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The effect of surgery in patients of brain injury with pneumonia complications on the recovery rate at the central referral hospital in eastern Indonesia: non-experimental study

Running title: Non-experimental studies of the effects of surgery in traumatic brain injury with complications of pneumonia on the recovery rate

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The effect of surgery in patients of brain injury with pneumonia complications on the recovery rate at the central referral hospital in eastern Indonesia: non-experimental study

Abstract*---*Background: *Traumatic brain injury is caused by a sudden collision from the outside of brain and eventually causes brain dysfunction. One complication in brain injury is found in 5-13% of patients with traumatic brain injury.*

Aim: *This study aimed to investigate the outcomes for patients by observing the profile of brain injury patients who have pneumonia in a central referral hospital in eastern Indonesia*

Method: *This study was conducted with a descriptive approach. This study observed personal data, causes of brain injury, diagnosis, treatment, and outcome of the patients after receiving treatment. The samples were 27 patients and used purposive sampling technique.*

Results: *The results showed 27 patients (24 males and 3 females) with age ranges from 41 years to 60 years (48.15%). The most common cause of traumatic brain injury found was a traffic accident (81.48%). Most diagnoses referred to Glasgow Coma Scale were a severe brain injury (70.07%) and the Surgical treatment that performed were craniotomy (40.74%) and decompression (40.74%). Tracheostomy was performed in 10 patients (37.04%). The most common cause of pneumonia is Hospital Acquired Pneumonia (88.89%) with bacterial culture results are Pseudomonas aeruginosa (40.74%). Patients mostly stayed at hospital for between 11-30 days (70.37%) and 70.37% of them were death*

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Conclusion*: Patients with severe brain injury caused by traffic accidents who had pneumonia did not show a positive result. Giving surgical procedures, tracheostomy, hospitalization, and treatment were not able to reduce the mortality percentage of the patients due to severe brain injury with pneumonia complication.*

Keywords*---Traumatic brain injury, Pneumonia, traffic accidents, Tracheostomy, Hospital Acquired Pneumonia*

I. Introduction

Brain injury can involve the entire structure of the layer, starting from the layer of the scalp or the outermost layer, the skull, dura mater, brain vascular to the brain tissue itself, both in the form of closed or open wounds[1]. In the United States, the incidence of brain injury every year is estimated at 500,000 cases and 10% of patients died before reaching the hospital. 80% of patients who reach hospitals are classified as mild brain injuries, 10% patients of moderate brain injuries and the remaining 10% patients of severe brain injuries. More than 100,000 people suffer from various levels of disability due to brain injury each year in the United States[2].

In Indonesia, brain injury is the most common cause of death in trauma for about half of all accidents, given that the head is the most common part and is vulnerable to being involved in an accident[3]. The distribution of brain injury cases involves more in productive age groups of 15-44 years and dominated by men than women[4,5]. At the central referral hospitalat Surabaya city, the mortality rate for all severity of brain injuries ranged from 6-11%. This number is higher than the international standard literature, which ranges from 3-8%.

Pneumonia is the most common disease in nosocomial infections in hospital patients. The incidence of Hospital Acquired Pneumonia (HAP) in patients with injuries occurs more frequently due to impaired tissue integrity and weakened host defense mechanism so that it is easy to get infected[6]. Severe brain injury patients are more at risk of developing HAP (50%) than moderate brain injury patients (30%) due to the longer duration of hospitalization[7]. The mortality rate of severe brain injury patients is 30-50%, if it followed by complications of nosocomial infection, the number increases to 70%[8].

Because of the high mortality rate due to severe brain injury with complications of pneumonia, this study conducted an investigation into the profile of brain injury patients who have pneumonia complication. Although there have been many studies discussed this, the profile of brain injury patients in the central referral hospital in eastern Indonesia has not been widely observed. Thus, the purpose of this study was to investigate the profile of brain injury patients who have pneumonia complication to determine the outcome of treatment that received by the patients.

II. Methods

Data Collection of Subject and Diagnosis data of Patients with Brain Injury

This study was a descriptive study with a prospective design. This study collected a data of brain injury patients who had pneumonia in the Intensive Observation Room (ROI) and the Inpatient Installation of Regional General Hospital of Dr. Soetomo, Surabaya. The study was conducted in the period of January 2017 to September 2017. The patient's basic data was from the patient's medical record with a diagnosis of brain injury that had pneumonia complications. The patient's basic data which was the primary data in the study including information about the patient's age and the sex of the patient.

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In addition, data collection on the causes of brain injury was carried out in patients. Based on the results, a diagnosis of brain injury case was based on from the patient observation. Diagnosis of brain injury cases are grouped into three categories based on the Glasgow Coma Scale (GCS), namely mild, moderate, and severe brain injury.

Investigation of treatment that received by the patients and the outcome of the treatment

Based on the findings from the patients and diagnosing the category of brain injury, then the treatment of brain injury patients was carried out. In the treatment data received by the patients classified into two categories, namely surgical treatment of tracheostomy and non-tracheostomy surgical treatment. Based on the treatments received by the patients, data can be obtained regarding follow-up actions, period of hospitalization, and causes of pneumonia. Furthermore, observation of the results of bacterial culture in brain injury patients who had pneumonia and the outcome of empirical antibiotic administration. Descriptive data analysis was presented in the form of a table. Based on the results, it was known that the highest value of each observed variable.

III. Results

Subject data collection and Diagnosis data collection of patients with brain injury

This study was carried out at Dr. Soetomo hospital Surabaya, in brain injury patients who had pneumonia in the Intensive Observation Room (ROI) and Inpatient Installation of Regional Dr. Soetomo hospital, Surabaya. Dr. Soetomo Hospital Surabaya was selected because this is a national hospital and the central referral hospital in eastern Indonesia. At this hospital, there were 27 patients with complications of pneumonia in the period time of this study.Based on the results of data collection, the number of cases of brain injury with pneumonia complication which were in 7 patients (25.93%) of moderate brain injury stage and 20 patients (74.07%) of severe brain injury stage respectively. The total number of patients with brain injury with complications of pneumonia in the period January 2017 to September 2017 was dominated by male patients, with age of 24 years (88.89%).

Most brain injury patients with pneumonia complication were patients with age of 41 years and 60 years, as many as 13 people (48.15%). A total of 22 patients (81.48%) who suffered brain injuries with pneumonia complication were caused by traffic accidents. The results of data distribution of brain injury patients with pneumonia are presented in Table 1.

Table1: Demographic Results of Brain Injury Patients with Pneumonia in Dr. Soetomo Hospital Surabaya

Clinical Characteristics		Frequency	%
Severe brain injury		20	74.07
Age	<20 years	6	30
	21 years – 40 years	4	20
	41 years – 60 years	8	40

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	61 years – 80 years	2	10
Gender	Male	17	85
	Female	3	15
Causes of Brain Injury	Traffic accident	17	85
	Falling	3	15
Moderate brain injury		7	25.93
Age	<20 years	1	14.29
	21 years – 40 years	0	0
	41 years – 60 years	5	71.43
	61 years – 80 years	1	14.29
Sexs	Male	17	85
	Female	3	15
Causes of Brain Injury	Traffic accident	5	71.43
	Falling	2	28.57

Investigation of treatment received by the patients and the outcome of the treatment

Based on this study, treatments that performed by physicians in patients with brain injury with pneumonia complications at moderate brain injury stage of 5 patients (71.43%) were Non-Operative Management and in severe brain injury patients of 20% (4 people) who received ICP monitor Kocher and evaluation of Craniotomy SDH (sub dural hematoma) & ICH (Intra Cranial hematoma + Decompression with a percentage of 20% (4 people). From the 27 brain injury patients with pneumonia complications, there were 10 patients (37.04%) received Tracheostomy and 17 people (58.62%) without Tracheostomy treatment. The results of the treatment received by the patients with pneumonia complications showed in Table 2.

Table 2: Demographic data of Treatment received by Brain Injury Patients with Pneumonia in Dr. Soetomo hospital Surabaya

Treatment		**Frequency**	**%**
Acute brain injury		20	74.07
Surgical Procedures	Non-Operative Management	1	5
	Non operative management + Debridement	2	10
	ICP monitor Kocher	4	20

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	Craniotomy evacuation ICH + Decompression	1	5
	Craniotomy evacuation ICH + Decompression + Debridement	1	5
	Craniotomy evacuation SDH&ICH + Decompression	4	20
	Craniotomy evacuation SDH + Decompression	2	10
	Craniotomy evacuation EDH + Osteoplasty	1	5
	Craniotomy Evacuation EDH + Osteoplasty + ICP Monitor Kocher	1	5
	Burr hole drainage + Evacuation EDH&SDH + Duraplasty + Decompression	1	5
	Suboccipital Decompression + Evacuation of ICH Cerebellum	1	5
	Debridement + Craniotomy + Explore dura + Evacuation of ICH	1	5
Tracheostomy	Yes	9	
Causes of Pneumonia	HAP	17	85
	VAP	3	15
Duration of Hospitalization	< 10 days	1	5
	11 days – 30 days	15	75
	31 days – 60 days	4	20
Outcome	Good Recovery	3	15
	Vegetative Status	1	5
	Death	17	85
Moderate brain injury		7	25.93
Surgical Procedures	Non-Operative Management	5	71.43
	Craniotomy + decompression + evacuation ICH	1	14.29
	Burr hole Drainage	1	14.29
Tracheostomy	Yes	1	
Causes of Pneumonia	HAP	7	100
	VAP	0	0
Duration of hospitalization	< 10 days	0	0
	11 days – 30 days	6	85.71
	31 days – 60 days	1	14.29
Outcome	Good Recovery	2	28.57
	Severe Disability	3	42.86

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	Death	2	28.57

Based on the causes of pneumonia in brain injury patients, it is categorized into two types, namely Ventilator Associated Pneumonia (VAP) and Hospital Acquired Pneumonia (HAP). Based on research data, the cause of pneumonia that occurs in patients with brain injury was caused by HAP with a high percentage of 88.89%. In moderate brain injury patients with pneumonia complication were 7 patients (100%) and severe brain injury patients with pneumonia complication were 17 patients (85%) (Table 2).In both categories, moderate (85.71%) and severe (75%) brain injury patients with pneumonia complication, most patients undergo hospitalizations for 11 days to 30 days. However, the outcome of treatment in patients did not show positive results in severe brain injury patients. This can be seen from the results of patient outcomes, about 17 people from 20 people (85%) were died. But on the contrary, in cases of moderate brain injury, patients showed quite positive outcomes, where only 2 from 7 patients were died. Whereas in other patients showed good recovery (28.57%) and moderate disability (42.86%).

In this study, the results of bacterial culture in brain injury patients who had pneumonia showed that the bacteria *Pseudomonas aeruginosa* was the most infecting bacteria in patients of 40.74%. From the cumulative antibiogram results, antibiotics Ceftazidime and Cefoperazone-sulbactam can be used as empirical therapy for *A. baumannii*, *P. aeruginosa*, and *K. pneumonia*, not for *E. coli* ESBL and *M. catarrhalis*. Then, antibiotics Levofloxacin, Ciprofloxacin and Amikacin can be used as empirical therapy for *P. aeruginosa*, *E. coli* ESBL, and *K. pneumonia*, not for *A. baumannii* and *M. catarrhalis*. Then, Ceftriaxone and meropenem antibiotics are not recommended for empirical therapy for the five-gram negative microbial isolates. This is based on the results of bacterial culture and the level of antimicrobial sensitivity presented in Table 3.

Table 3: Results of Bacterial Patterns from sputum isolates in brain injury patients with pneumonia at Dr. Soetomo Hospital Surabaya and Antimicrobial Sensitivity Value

Bacterial Sensitivity	Bacterial culture results (% amount)						
	Pseudomonas aeruginosa (40.74%)	*Acinobacterb aumannii* (25.93%)	*Klebsiella pneumonia* (11.11%)	*MRSA* (3.70%)	*Staphylococ cus aureus* (11.11%)	*Escherichia coli (ESBL+)* (3.70%)	*Moraxella catarrhalis* (3.70%)
	Antimicrobial for Gram-negative bacteria						
Amikacin	92	33	67	-	-	100	-
Tobramycin	92	33	100	-	-	100	-
Gentamicin	92	33	67	-	-	100	-
Ampicillin-sulbactam	-	50	67	-	-	-	-
Ceftazidime	83	50	67	-	-	-	-
Ceftriaxone	-	33	-	-	-	-	-

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Cefoperazone-sulbactam	83	50	100	-	-	-	-
Cotrimoxazol	-	50	67	-	-	-	100
Tetracycline	17	33	67	-	-	-	-
Ciprofloxacin	92	33	67	-	-	100	-
Levofloxacin	67	33	67	-	-	100	-
Kanamycin	8	-	-	-	-	-	-
Aztreonam	75	-	67	-	-	-	-
Piperacillin tazobactam	83	-	100	-	-	100	-
Cefoperazone	8	-	-	-	-	-	-
Imipenem	38	-	-	-	-	-	-
Meropenem	38	-	-	-	-	-	-
Erythromycin	8	-	-	-	-	100	-
Chloramphenicol	8	-	100	-	-	-	-
Moxifloxacin	17	-	-	-	-	-	-
Amoxicillin-clavulanic acid	-	-	100	-	-	-	-
Cephazollin	-	-	100	-	-	-	-
			Antimicrobial for Gram-Positive				
Chloramphenicol	-	-	-	100	33	-	-
Erythromycin	-	-	-	100	100	-	-
Clindamycin	-	-	-	100	100	-	-
Daptomycin	-	-	-	100	-	-	-
Quinipristin-dalfopristin	-	-	-	100	67	-	-
Moxifloxacin	-	-	-	100	-	-	-
Vancomycin	-	-	-	100	-	-	-
Linezolid	-	-	-	100	33	-	-
Gentamycin	-	-	-	-	100	-	-
Ampicillin-sulbactam	-	-	-	-	100	-	-
Oxacillin	-	-	-	-	100	-	-

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Cotrimoxazol	-	-	-	-	67	-	-
Levofloxacin	-	-	-	-	100	-	-
Moxifloxacin	-	-	-	-	100	-	-
Meropenem	-	-	-	-	33	-	-

IV. Discussion

This study aimed to determine the profile of brain injury patients with pneumonia complications in a referral hospital in eastern Indonesia. Based on this results study where, the data used was from the patient's medical record, most of the causes of brain injury was traffic accidents, dominated by men aged 41 to 60 years. Many cases of brain injury are experienced by patients with an earlier age range, namely in the fifth decade to 65 years[2,9]. Age is an important factor in determining mortality and morbidity. In patients over the age of 60 years, the level of morbidity and mortality is higher due to functional impairment of balance, reflectivity, visual ability, and concentration in driving[5]. In brain injury patients, most common cause was traffic accidents that more common occurs in male patients. This is influenced by mobility and the work demands for male patients that are mostly done in outdoors[4,5,9]. In developing countries, the rate of brain injury due to traffic accidents is quite high, especially motorcycle riders[3,5,10].

A common surgical treatment for patients with brain injury and pneumonia complication is to reduce intracranial pressure in patients[11]. In this study, patients who received ICP monitor Kocher (20%) and Craniotomy evaluation SDH & ICH + Decompression (20%) was performed in some cases of severe brain injury. In addition, in 9 patients who had severe brain injury received a Tracheostomy. The use of tracheostomy in brain injury patients can increase the risk of higher HAP or VAP. In this study, the incidence of HAP occurred in patients who had severe and moderate brain injury. The incidence of HAP in injured patients occurs more frequently as a result of impaired tissue integrity and weakening of the host's defense mechanism so that it is easy to get infected[6]. Meanwhile these resluts were in accordance with previous study that stated severe brain injury patients are at higher risk of developing HAP (50%) than moderate brain injury patients (30%) due to the longer duration of hospitalization in severe brain injury patients[7]. Furthermore, based on this study, patients with brain injury cases were hospitalized in a period of 11 days to 30 days. The average hospitalization time for patients with brain injury patients is 22 days to 29 days, but patients with brain injury with complications of HAP infection are 19 days[6]. The duration of patient hospitalization or the length of stay of a patient is affected by the presence or absence of concomitant complications[12]. Postoperative care also contributes to determining the length of the patient hospitalizations time[12,13].

In patients with moderate brain injury, the most common bacteria were *Klebsiella pneumonia* (42.86%) due to the length of bed rest. *Klebsiella pneumonia* is a pathogenic bacterium, facultative gram-negative, anaerobic and able to carry out lactose fermentation. These bacteria can cause disease because they have two types of O antigen and K antigen. Both of antigens increase pathogenicity. In addition, this bacterium is able to produce Extended Spectrum Beta Lactamase (ESBL) enzymes which can reduce various types of antibiotics effectivity. This can cause bacteria to become resistant and difficult to eliminate. Nosocomial infections caused by these bacteria are considered opportunistic, not actual pathogens because these bacteria infected weak patients[14].

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Whereas in severe brain injury patients were most found *Pseudomonas aeruginosa* (45%) due to the bed rest time for more than one week and also the use of ventilators. In severe brain injury patients who experienced a decrease in consciousness have a low immune system so that these bacteria can easily infecting patients. In Brazil, the *Pseudomonas aeruginosa* study showed that this bacterium is the most common cause of HAP / VAP in brain injury patients[15].

Based on the medical record data, 70.37% of patients died, the mortality rate was quite high. The most moderate brain injury patients were with severe disability (42.86%) while 85% of severe brain injury patients died. When compared to the mortality of severe brain injury patients was 30-50%, if followed by nosocomial infection complications, the number increased to 70% [8]. To reduce mortality, an evaluation of how to treat the nosocomial infection patients can be done. In addition, intensive follow-up of postoperative patients is believed to reduce mortality and morbidity[16, 17].There were 27 bacterial isolates from brain injury patients who had pneumonia, 23 Gram negative (85.18%) and 4 Gram positive (14.82%). The most Gram-negative bacteria was *Pseudomonas aeruginosa*, which is 12 (52.17%). Gram positive bacteria of *Staphylococcus aureus* was found about 3 (75%). From the results of the cumulative antibiogram, antibiotics, Ceftazidime and Cefoperazone-sulbactam can be used as empirical therapy for *A. baumannii*, *P. aeruginosa*, and *K. pneumonia*, not for *E. coli* ESBL and *M. catarrhalis*. Then, antibiotics Levofloxacin, Ciprofloxacin and Amikacin can be used as empirical therapy for *P. aeruginosa*, *E. coli* ESBL, and *K. pneumonia*, not for *A. baumannii* and *M. catarrhalis*. Then, Ceftriaxone and meropenem antibiotics are not recommended for empirical therapy for the five Gram negative microbial isolates.

This study still had a limitation such as not conducting intensive research, this research was prospective. This caused many patients were out of reach by the researchers. In this study used only data based on health medical records of brain injury patients who have pneumonia. So that data was very limited, several variables such as the results of culture, sensitivity, antibiotics, and others were not recorded properly. However, this results study provided additional information that most brain injuries occured due to traffic accidents, most occured in men. Based on the results also obtained information that patients who experienced brain injury and get tracheotomy can cause a higher incidence of HAP. This results study can be useful for the community in an effort to decrease the incidence of brain injury cases with pneumonia complication by being more careful in driving. With this results study can improve the quality of medical treatment and motivate people to be more careful in driving which can lead to loss of life. In addition, the results of this study can also provide information to doctors, practitioners, health workers, and scientists, in an effort to improve the handling and quality of treatment provided by brain injury patients with pneumonia complication.

V. Conclusion

From these results study it can be concluded that 27 brain injury cases experienced by middle-aged men due to traffic accidents. Based on the diagnosis, severe brain injury received surgery procedure and tracheotomy was performed to patients. However, the tracheotomy has a higher risk of HAP in the severe brain injury case. Giving action and treatment to patients with severe brain injury did not resulted a positive effect, the number of patients died because severe brain injury was still quite high.

Conflict of interest statement

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All authors have no conflict of interest to declare

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