 (12.7%)	6 (85.7%)	1 (14.3%)	0 (0%)
Normal scan	7 (12.7%)	5 (7.4%)	0 (0%)	2 (28.6%)

Statistical analysis showed that, there was no significant relationship between the ischemic location in terms of hemisphere of the brain or the involved arteries in the CT scan and outcome of patients ($p \leq 0.363$).

Mechanical ventilation and intensive care units are among the essential units of medical cares including patients with ischemic stroke.

Although, in recent years, the number of patients who were undergoing mechanical ventilation has increased day by day, but the outcome of mechanical ventilation on survival rate of patients and the economic impact of mechanical ventilation have not been thoroughly studied.

During the past 10 years, many studies have been conducted in order to investigate the effects of mechanical ventilation in patients admitted to intensive care units on their survival rate, hospitalization duration, the economic burden of hospitalization in ICU for families, and the views of friends and relatives about services of intensive care units (Needham d., 2004; Suarez J., 2004; and Borel C, Guy J., 1995).

Studies conducted between 1990 and 2005 on intensive care units and the use of mechanical ventilation in these units indicated that, in the last decade, the use of mechanical ventilation and hospitalization duration in intensive care units are increasing and this increase has been associated with improved survival of patients (Borel C, Guy J., 1995; Brochard L, Esteban A, Anzueto A, 2004).

In this work, we have studied 55 patients, 30 of whom were female and 25 were male and the average age was 70 years, while in the Mayo Clinic study, 24 patients were studied, 13 males and 11 females, and the average age of patients was 68 years. In the study of Berrouschot in Germany, 52 patients with the average age of 62 years were investigated and the study of Fanshawe and colleagues at University Hospital in Australia between 1994 and 1999 has

investigated 23 patients with the average age of 53 years. Moreover, the studies of Wijdicks and Brochard have investigated 49 and 124 patients, respectively (Wijdicks E, Scott J., 1997; Fanshawe M, Venkatesh B, Boots R., 2002; Berrouschot j, Rossler a, Koster J, Schneider D., 2000; Borel C, Guy J., 1995; Wijdicks E, Rabinstein A., 2004).

In our study, like other studies, there was no significant relationship between sex and mortality ($P \leq 0.355$) or age and mortality ($P \leq 0.098$).

In our study, there was no limitation in sampling in terms of age, but the study of Berrouschot and colleagues investigated patients who were in the age range of 18 to 85 years old. Moreover, we have considered the age more than 60 years as a risk factor for ischemic stroke. Mortality rate in our study and studies of Mayo Clinic, wijdicks, and Brochard were 70.9%, 71%, 88%, and 52% respectively (Wijdicks E, Rabinstein A., 2005; Berrouschot j, Rossler a, Koster J, Schneider D., 2000, Wijdicks E, Scott J., 1997; Fanshawe M, Venkatesh B, Boots R., 2002).

In comparison, mortality rate in our study is similar to the other studies and even lower than some developed countries. Determining the mortality rate, in our study, was based on hospital mortality and not post-discharge mortality. While in the study of Fanshawe and colleagues, patients were followed up for three months after discharge. Mortality rates in ICU, the ordinary medical care section, and within 3 months after discharge were 36%, 47% and 52%, respectively. In the study of Berrouschot and colleagues, in Australia, they followed up mortality for 3 months after discharge where, 42 patients out of 52 patients (81%) have died (Suarez J., 2004; J-M, J. Bion, A Connors, 2007).

In our research and similar studies, there was no significant relationship between mortality rate and ischemic area on the CT scan ($P \leq 0.363$).

In this study, the most common indication for mechanical ventilation was acute respiratory distress

syndrome (43.6%) followed by pneumonia aspiration, apnea, Cheyne–Stokes respiration, and neurogenic hyper-ventilation. Pulmonary edema, cerebral edema, and tonic-clonic seizures, respectively, were the most common indications for mechanical ventilation in the Mayo Clinic study. In this study the prognosis of patients with a seizure indication was better than other patients so that, from the seven patients who had successfully removed from ventilator, 4 patients were merely intubated because of seizures (67% survival) (Wijdicks E, Rabinstein A., 2005). In our study, no patient was under mechanical ventilation due to seizures which indicates the broad prophylactic treatment of seizures in patients of this center.

The indications that Berrouschot et al. were considered were similar to ours. In 47 patients out of 52 patients (90%), the impaired consciousness was the main reason of mechanical ventilation (5). Similarly, in the study of Australian University Hospital, impaired consciousness and inability to maintain airway and pneumonia aspiration was the main reason of mechanical ventilation (Fanshawe M, Venkatesh B, Boots R., 2002). However, in our work, as well as most of studies, there is no significant relationship between mortality rate and the indications of mechanical ventilation.

In the investigation of patients, in terms of, risk factors for ischemic stroke, high blood pressure, diabetes, high cholesterol, smoking, the age over 60 years, cardiovascular problems, and intravenous drug abuse were considered as risk factors, where, there were significant relationship between risk factors and the mortality rate like the Mayo Clinic study. The risk factors of the study of Fanshawe et al. were similar to ours (Wijdicks E, Rabinstein A., 2005, Fanshawe M, Venkatesh B, Boots R., 2002).

In the study of Berrouschot, the most common cause of death was midbrain herniation as a result of completely blocking of cerebral artery. Patients who were left alive have a relatively good survival rate (Berrouschot j, Rossler a, Koster J, Schneider D., 2000).

The limitations of this study were the lack of thrombolytic therapy, Hemi craniotomy to treat cerebral edema, brain CT scan at the onset of respiratory failure and its serial control, and not-determining the mortality rate and patients' quality of life after discharge.

4. Discussions

The mortality rate of patients with cerebral ischemia who require mechanical ventilation can be

very serious. Presence of cerebrovascular disease risk factors such as diabetes, hypertension, hyperlipidemia, high age, smoking, and AF rhythm are the only cases which had significant relationship with the outcome of stroke patients under mechanical ventilation. Although mechanical ventilation, alone, will not improve the outcome of the disease, but still is one of the main treatments. The use of modern treatments such as hemi craniotomy and thrombolytic agents should be thoroughly investigated in the treatment of these patients in order to be used in the case of improving the survival rate.

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