2021-06

Incidence and Predictors of Aspiration Pneumonia Among Traumatic Brain Injury Patients at Felegehiwot Comprehensive Specialized Hospital Bahirdar, North West Ethiopia, 2021. A Retrospective Longitudinal Study

Sahlu, Mitku

BAHIR DAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCE SCHOOL OF HEALTH SCINCE, DEPARTMENT OF ADULT HEALTH NURSING

INCIDENCE AND PREDICTORS OF ASPIRATION PNEUMONIA AMONG TRAUMATIC BRAIN INJURY PATIENTS AT FELEGEHIWOT COMPREHENSIVE SPECIALIZED HOSPITAL BAHIRDAR, NORTH WEST ETHIOPIA, 2021. A RETROSPECTIVE LONGITUDINAL STUDY

SAHLU MITKU (BSc. NURSE)

A THESIS SUBMITTED TO THE DEPARTMENT OF ADULT HEALTH NURSING, COLLEGE OF MEDICINE AND HEALTH SCIENCE IN PARTIAL FULFILLMENT OF THE REQUIREMENT TO DEGREE OF MASTERS IN ADULT HEALTH NURSING

JUNE, 2021

BAHIR DAR UNIVERSITY

INCIDENCE AND PREDICTORS OF ASPIRATION PNEUMONIA AMONG ADMITTED TRAUMATIC BRAIN INJURY PATIENTS AT FELEGEHIWOT COMPREHENSIVE SPECIALIZED HOSPITAL, FROM JANUARY 1, 2015 TO DECEMBER31, 2020, BAHIR DAR, NORTH WEST ETHIOPIA; A RETROSPECTIVE LONGITUDINAL STUDY, JUNE, 2021.

PRINCIPAL INVESTIGATOR

SAHLU MITKU (BSc. NURSE)

Email: sm092750@gmail.com

ADVISOR

EMIRU AYALEW (MSc. ASSISTANT PROFESSOR IN ADULT HEALTH NURSING)

Email: emiruayalew2010@gmail.com

GETASEW MULATU (MSC.IN EMERGENCY MEDICINE AND CRITICAL CARE NURSING)

Email: gechm2012@gmail.com

ACKNOWLEDGEMENTS

First I want to acknowledge Amhara regional health bureau for full educational sponsorship accesses.

Secondly I want to say thanks for Felegehiwot comprehensive specialized Hospital staffs for their support in providing all necessary information.

Next I would like to extend my sincere thanks to Mr. Emru Ayalew(MSc., assistant prof. in adult health nursing) and Mr. Getasew Mulatu(MSc.in emergency medicine and critical care nursing) for their grateful guidance and support to prepare this thesis.

Finally my heart felt gratitude will go to Abrham Tsedalu for his invaluable support.

ABSTRACT

Background: A significantly greater proportion of patients who died due to aspiration pneumonia were diagnosed with in-hospital aspiration pneumonia (19%), compared to those who were improved or died due to all other causes. Incidence and major predictors were not known clearly, especially in our country Ethiopia.

Objective: To determine incidence and predictors of aspiration pneumonia among adult traumatic brain injury patients at Felegehiwot comprehensive specialized hospital, Bahirdar, North west Ethiopia, 2021.

Methods: Institution based retrospective study was conducted from all adult traumatic brain injury patients who were admitted at Felegehiwot comprehensive specialized hospital in the past five years (January 1, 2015- December 31, 2020) for 51 days of survival. Descriptive statistics were used to describe patient characteristics. Kaplan-Meier survival curve and log-rank test were used to test for the presence of difference in survival among patients categorized differently with different characteristics. Cox proportional hazard regression model was used at 5% level of significance to determine the net effect of each explanatory variable on incidence of aspiration pneumonia after admission because of traumatic brain injury.

Result: A total of 396 patients aged >15 years diagnosed and admitted as traumatic brain injury in the past 5 years were included. Seventy patients (17.67%) were developed aspiration pneumonia providing incidence rate of 32.39(95% CI: 25-62-40.94) per1000 person days of observation. The overall median survival time could not be determined. The overall estimated survival rate was 77.68% (95% CI: 72.07-82.30) at 51 days of follow-up. Independent predictors in development of aspiration pneumonia for admission due to traumatic brain injury were being referral AHR (2.43; (95% CI: 1.12-5.25)), nasogastric tube insertion AHR (3.02; (95% CI: 1.43-6.39)) and baseline Glasgow comma scale <8 AHR (3.88; (95% CI: 1.42-10.062)).

Conclusion: Traumatic brain injury induced aspiration pneumonia in this study was an important health issue. Being referral, nasogastric tube insertion and low baseline Glasgow comma scale were significant predictors of incidence of aspiration pneumonia. It is better to improve prehospital and hospital care, first aid service and comma care during transportation and admission time. Prospective studies to cover limitations are recommended.

Key words: Aspiration pneumonia, Traumatic brain injury, Bahirdar, Ethiopia

Abbreviations

AP ---------- Aspiration Pneumonia

ARDS ---------- Acute Respiratory Distress Syndrome

CT ---------- Computed Tomography

CXR ---------- Chest X-Ray

FCSH ---------- Felegehiwot Comprehensive Specialized Hospital

GCS ---------- Glasgow Comma Scale

ICU ---------- Intensive Care Unit

IQR---------- Inter Quartile range

NGT ---------- Naso-Gastric Tube

TBI ---------- Traumatic Brain Injury

Table of Contents

Contents……..……page numbers

List of figures

List of tables

List of Appendixes

1. INTRODUCTION

1.1 Background

Aspiration is often the result of impaired swallowing, which allows oral or gastric contents, or both, to enter the lung, especially in patients who also have an ineffective cough reflex(1); when there is a decreased level of consciousness, compromised airway defense mechanisms, dysphagia, gastro esophageal reflux, and recurrent vomiting(2).

Decreased level of consciousness related injury severity indicators, might be Glasgow Coma Scale (GCS) scores and duration of post-traumatic amnesia; even if GCS is the usual determination(classification) method(3). Commonly severity of TBI was determined according to the GCS: mild (13-15 points), moderate (9-12 points) or severe (3-8 points)(4, 5).

Aspiration is a syndrome with variable respiratory manifestations that span acute, life-threatening illnesses, such as acute respiratory distress syndrome(ARDS), to chronic, sometimes insidious, respiratory disorders such as aspiration bronchiolitis(6).

Direct brain injury, depressed level of consciousness and inability to protect the airway, disruption of natural defense barriers, decreased mobility, and secondary pathophysiologic insults inherent to severe brain injury are the main cause of AP in critically-ill patients(7). AP has a clinical picture like tachycardia, hypotension, dyspnea, hypertension and central cyanosis(8).

Elevate head of bed, use sedatives sparingly, avoid bolus tube feedings, swallowing evaluation before oral feeding, and follow NGT feeding rules are some preventive measures(9).

early identification and risk management of dysphagia and aspiration pneumonia(AP) in TBI nursing home populations may maximize these individuals' quality and length of life(10).

Respiratory and cardiovascular complications were the most common early complications, with pneumonia incidence(40.6%)(11).

1.2 Statement of the Problem

Aspiration pneumonia is recognized as significant clinical problems for survivors of TBI; a significantly greater proportion of subjects who died due to AP were diagnosed with in-hospital aspiration pneumonia (19%), compared to those who were alive or died due to all other causes. Patients with AP also had a significantly larger proportion of subjects with longer rehabilitation length of stay and who were discharged to nursing homes(10).

The proportion of AP cases among patients with community-acquired pneumonia was 14.2%(12); and it represents 5% to 15% of pneumonias in the hospitalized population(8). The overall mortality related to extracranial organ dysfunction from TBI patients varied between 26 and 35%.

Pneumonia is one of the most common complications in severely injured patients, and it is supposed to represent a predisposing factor for the development of acute respiratory distress syndrome (ARDS) and multiple organ dysfunction(13).

Extracranial complications are common and influence the outcome from TBI; The role of extracranial pathology often has been underestimated in outcome assessment since most clinicians focus mainly on intracranial lesions and injury rather than consider the systemic effects of TBI(14).

In Ethiopia some studies were conducted following TBI patients for their complication and secondary diagnosis(not AP directly) in Addis Ababa and Jimma and found 3.5% and 12% prevalence of AP respectively(15, 16).

Mechanical ventilation is often necessary in the brain injured patient and respiratory failure which can be multi-etiological(17).

Prehospital airway management in severe TBI is attempts for prevention of AP in the brain injury field(18). Chin tuck for prevention of aspiration can reduce this AP by (19.6 %)(19).

AP is prevalent but infrequently studied complication following severe TBI(10), this least attention makes most health care professionals to overlook such extensive and fatal problem.

Basic problems are possibly lack of attention for extracranial complication; despite prevalent cause for morbidity and mortality from TBI, infrequently studied problems,

unknown usual time to occurrence of aspiration pneumonia and risk factors of AP on TBI patients and its preventive mechanism, absence of interventions necessary in the prehospital environment (in the scene area and at transportation). Generally Incidence and predictors for this extracranial complication is understudied and under prevented especially in Ethiopia, despite compromising such discrepancies and act upon it can provide better solution(15). TBI related AP can affect the victim and the community in many aspects including its economic crisis.

Therefore this study was aimed to assess usual time to occurrence of AP among TBI patients and risk factors for development of aspiration pneumonia.

It showed the importance of prehospital interventions in prevention of these extracranial complications, generally noticed the magnitude of the problem and importance of prevention of AP to reduce morbidity rate of TBI patients.

1.3 Significance of the Study

This study will be important for traumatic brain injury patients not to be victim of AP since health care professionals can intervene on possible risk factors and its worst results and gives information on importance of rapid health seeking behavior.

This study will be used for health care providers by giving some insight on prevention of this AP by identifying timing and risk factors for its development.

It also can notice health care providers the importance of early detection and treatment of AP to reduce extended morbidity and mortality status of TBI patients.

2. LITERATURE REVIEW

2.1 Incidence of aspiration pneumonia

A retrospective study conducted at Taiwan reveals; from patients with severe head injury admitted to the neurosurgical ICU 29.66% of patients develop pneumonia(20).

In the time to event context a study conducted in Taiwan reveals the duration for the development of pneumonia was 4.62 ± 3.21 days after admission(20).

A study conducted in India revealed that pneumonia(such as AP) generally presents around 5 to 7 days after TBI(11).

On the other hand a retrospective study conducted at Korea based on chest computed tomography(CT) there were 11.2% aspiration occurrence on chest CT(21).

In the study conducted in USA from patients admitted with TBI, 3.0% of them have developed AP during hospitalization(22).

In the study conducted in Utah, America 8.69% TBI patients develop AP (23).Where as in the study done at Columbia reveals AP represents 5% to 15% of pneumonias in the hospitalized population(8). Other prospective study conducted at California shows us; overall, 58 patients (25.4%) had witnessed aspiration events (24).

A cohort study done on patients with community-acquired pneumonia which is conducted at UK, 13.8% of the patients were considered to be at risk for aspiration, and this subgroup of patients had a higher 1-year mortality and increased risks of recurrent pneumonia and rehospitalization as compared with the rest of the study population(25). Evidences in Germany reveals in incidence of post-traumatic pneumonia poly‑ traumatized patients 19.9% of all patients developed pneumonia(13).

Evidence in Germany reveals that incidence of post‑ traumatic pneumonia in poly‑ traumatized patients poly trauma III(TBI only) the development of pneumonia covers around 14.8%(13).

Evidence from south African retrospective study on trauma patients admitdsfwt5hted to the ICU shows aspiration pneumonitis as the commonest extracranial complication(26).

A four-month prospective study of head injury patients at Jimma medical center, shows 12% of AP among head injury patients as a Secondary diagnosis(15).

In the same way a retrospective study conducted in Tikur Ambesa Specialized Hospital shows as 3.5% of them develops AP which is leading from other complications(16).

2.2 Predictors of Aspiration Pneumonia

2.2.1 Socio-Demographic Factors

Evidences in Korea(12), America(22), Utah(25), Taiwan(20), and one other study(27) reveals that older age has positively significant association with the development of AP among TBI patients.

Regarding to sex literatures conducted at Korea(12), America(22, 25), Taiwan(20), reports that being male has positively significant association for the development of AP on TBI patients.

Concerning on residence perspective Ethiopia and other low income countries patients face difficult timely arrival to health institutions, since most population live in rural areas.(15).

2.2.2 Clinical Factors

Evidences found in America(22), California(24), and Korea(21) reveals that low GCS or altered level of consciousness is determinant risk factor for development of AP in sever TBI patients. As GCS level gets lower there shouldn't have effective airway clearance, no adequate air way protection by epiglottis and there is insufficient gag and cough reflex(1, 28). Decreased level of consciousness associated with trauma, Intoxication or sedation from general anesthesia are risk factors for AP(9, 29). when there is a decreased level of consciousness, compromised airway defense mechanisms, dysphagia, gastro esophageal reflux, and recurrent vomiting will the result(2).

The study conducted as increased risk of pneumonia among ventilated patients with TBI reports that TBI patients who suffered blunt trauma, and/or had suffered a severe TBI were more likely to develop pneumonia(30). Besides this A study done at Turkey reports

the neck flexor muscular endurance of patients with damaged left hemisphere was better than patients with damaged right hemisphere for swallowing difficulty(31).

Evidences at Taiwan and America reveals that hemiplegia/hemiparesis has positively significant association with development of AP in TBI patients(20, 22).

A study done in Japan on risk factors for aspiration pneumonia among elderly subjects with deterioration of swallowing function had positively significant association with the incidence of AP(27).

In the other study conducted in Taiwan from patients with dysphagia incidence of AP was significant because of swallowing difficulty(32). Similarly a study in China done on nutritional status and AP compared to the enteral nutrition group, the complication occurrence rates of both enteral and parenteral nutrition group were significantly lower in aspirated pneumonia(33, 34).

In the other study conducted in Germany interprets poly-trauma related factors by identifying the role of TBI and chest trauma the strongest independent predictor of pneumonia in polytraumatized patients was the combination of chest injury and TBI, in-hospital mortality by TBI only was 25.3%; thus Pneumonia represented the strongest independent predictor of in-hospital mortality, followed by the combination of chest injury and TBI(13).

2.2.3 Institutional Factors

A study conducted in Utah reveals Patients with AP were more likely to be admitted to an ICU. Patients with AP had longer adjusted hospital lengths of stay and took more days to achieve clinical stability than patients with non-aspiration pneumonia(23).

A study conducted at Netherland reveals that minimum possible time of reaching to the hospital is determinant to prevent secondary brain injury and related problems(35).

In Ethiopia and other low income countries patients face long period in prehospital environment stayed without any attendance by health care provider, where secondary

brain injury and further complication e.g. aspiration are likely to occur worsens the condition of the patient(15).

Whereas evidence done in Korea on analysis of aspiration risk factors by chest CT in severe trauma patients no statistically significant differences in aspiration rate according to time of accident(21).

2.2.4 Intervention Related Factors

A study conducted in Taiwan shows that prophylactic use of antibiotics before and after emergency cranial surgery does not prevent pneumonia(20).

Similarly from evidence in Canada patients receiving prophylactic antimicrobial therapy were no less likely to require transfer to critical care and subsequently received more frequent escalation of antibiotic therapy and fewer antibiotic-free days(36).

The study conducted as Increased risk of pneumonia among ventilated patients with TBI reports TBI patients were more likely to develop pneumonia if they were on ventilation(30).

A study conducted in Taiwan and Japan shows that NGT were positively significant association with the development of pneumonia(20, 27).

Besides this a study in China done on nutritional status and AP compared to the enteral nutrition group, the complication occurrence rates of both enteral and parenteral nutrition group were significantly lower in aspirated pneumonia(33).

Evidence in San Diego reports the incidence of AP antipsychotic drug users was 0.3% in unexposed individuals and 1.2% in those with exposed(37). Similarly a study done at Japan reports, Impact of the number of aspiration risk factors patients with community-acquired pneumonia identified the important risk factors for AP as use of sleeping pills(38).

A study conducted in English reports as no specific antibacterial agent had evidence of superior efficacy. Broad-spectrum antibiotics resulted in the emergence of multi-resistant organisms(39).

Beside this a study conducted in Korea as effectiveness of chin tuck for prevention of aspiration; aspiration was reduced or eliminated in only (19.6 %) patients with chin tuck exercise(19).

Evidences in Singapore reveal that positive preventive effects of angiotensin converting enzyme inhibitors in reducing AP from patients with dysphagia problem(40).

Patients had improvement on measures of tongue pressure and reduced penetration aspiration after the completion of a 24 session tongue pressure resistance training programme(41).

2.3 Conceptual Frame Work

This frame work was developed from different literatures by extracting many variables from different studies (10, 13, 20, 21, 23), and arrows indicates significant associations of independent variables to development of outcome (AP) and relationship between some independent variables each other.

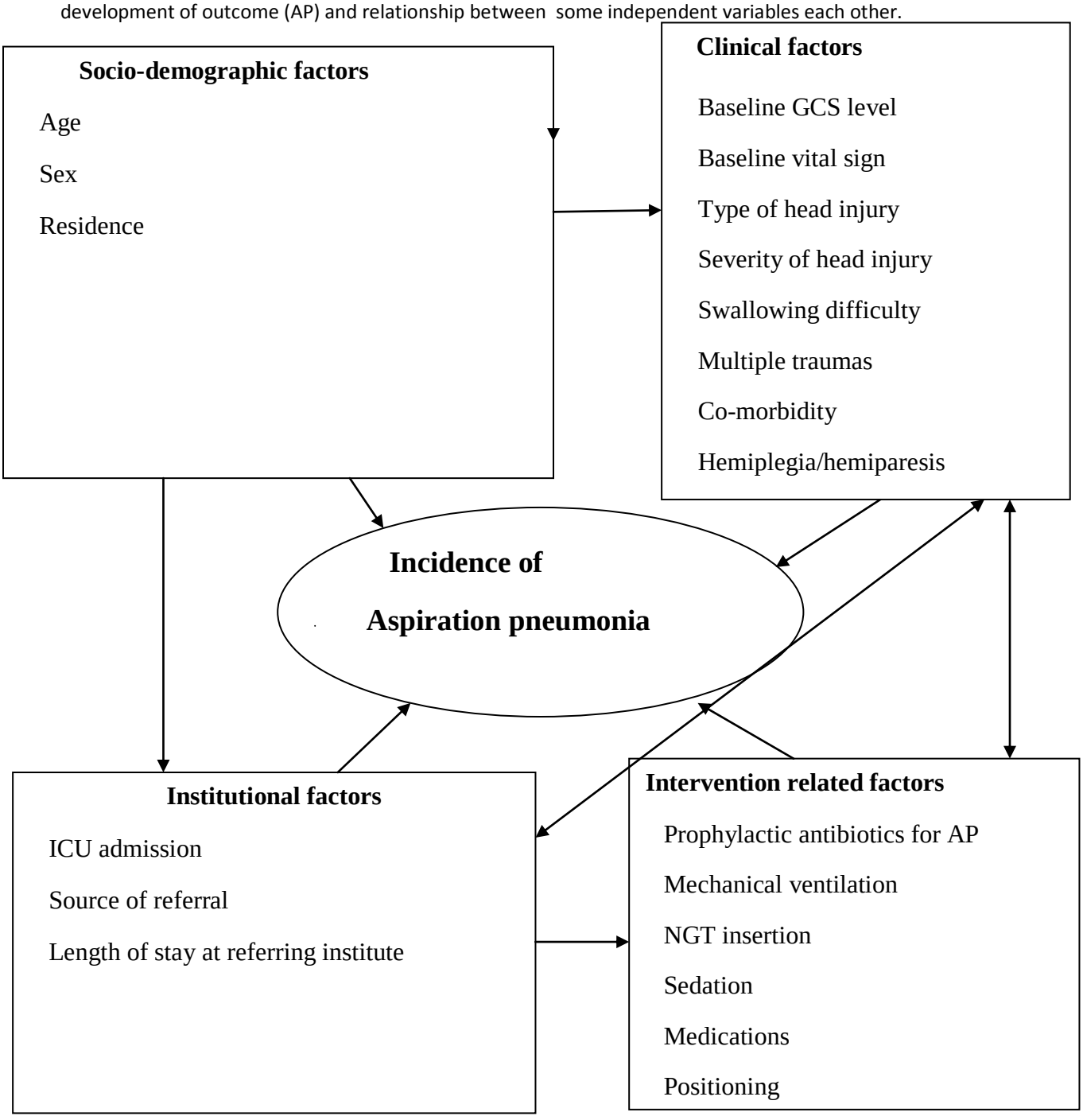

Figure 1; Conceptual frame work developed after different literatures were reviewed to show predictors of TBI related AP, 2021

3. OBJECTIVES OF THE STUDY

3.1 General objective

To assess incidence and predictors of aspiration pneumonia among adult traumatic brain injury patients at Felegehiwot comprehensive specialized hospital, Bahirdar, North west Ethiopia, 2021

3.2 Specific Objective

1. To determine incidence of aspiration pneumonia among adult traumatic brain injury patients
2. To identify predictors of aspiration pneumonia among adult traumatic brain injury patients

4. METHODS AND MATERIALS

4.1 Study area and period

This study was conducted at FCSH from admitted patients, found in Bahir Dar city (which is located at northwest Ethiopia), and it is 565 km away from Addis Ababa; from January 1, 2015 and December 31, 2020. Bahirdar has tourism areas like Abay river and lake Tana in the city and Tis-abay water fall in the round. FCSH serves for >5,000,000 people of the region and Bahirdar city. There are 4 governmental and 4 private hospitals in Bahirdar city. The surgical ward is equipped with 52 nurses, 11 general practitioners,6 surgeons 1 neurosurgeon and 100 beds; whereas in the ICU 28 nurses, 2 general practitioners, 12 beds(3 for the surgical side)(FCSH human resource).

4.2 Study Design

An institution based retrospective study was conducted at FCSH on adult TBI patients admitted at adult ICU and surgical ward.

4.3 Source and Study Population

4.3.1 Source population – All adult TBI patients who were admitted at FCSH due to diagnosis of TBI.

4.3.2 Study Population - All adult TBI patients from January 1, 2015 and December 31, 2020 at FCSH.

4.3.3 Study Unit - selected patients by computer generated simple random sampling technique.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

All TBI patients with aged ≥15(42, 43) admitted to FCSH ICU and surgical ward because of TBI from January 1, 2015 to December 31, 2020.

4.4.2 Exclusion Criteria

Adult TBI patients which have written diagnosis of AP before admission were excluded.

4.5 Study Variables

4.5.1 Dependent Variable

Incidence of Aspiration pneumonia in FCSH

4.5.2 Independent Variables

Socio-demographic factors	**Institutional factors**
Age	ICU admission
Sex	Source of referral
Residence	Length of stay at the referring institution
Clinical factors	**Intervention related factors**
GCS level	Prophylactic antibiotics for AP
Baseline vital signs	Mechanical ventilation
Type of head injury	NGT insertion
Severity of head injury	Sedation
Swallowing difficulty	Medications
Multiple traumas	positioning
Co-morbidity	
Hemiplegia/hemiparesis	

4.6 Operational Definition

Aspiration pneumonia was developed if there were written diagnosis of AP in the patient card after admission because of TBI.

Glasgow coma scale- is a scale used for assessing the neurological status of the patient and to classify head injury as mild TBI (13-15), moderate TBI (9-12) and severe TBI (less than or equal to 8)(5).

Censored; was defined as those TBI patients who were not develop the outcome of interest (AP) at the end of follow-up period, might be because of lost to follow-up, transfer to a different institution, against medical advice and death before AP at admission.

Event; was the occurrence of AP among TBI patients from admission to the end of the study at FCSH.

Time to event: - A time between admission and occurrence of AP.

Median survival time: -The time at which half the patients have suffered AP.

Index date and closing date to follow-up: the **index date** will be starting date for the calculation of survival and this was the first date of admission (January 1st 2015). **Closing date** will be the last date at which status of the patient on the follow-up(AP or censored) was determined(31st December 2020).

4.7 Sample Size Determination

The total sample size was determined via the double population proportion formula using epi-info version 7.2.0.1 software by assuming a one-to-one ratio of exposed to non-exposed, 95% level of confidence, and a power of 80%. Two literatures were used to extract variables that are significantly associated with development of AP and importantly linked with this study. Those were NGT, hemiplegia/hemiparesis, GCS, intubation and ventilation(20, 21).

The total sample size was determined using comparable literatures conducted at Korea on analysis of aspiration risk factors in severe trauma patients: based on findings of aspiration lung disease in chest CT. GCS decrement associated significantly with the occurrence of AP. Mild TBI was used as exposure group and moderate TBI was used as non-exposure (control group). Thus provided relatively large amount of sample size i.e. 374, and incomplete patient's charts and medical records that were not found during data collection were considered; 10% contingency was considered for each group and 37 TBI patient's charts were added to the initial sample. So the final sample size was 411 TBI patients chart (20)(table 1).

Table1 Sample Size Determination Calculated By Proportion of Variables from Previous Studies

Variables (reference)	Assumptions	Sample size	Total sample size
NGT(20)	P1=0.32, P2=0.07	92	101
Hemiplegia/paresis(20)	P1=0.41, P2=0.10	72	79
Ventilator(20)	P1=0.31, P2=0.12	166	182
Intubation(21)	P1=0.17, P2=0.03	170	187
GCS(21)	**P1=0.05, P2=0.14**	**374**	**411**

Where p1=proportion of exposed with outcome

P2= proportion of exposed without outcome

$Z_{@/2}$=taking 95% CI

Z_B=80% power,

R= is ratio of exposed to unexposed (1:1)

4.8 Sampling Technique and Procedure

The patient charts were selected by using computer generated random sampling technique from registration book of adult ICU, and surgical ward in FCSH.

This was carried out by using registration book of the past five years in adult ICU, and surgical ward, and selected by using medical registration number of these patients, then having cards through these medical record numbers at the card room.

4.9 Data Collection Tool and Procedure

4.91 Data Collection Tool and Period

The data was collected by using semi-structured data extraction checklist from March 16, 2021 to April 16, 2021.

The data extraction checklist had socio-demographic data related questions, clinical variables, pre-injury health related variables and intervention related questions were collected for all subjects in the sample from medical records.

4.9.2 Data Collection Procedure

The data was collected from selected cards by semi-structured data extraction checklist. Before cascading data collection two BSc. Nurses for data collection and one MSc. Nurse for supervision were recruited.

Two days training was provided for data collectors and a supervisor about the meaning of every item of questionnaire and the techniques of data collection.

4.10 Data Quality Control

Before the actual data collection pretest was conducted on 5% (21) of the sample size in FCSH, two weeks before the actual data collection. The pretest was analyzed and interpreted finally modification was done on data extraction tool (variables were adjusted by their access).

Quality of data was assured by training data collectors and supervisors, monitoring the data collection process and checking completeness of data during collection time.

4.11 Data Processing and Analysis Procedure

The collected data was verified, coded, entered by epi-data version 3.1 and exported to STATA version 14.2. The Kaplan-Meire survival curve was used to estimate the median survival time. Log rank test was used to compare survival curves between categorical variables. Cox-proportional hazard regression model was used to see the association of each independent variable with the dependent variable and Pair wise correlation tests was used to check the presence of multicolinearity between each independent variable. Bivariable Cox regression analysis was used to assess the degree of relationship within each predictor variable and TBI related AP.

Variables that have P-value of <0.25(44) with traumatic brain injury related aspiration pneumonia in the Bivariable Cox proportional hazards regression model and had no multicolinearity were entered to the multivariable Cox-proportional hazards regression analysis model. The measure of necessary assumptions of Cox proportional hazard model was checked using Schoenfeld residuals test. Cox Snell residuals test was used to assess overall model fitness.

P-value of less than 0.05 at 95% confidence interval was taken as a cutoff point to declare statistically significant association between predictors and post traumatic AP.

The results of study were presented using text, table and figure.

4.12 Ethical Considerations

Primarily ethical clearance was obtained from ethical review board of Bahirdar University, college of medicine and health science. Permission letter was given to FCSH before data collection. Supporting letter was obtained from FCSH quality office. Data was only used for the purpose of study not for other purposes.

5. RESULT

5.1 Socio-Demographic Characteristics of the Study Participants

There were 1450 TBI patients listed in the registration book of ICU(378) and surgical ward(1072) between January 1, 2015 and December 31, 2020 in FHCSH. Four hundred eleven (411) patient charts were selected by computer generated simple random sampling technique, and three hundred ninety six (396) were eligible and 15 patient charts were ineligible among selected patient charts. From these 396 patient charts 326(82.32%) were censored and 70(17.68%) were developed AP. The median age of patients at the time of admission was 29 years (IQR 22-39). Most 367(92.68%) of TBI and 66 (94.2%) of posttraumatic AP were in the age group of 15-54years. Most 288(72.73%) came from rural area; and 56(80%) of the posttraumatic AP were from this groups, which could show rural residency is much more affected than the urban one (table 2).

Table 2: Socio-Demographic Characteristics of TBI Patients at FCSH Bahirdar, Ethiopia, From January1, 2015 to December 31, 2020

Variables	**category**	**vital status**		**total no.(%)**
		Censored	AP	
		Number (%)	Number (%)	
Gender	Male	269(83.2)	54(16.7)	323(81.56)
	Female	57(78.08)	16(21.91)	73(18.43)
Age	15-54	301(82.01)	66(17.98)	367(92.67)
	55-64	15(88.23)	2(11.76)	17(4.29)
	65-74	10 (83.33)	2(16.66)	12(3.03)
Residence	Urban	94(87.03)	14(12.96)	108(27.27)
	Rural	232(80.55)	56(19.44)	288(72.72)

5.2 Institutional Characteristics of Study Participant

Concerning on their system of transfer to FCSH 290(73.2%) of patients were referred from other health institutions; and 86% of posttraumatic AP were from such groups which is higher as compared to directly admitted TBI patients. The median time for

duration of presentation to FCSH was 8 hours(IQR 4-24) and their duration of presentation to FCSH revealed that most 281(71%) of patients were arrived within 18 hours after injury; 80% of patients who developed AP were in this group. (Table 3)

5.3 Clinical Characteristics of Study Participant

The median baseline GCS level is 9(IQR 6-13). Fifty three (75.7%) patients with AP were originated from GCS level within 3-8; which were measured at the time of admission to FCSH. Similarly some patients with GCS level of >8 at base line might deteriorate and had the level <8 which in turn results AP. (Table 3)

5.4 Intervention Related Characteristics of Study Participant

Two hundred twelve (53.54%) TBI patients and 61(87.1%) posttraumatic AP had NGT (inserted for feeding and medication instillation purpose); which has much higher incidence of AP than that of patients without NGT. (Table 3)

Table 3: Institutional, Clinical and Intervention Related Characteristics Study Participants

Variables	category	vital status		total no.(%)
		Censored	AP	
		Number (%)	Number (%)	
		Institutional factors		
System of transfer	Directly admitted	96 (90.56)	10(9.43)	106(26.76)
to FCSH	Referred	230(79.31)	60(20.68)	290(73.23)
ICU	Yes	68(66.66)	34(33.33)	102(25.75)
admission	No	258(87.75)	36(12.24)	294(74.24)
Duration of	0.5-3.5	73(83.9)	14(16.09)	87(21.96)
Presentation	4-7.5	80(83.33)	16(16.66)	96(24.24)
at FCSH	8-18.5	72(73.46)	26(26.53)	98(24.74)
	19-360	101(87.82)	14(12.17)	115(29.04)

Table 3(con…)

Variables	category	vital status		total no.(%)
		Censored	AP	
		Number (%)	Number (%)	
		Clinical factors		
GCS level	3-8	111(67.68)	53(32.31)	164(41.41)
	9-12	93(88.57)	12(11.42)	105(26.51)
	13-15	122(96.06)	5(3.93)	127(32.07)
Head injury	Blunt	70(71.42)	28(28.57)	98(24.74)
Type	Penetrating	256(85.9)	42(14.09)	298(75.25)
Head injury	mild	101(96.19)	4(3.8)	105(26.51)
Severity	moderate	113(88.97)	14(11.02)	127(32.07)
	Sever	112(68.29)	52(31.7)	164(41.41)
Hemiplegia or	Yes	49(87.5)	7(12.5)	56(14.14)
Hemiparesis	No	277(81.47)	63(18.52)	340(85.85)
Respiratory	16-24	218(89.3)	26(10.65)	244(61.61)
Rate(baseline)	>25	108(71.05)	44(28.94)	152(38.38)
Pulse rate	<60	22(88)	3(12)	25(6.31)
(Baseline)	60-100	254(84.38)	47(15.61)	301(76.01)
	>100	50(71.42)	20(28.57)	70(17.67)
Temperature	<36	35(92.1)	3(7.89)	38(9.59)
(Baseline)	36-38	276(82.38)	59(17.61)	335(84.59)
	>38	15(65.21)	8(34.78)	23(5.8)
		Intervention	related	Factors
NGT insertion	Yes	151(71.22)	61(28.77)	212(53.53)
	No	175(95.1)	9(4.89)	184(46.46)
Mechanical	Yes	49(69.01)	22(30.98)	71(17.92)
Ventilation	No	277(85.23)	48(14.76)	325(82.07)
Sedation	Yes	48(64)	27(36)	75(18.93)
	No	278(86.6)	43(13.39)	321(81.06)
Positioning	Yes	222(83.14)	45(16.85)	267(67.42)
	No	104(80.62)	25(19.37)	129(32.57)

5.5 Survival Status of TBI Patients to Develop AP

The overall incidence rate of AP in the cohort during the 2161 person days of observation (PDO) was 32.39 per 1000(95%CI:-25.62-40) person days of follow-up. Three hundred twenty six(82.3%) patients were censored until the end of the study period. Among censored patients 223(68.4%) of patients were improved and discharged to home, 77(23.61%) were died, 7(2.1%) were referred to the other institutions, and 19(5.8%) of them were left against medical advice before development of the outcome (AP).

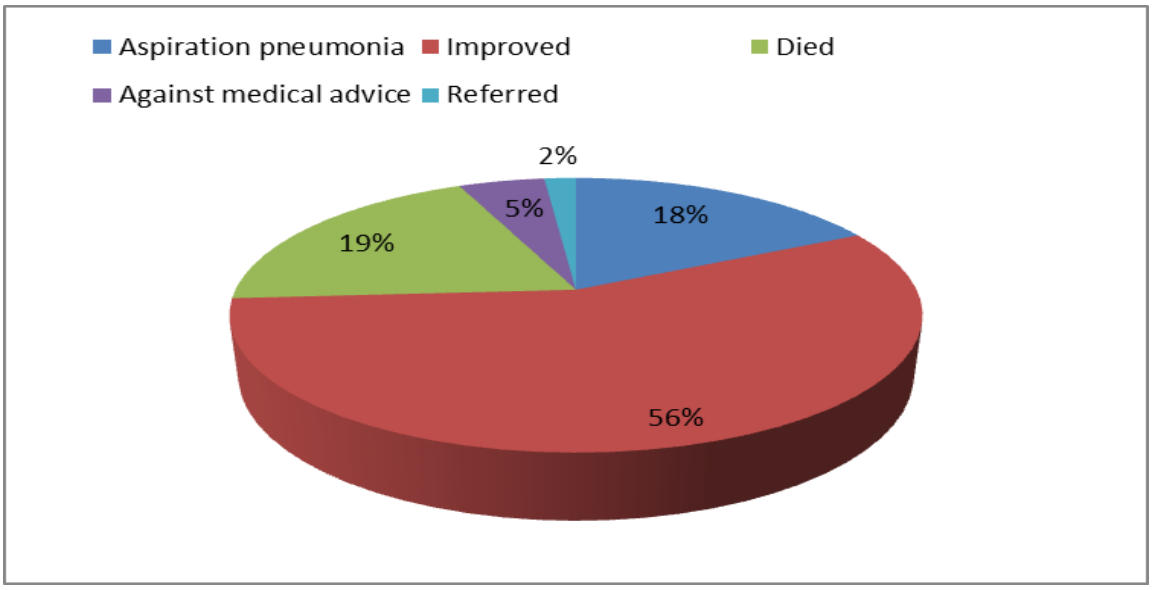

Figure 2: The Proportion of Traumatic Brain Injury Patient Outcome in FCSH admitted patients, Bahirdar Ethiopia January 1, 2015-December31, 2020

5.6 Overall Incidence of AP in TBI Patients

Three hundred ninety six TBI patients were followed for a total of 2161 days. Kaplan Meier survival estimation showed that cumulative survival probability after admitted to FCSH was 77.68% (95% CI: 72.07-82.3) at 2161 days of follow-up. The estimated cumulative survival probability was 93.18% (95% CI:90.21-95.27) in the first 24 hours follow-up time, 87.75% (95% CI:83.97-90.69) in the next 48 hours, 83.08% (95% CI:78.70-86.64) in the next 72 hours, 78.84% (95% CI:73.74-83.05) after the first week of follow-up and 77.68% (95% CI:72.07-82.30) at the 8^{th} day and for the rest entire period.

The probability of having event free days decrease as the follow-up time increases. In this study the highest rate of AP were occurred in the first week after TBI related admission.

5.7 Incidence of AP among Different Groups of TBI Patients

Equality of survival curves were tested by log-rank test for the presence of any significant differences in survival time among various levels of categorical variables. This study shows some significant difference among survival functions of different categorical variables. The Kaplan-Meier analysis indicated significant evidence of differences in survival times. i.e. the mean incidence rate of AP for referral patients was lower than those who were directly admitted; which is statistically significant at a p-value of 0.0114. The mean incidence rate of AP for sedation was lower than patients without sedation; which is statistically significant at a p-value of <0.01; which reveals sedation shortens time for occurrence of AP. Concerning on NGT insertion, the mean incidence rate of AP for patients with NGT was higher than without; that is statistically significant at a p-value of <0.01. The mean incidence rate of AP for patients with blunt TBI is shorter than penetrating type of TBI; which is significantly associated at 0.0026. This indicates being a victim for blunt TBI shortens the time to occurrence of AP as compared to penetrating type of TBI. As baseline GCS level decrease cumulative survival times get shorter and shorter; this is significantly associated as p-value <0.01. (Table 4) and (figure 4-6).

Table 4 Survival Time, Cumulative Survival Probability and Log-Rank Test in 51 Days of Follow-Up (Kaplan-Meier Method) Of TBI Patients at FCSH

		Survival time, in days		
Covariates	**Category**	**Mean (95%: CI)**	**Overall, 51 days survival (%)**	**Log-rank test (P-value)**
System of Transfer to FCSH	Directly admitted	43.6(39.68-47.51)	86.36	0.0114
	Referred	38.61(35.66-41.57)	74.41	
Mechanical Ventilation	Yes	31.03(24.57-37.49)	60.04	0.0004
	No	41.98(39.41-44.56)	81.31	
Sedation	Yes	31.54(25.73-37.36)	59.91	0.0000
	No	33.53(31.58-35.48)	82.63	
Nasogastric Tube	Yes	34.62(31.1-38.13)	66.15	0.0000
	No	26.53(25.59-27.47)	94.40	

Table 4(con…)

Covariates	Categories	Mean(95%: CI)	Overall survival days (%)	Log rank test p-value
ICU	Yes	31.3(25.92-36.68)	59.24	0.0000
Admission	No	41.23(39.12- 43.33)	85.17	
Head injury	Blunt	35.89(31.12-40.65)	69.18	0.0026
Type	Penetrating	40.86(38.09-43.63)	80.53	
Head injury	Mild	23.61(20.73-26.48)	87.85	0.0000
Severity	Moderate	29.94(27.91-31.98)	87.19	
	Sever	32.17(27.98-36.37)	61.34	
Respiratory	16-24	43.69(40.74- 46.64)	84.64	0.0000
Rate	>25	33.31(29.4-37.21)	66.50	
Pulse rate	<60	14.06(12.01-16.1)	86.05	0.0302
	60-100	27.71(25.97-29.46)	79.86	
	>100	34.41(28.31-40.52)	65.92	
Temperature	<36	21.5(17.42-25.57)	81.59	0.0212
	36-38	40.65(38.21-43.09)	78.72	
	>38	12.74(8.38-17.11)	56.03	
GCS level	<8	31.82(27.61-36.02)	60.54	0.0000
	9-12	30.01(27.89-32.13)	87.56	
	13-15	24.06(22.02-26.10)	90.49	

NB: - P-value<0.05 indicates significant difference with in groups.

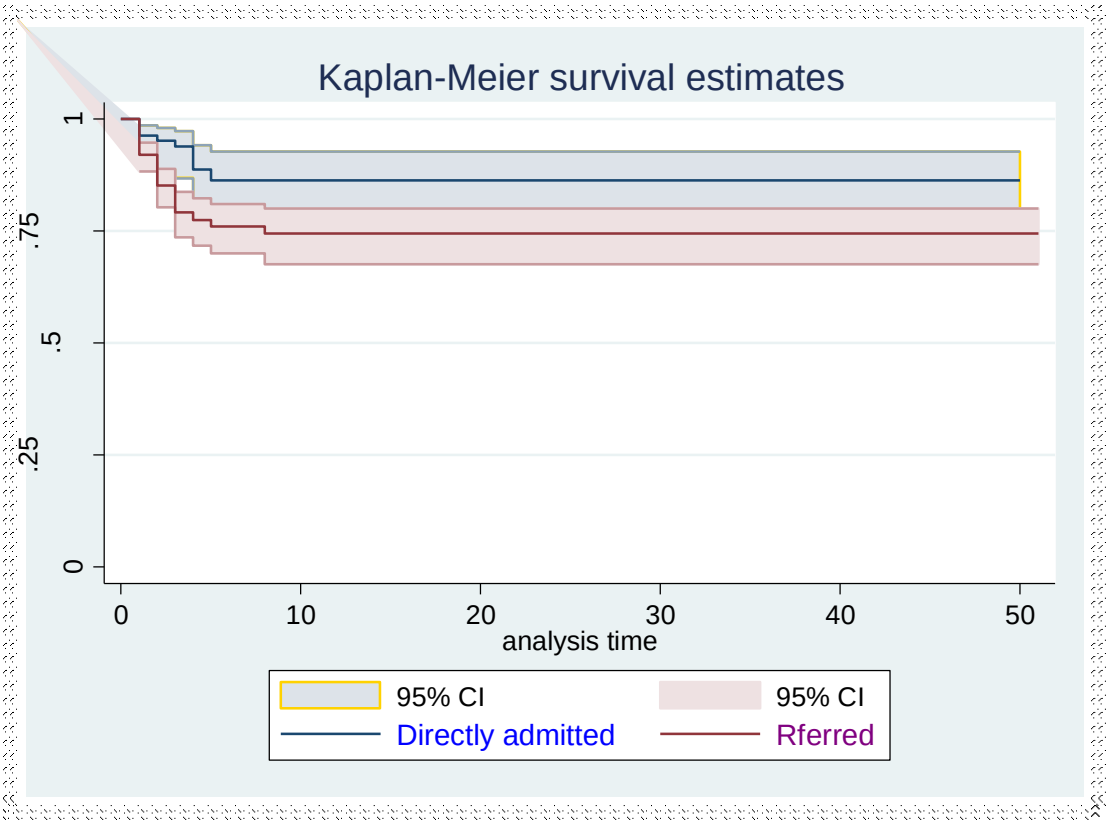

Figure 3- The Kaplan-Meier Survival Curves Comparing Incidence Of AP On Directly Admitted Versus Referral Patients In FCSH, Bahirdar Ethiopia From January 1, 2015 To December 31, 2020.

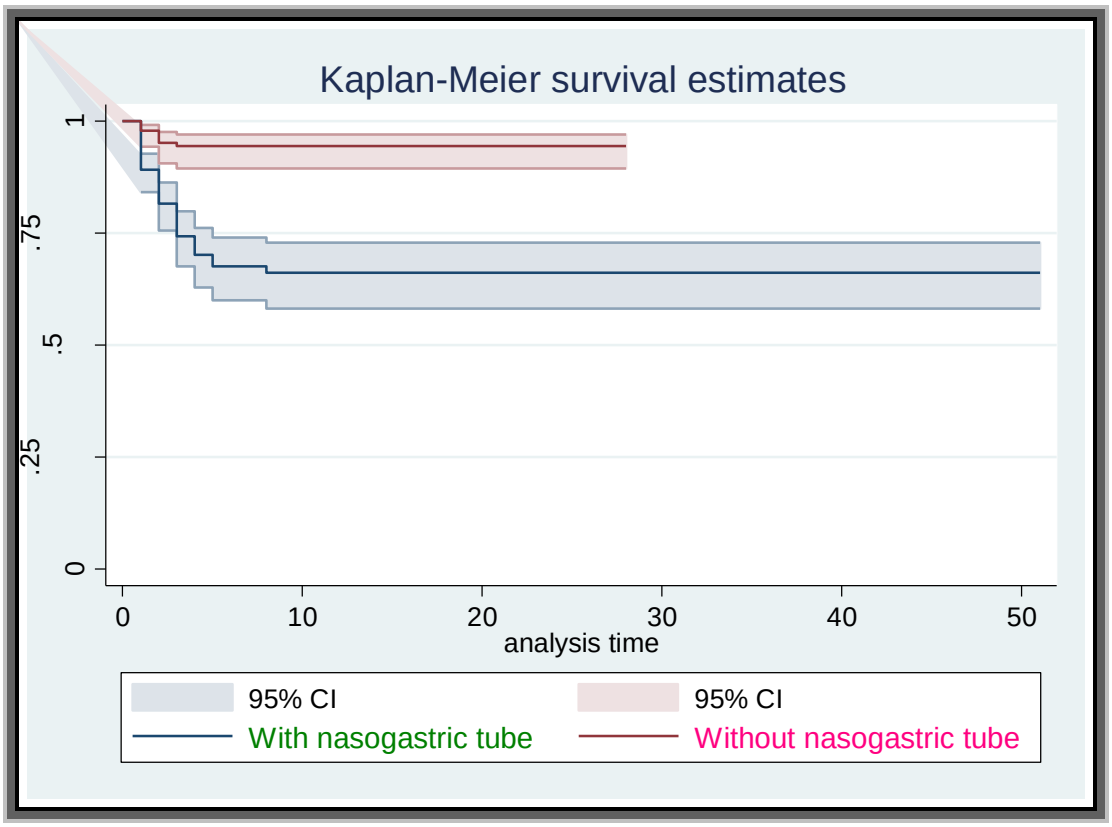

Figure 4- The Kaplan-Meier Survival Curves Comparing Incidence Of AP On Patients With Nasogastric Tube Versus Without NGT In FCSH, Bahirdar Ethiopia From January 1, 2015 To December 31, 2020.

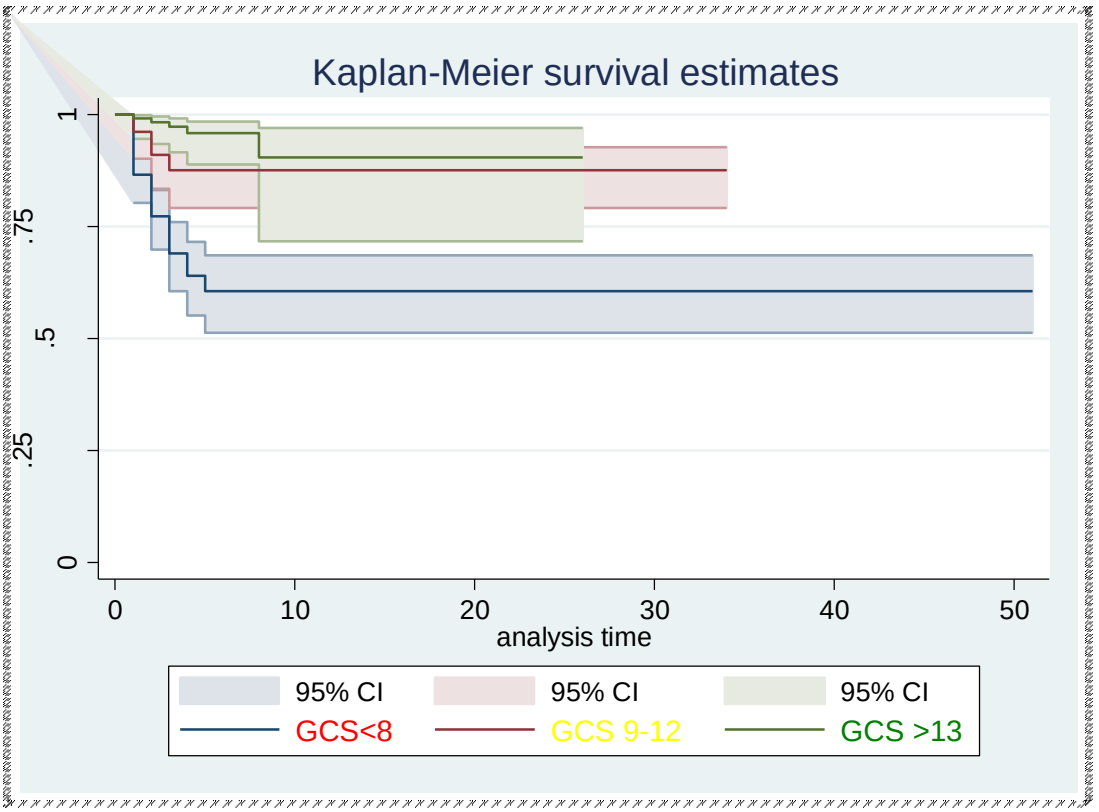

Figure 5- The Kaplan-Meier Survival Curves Comparing Incidence Of AP On Patients With Three Categories Of Baseline GCS Level In FCSH, Bahirdar Ethiopia From January 1, 2015 To December 31, 2020.

5.8 Predictors of Aspiration Pneumonia

In Bivariable cox proportional hazard regression model; system of transfer to FCSH, residence, duration of presentation, mechanical ventilation use, sedation status, NGT insertion, head injury type, GCS level and vital signs like pulse rate, respiratory rate, temperature were fulfilled the criteria to be analyzed in multivariable cox regression analysis; which have p-value of <0.25(44) in Bivariable analysis and non collinear independent variables(based on pair wise correlation test). In multivariable cox proportional hazard model, three variables were significantly associated with the development of TBI related AP (being referral, NGT insertion and GCS level).

The result of multivariable cox regression analysis revealed that the hazard of developing AP since referred from other health institutions is 2.43 times higher as compared to those patients who were directly admitted to FCSH; AHR (2.43; 95% CI (1.12-5.25)). Patients who had naso gastric tube for feeding and medication installation purpose were

3.02 times more likely to develop TBI related AP than patients who had not such an intervention AHR (3.02 95%CI:(1.43-6.39)). The hazard of developing AP among patients who had GCS level of less than 8 were 3.88 times more risky than the baseline GCS level >13 category of GCS level AHR(3.88; 95% CI(1.42-10.62)).

Table 5: Results of the Bivariable and Multivariable Cox Proportional Hazard Regression Analysis of TBI Patients at FCSH

Covariates	**Category**	**Vital status**		**Bivariable**	**Multivariable**	**Multivariable**
		Censored	**AP**	**CHR (95%: CI)**	**AHR (95%: CI)**	**P-value**
System of transfer	Directly admitted	96	10	1	1	
to FCSH	Referred	230	60	2.26(1.15-4.42)	2.43(1.12-5.25)	0.024
Residence	Urban	94	14	1	1	
	Rural	232	56	1.53(0.85-2.76)	1.41(0.74-2.68)	0.283
Duration of	0.5-3.5	73	14	1.37(0.65-2.89)	1.98(0.85-4.59)	0.109
Presentation	4-7.5	80	16	1.39(0.68-2.85)	1.16(0.55-2.43)	0.692
	8-18.5	72	26	2.20(1.14-4.21)	1.88(0.95-3.72)	0.069
	19-360	101	14	1	1	
Mechanical	Yes	49	22	2.36(1.42-3.92)	1.07(0.6-1.91)	0.808
Ventilation	No	277	48	1	1	
Sedation	Yes	48	27	2.59(1.6-4.2)	1.27(0.73-2.21)	0.379
	No	278	43	1	1	
NGT	Yes	15	61	5.65(2.80-11.39)	3.02(1.43-6.39)	0.004
Insertion	No	175	9	1	1	
Head injury	Blunt	70	28	2.01(1.25-3.25)	1.33(0.81-2.21)	0.255
Type	Penetrating	256	42	1	1	
GCS level	<8	111	53	9.18(3.67-22.99)	3.88(1.42-10.62)	0.008
	9-12	93	12	2.83(0.99-8.04)	1.57(0.53- 4.62)	0.407
	>13	122	5	1	1	

Table5 con…

Covariates	Category	Vital status		Bivariable	Multivariable	Multivariable
		Censored	AP	CHR (95%: CI)	AHR (95%: CI)	P-value
Pulse rate	<60	22	3	1	1	
	60-100	254	47	1.26(0.39-4.07)	1.29(0.38-4.34)	0.675
	<100	50	20	2.42(0.71- 8.15)	1.23(.35-4.31)	0.746
Respiratory	16-24	218	26	1	1	
Rate	>25	108	44	2.90(1.78-4.71)	1.39(0.82-2.36)	0.216
Temperatur	<36	35	3	1	1	
E	36-38	276	59	2.26(.70-7.21)	2.05(0.62-6.74)	0.234
	>38	15	8	4.98(1.32-18.80)	2.58(0.65-10.21)	0.176

NB:- **CI**-confidence interval, **AHR**-adjusted hazard ratio, **CHR**- crude hazard ratio, **GCS** –Glasgow comma scale, **NGT**- nasogastric tube, **FCSH**- Felegehiwot comprehensive specialized hospital.

5.9 Overall Model Fitness Test

The figure below shows overall model fitness of the data in cox proportional hazard regression model. Residuals have a standard censored exponential distribution with hazard ratio. If we compare the jagged line with the reference line (cox Snell residual), we observe that, the hazard function follows the hazard function closely with some detachment at the end. This indicates as the cox model does fit these data to reasonable manner. Hence, the cox smell residuals test shows overall goodness of fit of the model.

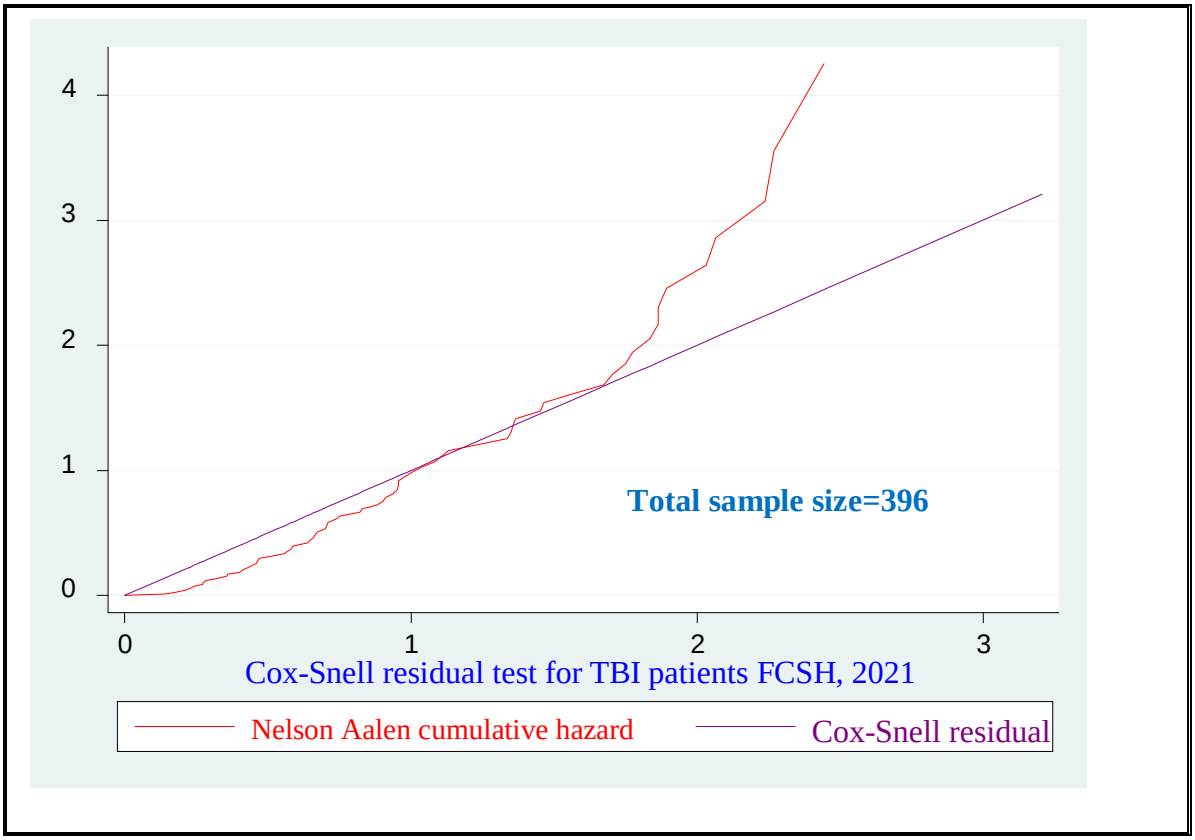

Figure 6: Cox Snell Residual Test Showing Overall Goodness Of Fit For Posttraumatic AP In FCSH From January 1, 2015-December 31, 2020.

5.10 Test of Proportional Hazard Assumption

Effect of socio-demographic, institutional, clinical and intervention related characteristics of TBI patients for incidence of AP were examined by cox proportional hazards regression model. Variables included in the model as a predictors were Residence admission, duration of presentation, mechanical ventilation use, sedation status, nasogastric tube insertion, head injury type, respiratory rate, pulse rate, temperature and GCS level. A goodness of fit (GOF) test was conducted to assess the proportional hazard assumptions of the cox model for given predictor variables statistically. It reveals that almost all variables included in the model satisfied PH assumptions (p-value >0.05 except residence). The overall global test is **0.1083**. So is good fit, since it is greater than 0.05(table 6).

Table 6: Goodness of Fit Test Assesses Proportional Hazard Assumption for incidence of posttraumatic AP in FCSH admitted patients, January 1, 2015-December 31, 2020

Predictors	**Rho***	**Chi-square**	**df****	**P-value**
Residence	-0.27148	4.44	1	0.0351
Admission	0.01098	0.01	1	0.9263
Duration of presentation	-0.05587	0.24	1	0.6258
Mechanical ventilation use	0.03927	0.12	1	0.7282
Sedation status	-0.05844	0.26	1	0.6080
Nasogastric tube insertion	-0.17106	2.53	1	0.1115
Head injury type	0.20392	3.23	1	0.0721
Respiratory rate	-0.13697	1.42	1	0.2328
Pulse rate	-0.01167	0.01	1	0.9277
Temperature	-0.12628	0.94	1	0.3319
GCS level	0.14110	1.69	1	0.1931
Global test		**16.99**	**11**	**0.1083**

***- the correlation coefficient between residuals and time**

****- degree of freedom**

6. DISCUSSION

Aspiration pneumonia is a recognized complication following TBI. This study sought to identify the incidence and known risk factors associated with TBI induced AP while patients were in admission.

During the study period 17.67% of patients were developed AP; which was lower than the result of study conducted at Taiwan as "pneumonia incidence among sever TBI patients"(29.66%)(20), this might be because of variation in diagnostic approaches. The cumulative probability of event free survival days for AP were 93.18%, 87.75%,83.08%, 78.84% and 77.68% at 1^{st}, 2^{nd}, 3^{rd}, 7^{th} and 8^{th} day and for the rest entire period respectively; which is shorter than the finding in the study conducted as pneumonia incidence among sever TBI patients 65%, 60%, 55%, 55%, 55% at 10,20,30,40, and 50^{th} days respectively(20). This discrepancy might be because of clinical service variation between these two countries.

The hazard of developing aspiration pneumonia among referral TBI patients was 2.43 times higher as compared to TBI patients which were directly admitted to FCSH. This is probably because distance from place of injury to hospital and rescuing speed (unlike developed countries who use helicopter for ambulance service, low income countries use own foot, by vehicle ambulance, private car and stretcher), stayed without any medical attendance by a health care professionals, generally long time transport to hospital and absence of prehospital medical care expose for such a problem(15).

Those TBI patients who had nasogastric tube for feeding and medication installation purpose were 3.02 times higher to develop AP as compared to those TBI patients who didn't have nasogastric tube; AHR 3.04 95% CI (1.44-6.40). This finding is in line with the finding of the study conducted at Taiwan as pneumonia incidence among sever TBI patients (AHR: 4.56) 95% CI 1.11–18.64 (20); Since NGT can mainly be risk factor for aspiration pneumonia, while there were misplacement during insertion, displacement of tube location in the meantime, adding additional feed from excessive residuals (i.e. >150ml) and bolus feedings for high risk patients (33, 34) elevated intra-abdominal pressure also causes for aspiration pneumonia in critically ill patients(45). NGT increases

the chance of gastro esophageal reflux of gastric contents than that of patients without NGT(46).

TBI patients admitted with baseline GCS level of <8 were 3.88 times more likely to develop aspiration pneumonia than GCS level >13; AHR 3.88(95%CI: 1.42-10.62). This finding is in line with the study conducted as analysis of aspiration risk in severe trauma patients by CT findings in Korea i.e. OR 5.073 (95%:CI, 2.442–10.539) since both studies showed this factor as predictor for AP(1). As GCS level gets lower there shouldn't have effective airway clearance, no adequate air way protection by epiglottis and there is insufficient gag and cough reflex(1, 28): These abnormalities in turn results aspiration of oral and gastric contents which results aspiration pneumonia. Decreased level of consciousness associated with trauma, Intoxication or sedation from general anesthesia are risk factors for aspiration pneumonia(9, 29). when there is a decreased level of consciousness, compromised airway defense mechanisms, dysphagia, gastro esophageal reflux, and recurrent vomiting(2). Dysphagia from neurologic deficits can also considered as main cause for AP in adults(47).

Implications

This study implies that improved preventive measures are better management options by health care providers especially on prehospital and admission areas.

7. LIMITATION OF THE STUDY

This study has some limitations. Inability to obtain necessary information like occupation status of the patient, way of transportation for arrival and similar information which can be an influential factor for incidence of aspiration pneumonia is one limitation. Poor diagnostic approach of aspiration pneumonia (i.e. lack of chest CT and similar tools) is a bottle neck for difficulty to distinguishing from differential diagnoses.

8. CONCLUSION

Aspiration pneumonia is an important health issue for patients admitted with TBI. The overall incidence rate were 32.39 per 1000 person days of follow-up and being referral, nasogastric tube insertion and lower GCS level were significant predictors of incidence of aspiration pneumonia. Prehospital air way management, adherence to standard NGT insertion and feeding procedural rules, and comma care are important management issues for prevention of posttraumatic AP.

9. RECOMMENDATIONS

To Amhara regional health bureau

The present study reveals higher incidence of TBI related aspiration pneumonia in referral and sever TBI patients. This indicates the need to better improve prehospital and hospital care, assess emergency services and first aid measures during transportation and admission time.

To Felegehiwot referral hospital

In this study patients having NGT and baseline GCS <8 patients were more affected groups than their comparative groups. So it shall better to improve comma care and similar interventions in the admission area.

To future researchers

Further prospective follow-up studies on incidence of aspiration pneumonia among TBI patients is better to be conducted by incorporating important predictors that can't be accessed by chart review.

10. REFERENCES

1. Mandell LA, Niederman MS. Aspiration pneumonia. New England Journal of Medicine. 2019;380(7):651-63.
2. Hu X, Lee JS, Pianosi PT, Ryu JH. Aspiration-related pulmonary syndromes. Chest. 2015;147(3):815-23.
3. Spitz G, Maller JJ, Ng A, O'Sullivan R, Ferris NJ, Ponsford JL. Detecting lesions after traumatic brain injury using susceptibility weighted imaging: a comparison with fluid-attenuated inversion recovery and correlation with clinical outcome. Journal of neurotrauma. 2013;30(24):2038-50.
4. Silva THd, Massetti T, Silva TDd, Paiva LdS, Papa DCR, Monteiro CBdM, et al. Influence of severity of traumatic brain injury at hospital admission on clinical outcomes. Fisioterapia e Pesquisa. 2018;25(1):3-8.
5. Mbakile-Mahlanza L, Manderson L, Ponsford J. The experience of traumatic brain injury in Botswana. Neuropsychological rehabilitation. 2015;25(6):936-58.
6. Lee AS, Ryu JH, editors. Aspiration pneumonia and related syndromes. Mayo Clinic Proceedings; 2018: Elsevier.
7. Lee K, Rincon F. Pulmonary complications in patients with severe brain injury. Critical care research and practice. 2012;2012.
8. DiBardino DM, Wunderink RG. Aspiration pneumonia: a review of modern trends. Journal of critical care. 2015;30(1):40-8.
9. Prevention of Aspiration in Adults. Crit Care Nurse. 2016;36(1):e20-4.
10. Howle AA, Nott MT, Baguley IJ. Aspiration pneumonia following severe traumatic brain injury: prevalence and risk factors for long-term mortality. Brain Impairment. 2011;12(3):179.
11. Gundappa P. Extracranial Complications of Traumatic Brain Injury: Pathophysiology—A Review. Journal of Neuroanaesthesiology and Critical Care. 2019;6(03):200-12.
12. Jeon I, Jung GP, Seo HG, Ryu JS, Han TR, Oh B-M. Proportion of aspiration pneumonia cases among patients with community-acquired pneumonia: A single-center study in Korea. Annals of rehabilitation medicine. 2019;43(2):121.
13. Hofman M, Andruszkow H, Kobbe P, Poeze M, Hildebrand F. Incidence of post-traumatic pneumonia in poly-traumatized patients: identifying the role of traumatic brain injury and chest trauma. European journal of trauma and emergency surgery. 2020;46(1):11-9.
14. Robba C, Bonatti G, Pelosi P, Citerio G. Extracranial complications after traumatic brain injury: targeting the brain and the body. Current Opinion in Critical Care. 2020;26(2):137-46.
15. Aenderl I, Gashaw T, Siebeck M, Mutschler W. Head injury-a neglected public health problem: a four-month prospective study at Jimma University specialized hospital, Ethiopia. Ethiopian journal of health sciences. 2014;24(1):27-34.
16. Biluts H, Hailemichael B. A 2-years description of traumatic brain injury admissions in Tikur Anbessa Specialized Hospital. East and Central African Journal of Surgery. 2016;21(2):81-8.
17. Della Torre V, Badenes R, Corradi F, Racca F, Lavinio A, Matta B, et al. Acute respiratory distress syndrome in traumatic brain injury: how do we manage it? Journal of thoracic disease. 2017;9(12):5368.
18. Gamberini L, Baldazzi M, Coniglio C, Gordini G, Bardi T. Prehospital airway management in severe traumatic brain injury. Air Medical Journal. 2019;38(5):366-73.
19. Ra JY, Hyun JK, Ko KR, Lee SJ. Chin tuck for prevention of aspiration: effectiveness and appropriate posture. Dysphagia. 2014;29(5):603-9.

20. Wang K-W, CHen H-J, Lu K, Liliang P-C, Huang C-K, Tang P-L, et al. Pneumonia in patients with severe head injury: incidence, risk factors, and outcomes. Journal of neurosurgery. 2013;118(2):358-63.
21. Heo GJ, Lee J, Choi WS, Hyun SY, Cho J-S. analysis of aspiration risk factors in Severe Trauma Patients: Based on findings of aspiration lung disease in Chest Computed Tomography. Journal of Trauma and Injury. 2020;33(2):88-95.
22. Asemota AO, Alsulaim HA, Alshaikh H, Gani F, Najafian A, Nagarajan N, et al. Aspiration Pneumonitis in Patients with Acute Traumatic Brain Injury. Journal of the American College of Surgeons. 2016;223(4):e195-e6.
23. Lanspa MJ, Peyrani P, Wiemken T, Wilson EL, Ramirez JA, Dean NC. Characteristics associated with clinician diagnosis of aspiration pneumonia: a descriptive study of afflicted patients and their outcomes. Journal of hospital medicine. 2015;10(2):90-6.
24. Benjamin E, Haltmeier T, Chouliaras K, Siboni S, Durso J, Inaba K, et al. Witnessed aspiration in trauma: frequent occurrence, rare morbidity—a prospective analysis. Journal of trauma and acute care surgery. 2015;79(6):1030-7.
25. Taylor JK, Fleming GB, Singanayagam A, Hill AT, Chalmers JD. Risk factors for aspiration in community-acquired pneumonia: analysis of a hospitalized UK cohort. The American journal of medicine. 2013;126(11):995-1001.
26. Arnold-Day C, Oseni A, Semple P. Extracranial healthcare-associated complications in severe traumatic brain injury patients at Groote Schuur Hospital's neurocritical care unit. Southern African Journal of Critical Care. 2019;35(1):27-8.
27. Manabe T, Teramoto S, Tamiya N, Okochi J, Hizawa N. Risk factors for aspiration pneumonia in older adults. PloS one. 2015;10(10):e0140060.
28. Hu PJ, Pittet J-F, Kerby JD, Bosarge PL, Wagener BM. Acute brain trauma, lung injury, and pneumonia: more than just altered mental status and decreased airway protection. American Journal of Physiology-Lung Cellular and Molecular Physiology. 2017;313(1):L1-L15.
29. Facts T. The American Association for the Surgery of Trauma. 2019.
30. Hui X, Haider AH, Hashmi ZG, Rushing AP, Dhiman N, Scott VK, et al. Increased risk of pneumonia among ventilated patients with traumatic brain injury: every day counts! journal of surgical research. 2013;184(1):438-43.
31. Sayaca C, Sapcíoglu TY, Kaya D. Does the right or left hemisphere involvement affect the swallowing in patients with hemiplegia? NeuroRehabilitation. (Preprint):1-10.
32. Lo W-L, Leu H-B, Yang M-C, Wang D-H, Hsu M-L. Dysphagia and risk of aspiration pneumonia: A nonrandomized, pair-matched cohort study. Journal of dental sciences. 2019;14(3):241-7.
33. Fan M-c, Wang Q-l, Fang W, Jiang Y-x, Sun P, Wang Z-h. Early enteral combined with parenteral nutrition treatment for severe traumatic brain injury: effects on immune function, nutritional status and outcomes. Chinese Medical Sciences Journal. 2016;31(4):213-20.
34. Yang F-H, Lin F-Y, Hwu Y-J. The Feasibility Study of a Revised Standard Care Procedure on the Capacity of Nasogastric Tube Placement Verification Among Critical Care Nurses. The Journal of Nursing Research. 2019;27(4):e31.
35. Franschman G, Verburg N, Brens-Heldens V, Andriessen T, Van der Naalt J, Peerdeman S, et al. Effects of physician-based emergency medical service dispatch in severe traumatic brain injury on prehospital run time. Injury. 2012;43(11):1838-42.
36. Dragan V, Wei Y, Elligsen M, Kiss A, Walker SA, Leis JA. Prophylactic antimicrobial therapy for acute aspiration pneumonitis. Clinical Infectious Diseases. 2018;67(4):513-8.
37. Herzig SJ, LaSalvia MT, Naidus E, Rothberg MB, Zhou W, Gurwitz JH, et al. Antipsychotics and the risk of aspiration pneumonia in individuals hospitalized for

nonpsychiatric conditions: a cohort study. Journal of the American Geriatrics Society. 2017;65(12):2580-6.
38. Noguchi S, Yatera K, Kato T, Chojin Y, Fujino Y, Akata K, et al. Impact of the number of aspiration risk factors on mortality and recurrence in community-onset pneumonia. Clinical Interventions in Aging. 2017;12:2087.
39. Bowerman TJ, Zhang J, Waite LM. Antibacterial treatment of aspiration pneumonia in older people: a systematic review. Clinical interventions in aging. 2018;13:2201.
40. Tay WY, Low LL, Tan SY, Vasanwala FF. Evidence-based measures for preventing aspiration pneumonia in patients with dysphagia. Proceedings of Singapore Healthcare. 2014;23(2):158-65.
41. Steele CM, Bailey GL, Polacco REC, Hori SF, Molfenter SM, Oshalla M, et al. Outcomes of tongue-pressure strength and accuracy training for dysphagia following acquired brain injury. International journal of speech-language pathology. 2013;15(5):492-502.
42. Odgaard L, Aadal L, Eskildsen M, Poulsen I. Nursing sensitive outcomes after severe traumatic brain injury: a nationwide study. Journal of neuroscience nursing. 2018;50(3):149-54.
43. Seifu W, Woldemichael K, Tsehaineh B. Prevalence and risk factors for diabetes mellitus and impaired fasting glucose among adults aged 15–64 years in Gilgel Gibe Field Research Center, Southwest Ethiopia, 2013: through a WHO step wise approach. MOJ Public Health. 2015;2(4):00035.
44. Hosmer Jr DW, Lemeshow S, Sturdivant RX. Applied logistic regression: John Wiley & Sons; 2013.
45. Galvagno SM, Nahmias JT, Young DA. Advanced trauma life support® Update 2019: management and applications for adults and special populations. Anesthesiology clinics. 2019;37(1):13-32.
46. Kim G, Baek S, Park H-w, Kang EK, Lee G. Effect of nasogastric tube on aspiration risk: results from 147 patients with dysphagia and literature review. Dysphagia. 2018;33(6):731-8.
47. Goldsmith T, Kurash A. Swallowing disorders and aspiration in palliative care: Definition, consequences, pathophysiology, and etiology. Up ToDate: UpToDate Inc Waltham, MA; 2019.

11. APPENDIXES

Appendix 1 Information sheet

Title of the Research Project: **Incidence of aspiration pneumonia and its predictors among traumatic brain injury in Felegehiwot comprehensive specialized hospital, Amhara regional state, northwest Ethiopia, 2021: a retrospective cohort study**.

Name of Investigator: Sahlu Mitku (BSc, nurse)

Name of the Organization: Bahir Dar University, College of Medicine and Health Sciences, School of health sciences department of Adult Health Nursing.

Introduction: This information sheet was prepared for Amhara regional health bureau, Felegehiwot comprehensive specialized hospital administrators, card room coordinator, and head nurses of Surgical, Adult ICU wards. The aim of this form was to make the above stakeholders clear about the purpose of this research, data collection procedures and get permission to conduct the research.

Purpose of the Research will be to determine incidence of aspiration pneumonia and its predictors among TBI hospitalized adult patients in Felegehiwot comprehensive specialized hospital, Amhara regional state, northwest Ethiopia, 2021: a retrospective cohort study.

Procedure: to achieve the above objective first information regarding the total number of traumatic brain injury patients and the medical registration number of each patient was obtained from Health management and information system (HMIS) of Felegehiwot comprehensive specialized hospital. Then detail information about each patient was extracted from each selected patient chart.

Risk and /or Discomfort: Since the study will be conducted by taking appropriate information from patient chart, it didn't inflict any harm on the patients. The name or any other identifying information will not be recorded on the data extraction checklist and all information taken from the chart kept strictly confidential and in a safe place. The information retrieved will be only used for the study purpose.

Benefits: the research have no direct benefit for one whose document/ record will be included in this research. But the indirect benefit of the research for the participant and

other clients in the program is clear as mentioned in significance of the study. This is because if program planners/care givers prepare predicted plan there will be benefit for clients in the program of getting appropriate care and treatment services and the fate of preventing aspiration pneumonia on traumatic brain injury patients may progress. Of all, the research work has a paramount direct benefit for health care planners, managers, care givers, patients and patient families.

Confidentiality: to reassure confidentiality the data on the chart will be collected by BSc holder nurses who are working out of Felegehiwot comprehensive specialized hospital and information will be collected without the name of the clients. The information collected from this research project will be kept confidential and stored in a secured file. In addition, it is not revealed to anyone except the investigator and advisers and it is kept in key and locked system with computer pass ward.

Person to contact: This research project is reviewed and approved by the institutional review board of College of Medicine and Health Science, Bahir Dar University. If anyone is wanted to know more information, he/she could contact the committee through the address below. For those who had questions the following addresses are written for clarity to contact us any time.

1. **Sahlu Mitku:** Bahir Dar University, College of Medicine and Health Science, Department of Adult Health Nursing: principal investigator
   Cell phone: +251918092750 E-mail: sm092750@gmail.com
2. **Mr. Emiru Ayalew:** Bahir Dar University, College of Medicine and Health Science, Department of Adult Health Nursing: principal Advisor
   Cell phone: +251912121688 E-mail: emiruayalew2010@gmail.com
3. **Mr. Getasew Mulatu**: Bahir Dar University, College of Medicine and Health Science, Department of Emergency and critical care nursing: co-advisor

   Cell phone: +251993445062 E-mail: gechm2012@gmail.com

Appendix 2 - Candidates Declaration Sheet

Declaration

I, the undersigned, MSc Student declare that, this thesis is my original work in partial fulfillment of the requirement for the degree of Master of Science in Adult Health Nursing.

Student's Name: Sahlu Mitku

Signature: _____

Place of submission: department of Adult Health Nursing, college of medicine and health science, Bahir Dar University.

Date of Submission: ----------

Appendix 3- Advisors Approval Form

Bahir Dar University

College of Medicine and Health Sciences, School of Health Sciences, Department of Adult Health Nursing

Approval of thesis for defense

We hereby certify that we have supervised, read, and evaluated this thesis titled " Incidence of aspiration pneumonia and its predictors among hospitalized adult patients in Felegehiwot comprehensive specialized hospital, Amhara regional state, northwest Ethiopia, 2020: a retrospective cohort study ." by Sahlu Mitku prepared under our guidance. We recommend the thesis be submitted for oral.

Advisor's name	Signature	Date
1. Emiru Ayalew	----------	----------
2. Getasew mulatu	----------	----------

Appendix 4- Examiners Approval Form

Bahirdar University

College of Medicine and Health Science, School of Health Science, Department of Adult Health Nursing

Approval of thesis for defense result

We hereby certify that we have examined this thesis entitled "**incidence and predictors of aspiration pneumonia among traumatic brain injury patients admitted at Felegehiwot comprehensive specialized hospital, Bahirdar, North West Ethiopia a retrospective study"** by Sahlu Mitku. We recommend that _____is approved for the degree of "_____."

Board of examiner's

_____	_____	_____
External examiner's name	**signature**	**date**
_____	_____	_____
Internal examiner's name	**signature**	**date**
_____	_____	_____
Chair person's name	**signature**	**date**

Appendix 5 - Data extraction tool

This review check list is prepared to collect data on TBI patients' medical records retrospectively to determine predictors of aspiration pneumonia among adult traumatic brain injury patients. It contains Socio-demographic, Institutional, clinical, intervention related factor predictors. It is adapted from similar studies conducted out of Ethiopia after exhaustive review of comparable literatures (8, 14, 15, 17, 26). Code----------

Admission---------- A. Directly admitted from FHCSH

B. Referred from other institutions

Variables	Response	Remark
Part I - Socio demographic characteristics of patients		
1. Age in years	----------	
2.Sex	1. Male 2. Female	
3.Residence	1. Urban 2. Rural	

Part II- Institutional factors		
If directly admitted go to question number 7 4. Source of referral	1. Health center 2. Primary hospital 3. General hospital 4. Referral hospital 5. Specialized hospital 6. Self-referral 7. Others----------	
5.Duration for presentation to referring institution after injury	----------(hour or days, weeks)	

6.Length of stay in referring institution	----------(hours or days, weeks)	
7.Duration for presentation at FHCSH (for both referred and directly admitted patients)	----------(hours, days, weeks)	
Part III Intervention related factors		
8.Interventions done at referring institution(if referred)	1. Nothing 2. Prophylactic antibiotics for AP 3. Mechanical ventilation 4. NGT insertion 5. Positioning 6. Others……	You can choose more than one response
9.Interventions at FHCSH	1. Mechanical ventilation 2. Sedation 3. NGT insertion 4. Medications 5. Prophylactic antibiotics 6. Positioning 7. Others……..	You can choose more than one interventions

Part IV Clinical characteristics		
10.Coexisted injuries	1. Head only 2. Oral 3. Neck 4. Chest 5. Spine	You can choose more than one option.

	6. Others ----------	
11. Was there any comorbidity?	1. Dyspepsia 2. Gastroesophagial reflux disease 3. Parkinsonism 4. Others----------	You can choose more than one option.
12.Type of head injury	1. Blunt head injury 2. Penetrating TBI	
13. Severity of head injury based on Initial/day1 GCS	1. Mild 2. Moderate 3. Severe TBI	
14. Was AP developed after injury?	1. Yes 2. No	
15.If developed Time to development?	After----days/weeks of admission	
16.Was there CXR imaging for AP?	1. Yes 2. No	
17.If any CXR what was the finding?	1. Pneumonia 2. No	
18.Intervention for that AP	1. Treated 2. No	
19. if treated what treatment has provided?	_____	
20.If treated what was an outcome?	1. improved 2. Died 3. Referred 4. Against medical advice	
21.Had the patient swallowing difficulty?	1. Yes 2. No	
22.Had the patient hemiplegia/paresis?	1. Yes 2. No	

23.Total length of hospital stays	----------(hours,days)

Vital signs	RR (bpm)	PR (bpm)	T^oc	$SPO_{2\ \%}$	GCS (Number)
1^{st} contact					

Abbreviations- RR (bpm) - respiratory rate by breath per minute, **PR (bpm)** - pulse rate by beat per minute, **T^oc** - temperature by degree centigrade, **SPO2** - oxygen saturation, **GCS** - Glasgow comma scale **AP** - aspiration pneumonia, **CXR** - chest x-ray, **TBI** - traumatic brain injury, **NGT** - naso-gastric tube **FHCSH** -Felegehiwot comprehensive specialized hospital

Collected by---------- sign---------- Date----------

Approved by---------- Sign---------- Date----------