DETERMINANTS OF BAD OUTCOME IN SPINAL INJURIES- A CASE CONTROL STUDY

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ABSTRACT

BACKGROUND

Craniospinal injuries are most important cause of mortality and long-term morbidity. There are no studies in our setup to develop a protocol for management of craniospinal injury victims, their transportation, risk factors for severity and factors that determining the prognosis, hence this study. Even now, it is important that the '108' ambulance services was not operating in our place, which had given all the support of transportation in a scientific manner. In 1999-2000, there were 37,072 accidents in Kerala; of this, 9184 came to medical college, Trivandrum; 208 (18%) out of 1111 craniospinal injuries died. The primary goal of transportation is to transfer a patient to an emergency room with all system stabilised in order to enhance the potential for maximal neurological recovery and to avoid any additional secondary injury.

MATERIALS AND METHODS

Is delay in reaching a tertiary care centre, a determinant of bad outcome as measured by case fatality and paralysis in spinal injuries?.
Setting- Tertiary care centre, Government Medical College Hospital, Thiruvananthapuram.
Sample size- 76 cases and 76 controls.
Data collection- Researcher administered structured questionnaire.
Statistical methods- Using EPI6 and SPSS.

RESULTS

Average delay suffered by a severe case was 22.40 hrs. The average age of a severe victim was 43 yrs. and the average distance that a severe spinal injury victim travelled was 54 kms.
Delay more than 3.5 hrs. had an odds ratio of 8.94 (95%, CI: 3.99-2028).
Delay- (Odds ratio): 0-2 hrs. (1); 2.001-4 (7.24); 4.001-6 (18.55); 6.0001-16:(11.96); >16 hrs. (43.28).
Distance more than or equal to 41 kms had OR of 2.095 (1.01-4.36).
Distance- (Odds ratio); 0=<40 (1) -=>41; (2.28).
Age- =<20; (1) 21-40:(1.53) =>41; (2.28).
Cervical spine injury victims had an odds ratio of 5.08 (95%, CI: 2.54-10.13).
Employed persons are at higher odds of 4.40 (95%, CI: 1.59-12.12).
Manual labourers and tree climbing had OR=3.08 (95%, CI: 0.81-11.67).

CONCLUSION

The major aetiological factors found significant to contract a bad outcome following spinal injuries were- 1. Delay in seeking treatment. 2. Number of shifting after accident. 3. Distance from the site of accident to the treatment center. 4. The nature of injury in the form of cervical spine injury. 5. The occupation of accident victims. 6. The mechanism of injury like RTA, fall from height, etc., age, alcohol habits, gender and co-morbid conditions not came forward as significant risk factors.

KEYWORDS

Bad Outcome, Odds ratio, Case-Control study, Trend Analysis, Delay.

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BACKGROUND

Kerala is one of the states with highest rate of accidents and trauma ranks as fourth among the causes of death. Injuries contribute to a major cause of mortality and morbidity in adults as well as children. Economic loss is tremendous and preventive strategies are mandatory. Spinal injuries are a major concern when its sequel are considered. In USA, two hundred thousands are living with spinal injuries as a result of trauma and 8,000-10,000 cases were added every year, out of which children/paediatric injury cases range from 5-15%. Risk factors of severe injuries are to be quantified and this study will focus on the risk factors that lead to bad outcome of spinal injuries in a tertiary setup in Kerala. While there have been advances in the treatment of trauma, the treatment modalities depends on the patient's survival until

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they reach an adequate medical centre. Preventing injury and avoiding delay have the potential to save life to decrease the morbidity and to ultimately save billions of healthcare expenditure. Delay in reaching can be the most critical determinant of survival. The burden of injury in India × 1,00,000 disability adjusted life years lost in 1990 statistics by Prof. G.K. Singh explains the injury burden among males and females in India and world separately. The major classification of injuries are intentional and unintentional.[1]

Variable	Men		Women	
	India	World	India	World
Injury	147.6	1092.1	119.4	533.9
Unintentional	126.3	751.7	104.8	373.3
Motor vehicle	23.1	231.3	9.4	86.3
Poisoning	2.1	29.5	0.8	13.9
Falls	28.9	124.2	21.1	74.6
Occupational	5.1	26.7	3.9	7.7
Intentional	21.4	340.4	14.6	160.6
Self-inflicted	11.1	106.0	10.8	69.3
Homicide/violence	8.2	142.0	2.8	41.4

Table 1. Classification of Injuries and DALY Loss

Along with the mortality, many people get injured during the accidents, which may lead to long-term and short-term morbidity. The true cost to society due to injuries and the potential impact of injury prevention on the overall burden of disability is unanswered. Rehabilitation of the disabled has been identified as a priority in the health sector and in the decentralised planning in Kerala. The impact of craniospinal injuries and predictors for short-term and long-term sequel needs to be assessed. This will help us in developing intervention strategies and rehabilitation.[2]

Year	No. of Accidents	Persons Injured	Persons Killed	Percentage Fatality
1960	1528	1663	235	14.13
1965	2394	2685	325	12.1
1970	4214	4300	500	11.62
1975	5683	5732	1067	18.61
1980	7064	9913	1184	11.94
1985	10451	14502	1547	10.66
1990	20447	26996	1793	6.64
2000	37072	49399	2711	5.49

Table 2. Growth of Road Accidents in Kerala is shown below (Source- NATPAC ,Trivandrum)

The fatality showed a decreased trend from 1990 onwards because of the better facilities and advancement in treatment protocols.

The victims who are injured comes under 40 years of age. The Trivandrum Medical College Statistics Study shown below demonstrates 70% of accident victims come under 40 years. Nearly, 25% come under 20 years of age.

Group Number	Age	Percentage of Accidents	Cumulative Percentage
1	Below 10	13.25	
2	10-20	13.25	26.50
3	20-30	26.89	53.39
4	30-40	16.67	70.06
5	40-50	15.15	85.21
6	50-60	10.61	95.86
7	60 and above	4.18	100

Table 3. Age Distribution of Road Accidents in Medical College, Trivandrum, During 1999-2000

Spinal Cord Injuries

Till recent times, spinal cord injuries have been one of the most neglected injuries due to delayed, frequently un-standardised and inadequate treatment. These factors always give poor results bedsides producing rehabilitative problems for the patients. Pessimistic attitude towards spinal injuries have persisted from time immemorial. 5000 years ago, Edwin Smith in Surgical Papyrus of Egypt described spinal cord injuries in case reports as ailments not to be treated. By 20th century, dedicated spinal centres took great stride in improving emergency care, initial medical and surgical treatment and towards rehabilitation of spinal cord injury patients. 40%-50% spinal cord injury patients may present with additional associated injuries and 10-20% of these patients may have more than 2 associated injuries. Commonest causes of mortality following severe spinal injuries are fulminant pneumonia, septicaemia from bed sores, urinary tract infections and heart problems. In the literature, it was noted that, 1 year mortality for quadriplegic patients varies from 7.5-40%. However, for patients more than 50 years, overall mortality stands at 23%.[3]

Successful treatment of spinal cord injuries depends on the following factors.[4,5]

1. Early recognition of injury. 2. Prompt medical care. 3. Mechanical stabilisation of injury. 4. Prevention of getting additional injuries. 5. Prevention of complications.

Physiology of Delay of Care- Beginning with the initial insult, a cascading series of events related to both the disruption of blood flow and direct injury to the neural membrane. The entire events results in progression of vasogenic oedema identified up to 2 weeks following the initial insult. After 5 to 6 days, phagocytes start the process of resorption of haemorrhagic debris. Activated glial cells cause Wallerian degeneration of fibre tracts, which ultimately leads to scar formation or gliosis ensuring over a period of 3 to 6 months. Great care must be afforded in the movement of unconscious patients, because 5 to 10% of these patients have a significant cervical spine injury. Oxygen level is monitored essentially. Otherwise, the physiological effect of spinal cord injuries including loss of sympathetic tone with resultant neurogenic hypotension and decreased respiratory function may mask the presence of tissue hypoxaemia, a major cause of secondary neuronal injury.[5]

Transportation of Patients- The primary goal of transportation is to transfer a patient to an emergency room with all systems stabilised in order to enhance the potential for maximal neurogenic recovery and to avoid any additional secondary injury. The safest means of transportation is to secure the patient in supine position in a spinal board by

strapping the forehead, thorax and extremities. The chin should not be taped alone as the sole point for control. A front open cervical collar, which enable us to note tracheal shift in the case of tension pneumothorax and to perform emergency cricothyroidotomy, if necessary. Children up to 6 yrs. having large head needs occipital recess placement of head so that the head and neck to be kept in proper extension.[4] The patient should be transported in Trendelenburg's position 20-40 degrees to maximise cardiovascular function and to avoid gastric aspiration. The feet forward position is the safest to avoid undue harm to the patient with a cervical spine injury. Cervical traction should not be put with free weights as they can cause over distraction during acceleration of the transport vehicle.[6]

Aims and Objectives

Aim- Aim of this study is to find out delay in reaching a tertiary care centre, a determinant of bad outcome as measured by case fatality and paralysis in spinal injuries?

Objectives

1. To find out whether delay in reaching a tertiary care centre is a risk factor for the bad outcome of spinal injuries.
2. To find out the determinants of bad outcome.

MATERIALS AND METHODS

Design- Prospective case control study was chosen because the spinal injuries are rare events. By the time, the patient reach us, the exposure event relationship has already occurred.

Setting- Tertiary care centre, Government Medical College Hospital, Thiruvananthapuram. Most of the spinal injury cases get referred to this centre from the surrounding districts as the operation facilities in the peripheral hospitals are limited. Also, most of the patients are from the poor socioeconomic strata, not able to go for private treatment facilities. The risk of exposure was common to the cases and controls as they came from the same geographic area. So, this sample represents the referral population.

Participants- The victims registered in the emergency department of Medical College Hospital, Thiruvananthapuram.

Inclusion Criteria- Severe spinal injuries from September to December 2001. Severity (bad outcome) was assessed by 1. Death and 2. Paralysis.

Exclusion Criteria- Brought dead cases to the emergency department.

Definition of Controls- Mild and moderate cases of spinal injuries during the same period.

Sample Size Estimation- The most significant independent factor considered for the sample size calculation based on case control approach was delay as a dichotomised variable and the prevalence of the delay among control group was taken as 40%. All present treatment modalities give best results if delivered as the earliest and warrants the study variable to get dichotomised. Since, it was taken as a continuous variable sample size was calculated according to the results obtained from a pilot study conducted by the researcher (Sample=20, prevalence of delay among control group 40%, alpha error=0.05, beta error=0.2, the smallest difference of delay between cases and controls was 5 hrs. with a standard deviation of 10). Based on the relative risk 3, the sample size was worked out to be cases 63 and controls 63, i.e. 1:1 proportion. Present study included 76 cases and controls to do a logistic model also. The sample size was also calculated with the distance and true number of shifts as variables. The maximum number were selected. The sample size also calculated based on the method of comparison of two means taking delay as a continuous variable.

Method of Collection of Cases and Controls- Incident cases were selected from the emergency department of Medical College Hospital, Trivandrum. The differentiation to cases and controls was done at 14^{th} day of occurrence of the injury. Controls who were discharged earlier were reviewed on the 14^{th} day.

Data Collection- By a pre-piloted structured questionnaire. Most of the questions were closed ended to get 1. Greater precision; 2. Uniformity; 3. Easier coding and tabulation of responses.

Methods of Administration of Questionnaire-

Researcher administered questionnaire interviewing the patients supplementing the answers by bystander also.

Ethical clearance was taken from the institutional ethical committee after presenting the protocol before the body and proper discussion. Informed consent in English and Malayalam were obtained.

Statistical Methods- The data was analysed using descriptive and analytical statistics using EPI6 and SPSS. Since, the outcome was dichotomised logistic multivariate model also developed.

RESULTS

A prospective case control study was undertaken during September to December, 2001 at Medical College, Thiruvananthapuram, to investigate the possible association of delay and bad outcome in spinal injuries and the possible determinants of bad outcome. 76 cases and 76 controls were analysed.

Name of the Explanatory Variables	Nature of the Variable Continuous	Bad outcome		Total 152	P value
		Absent 76	Present 76		
		Absent	Present		
Delay (hrs.)	Mean Median	5.95 (18.65) 2	22.40 56.63) 5	152	MW Test 0.000
Age (yrs.)	Mean (SD) Median	39.02 (11.52) 40	42.97 (12.37 43	152	0.96
Distance	Mean (SD) Median	39.43 (26.57) 30	54.43 (41.04) 40	152	0.002
Number of shifting	Mean (SD) Median	9.36 (1.90) 9	10.17 (1.97) 11	152	0.001
Education (yrs. of schooling)	Mean (SD) Median	7 (3.34) 9	5 (4.06) 6.5	152	0.002

Table 4. Results of Continuous Variables

MW-Mann-Whitney Test

Variable Studied	Bad Outcome Absent	Bad Outcome Present	Total (as Percentage of Total Sample)	Chi-Square	P Value
1. Occupation			**152**		
Unemployed	18	5	23 (15.13)	11.49	0.0031
Office work and Professional	14	9	23 (15.13)		
Manual labourer	36	53	89 (58.55)		
Tree climbing and rock work	8	9	17 (11.18)		
2. Nature of injury			**152**		
Assault	6	11	17 (11.18)	9.04	0.01
Road traffic accident	33	16	49 (32.23)		
Fall at construction work	37	49	86 (56.57)		
3. Alcohol habit			**152**		
Never	37	31	68 (44.73)	0.67	0.414
Occasional	37	37	74 (48.68)		
Daily	2	8	10 (6.5)		

Table 5. Results of Categorical Variables

Gender	Bad Outcome Absent	Bad Outcome Present	Total=152 (as Percentage of Total Sample)	Chi-Square	P Value
Female	11	7	18 (11.84)	0.57	0.451
Male	65	69	134 (88.15)		
Cervical spine injury					
Absent	56	27	83 (54.60)	20.81	0.000
Present	20	49	69 (45.39)		
Co-morbid conditions					
Absent	69	68	137 (90.13)	0.07	0.78
Present	7	8	15 (9.8)		

Table 6. Results of Categorical Binary Variables

Names of Variables	Odds Ratio	95% CI	x^2	P value
1. Delay				
0=<3.50 hrs. 1=>3.51 hrs.	8.94	3.99-20.28	35.41	0.000
2. Distance in kms.				
0=<40	2.095	1.01-4.36	4.07	0.044
1=>41				
3. Occupation				
0=Unemployed	4.40	1.59-12.12	11.49	0.003
1=Employed				
4. Alcohol habit				
0=Never	1.97	0.727-2.60	0.67	0.32
1=Yes				

5. Co-Morbid Conditions				
0=No 1=Present	1.159	0.412-3.25	0.07	0.78
6. Site of injury				
0=Non-cervical 1=Cervical	5.08	2.54-10.13	20.81	0.000
7. Gender				
0=Female 1=Male	0.60	0.19-1.82	0.57	0.451

Table 7. Showing Independent Variable and the Summary Categorical Statistics as Effect Estimates

In order to establish the dose response relationship- Chi-square for linear trend done for age and delay. Age was not significant and delay came out as significant variable.

Name of Variable	Odds Ratio	P Value	Chi-Square for Linear Trend
1. Delay 0-2 hrs. 2.001-4 4.001-6 6.0001-16 >16 hrs.	 1 7.24 18.55 11.96 43.28	0.000	37.061 (p value 0.000)
2. Distance 0=<40 1=>41	 1 2.095	0.029	
3. Age =<20 21-40 =>41	 1 1.83 2.28	 0.49 0.35	0.980 (p value 0.322)

Table 8. Showing Chi-Square for Linear Trend

Log likelihood ratio=37.502043, pseudo r^2=0.3088.

Step 1	B	S.E.	Wal	df	Sig.	Exp.	95% CI for	
							Lower	Upper
DELHR	0.02	0.01	4.10	1	0.04	1.02	1	1.04
CERVICAL	2.22	0.47	21.60	1	0.00	9.28	3.62	23.74
OCCUPG			7.60	2	0.02			
OCCUPGP	1.12	0.68	2.74	1	0.09	3.08	0.81	11.67
OCCUPGP	-	0.83	0.25	1	0.61	0.65	0.13	3.34
NATINJ			6.37	2	0.04			
NATINJGP	-	0.74	3.73	1	0.05	0.23	0.05	1.02
NATINJGP		0.70	0.13	1	0.71	0.77	0.19	3.04
DISGP	0.94	0.42	4.84	1	0.02	2.56	1.10	5.94
TRUESH	0.23	0.10	4.78	1	0.02	1.26	1.02	1.56
Constant	-	1.41	8.30	1	0.00	0.01		

Table 9. Multivariate Analysis Using Logistic Model

a. Variable(s) entered on step 1: DELHRS, CERVICAL, OCCUPGP1, NATINJGP.

Step 1	B	S.E.	Wald	df	Sig.	Exp. (B)
DELHRS	0.143	0.167	0.731	1	0.393	1.153
CERVICAL 1	2.194	0.482	20.725	1	0.000	8.974
OCCUPGP1			7.859	2	0.020	
OCCUPGP1 (1)	1.169	0.684	2.921	1	0.087	3.220
OCCUPGP1(2)	-0.463	0.870	0.284	1	0.594	0.629
NATINJGP			5.437	2	0.066	
NATINJGP(1)	-1.332	0.770	2.995	1	0.084	0.264
NATINJGP(2)	-.214	0.719	0.089	1	0.765	0.807
DISGP(1)	0.835	0.471	3.138	1	0.076	2.305
TRUESHIF	0.280	0.122	5.232	1	0.022	1.323
DELHRS by TRUESHIF	-0.011	0.013	0.645	1	0.422	0.989
DELHRS by VAR00002	0.000	0.000	0.075	1	0.784	1.000
Constant	-4.639	1.621	8.191	1	0.004	0.010

Table 10. Multivariate Logistic Model with Interaction Terms

a. Variable(s) entered Step 1- DELHRS, CERVICAL, OCCUPGP1, NATINJGP, DISGP, TRUESHIF, DELHRS*TRUESHIF, DELHRS *VAR00002.

To distinguish whether a normality assumption is maintained or not, which will help in the analysis, the distribution charts were prepared. The distribution charts are given below.

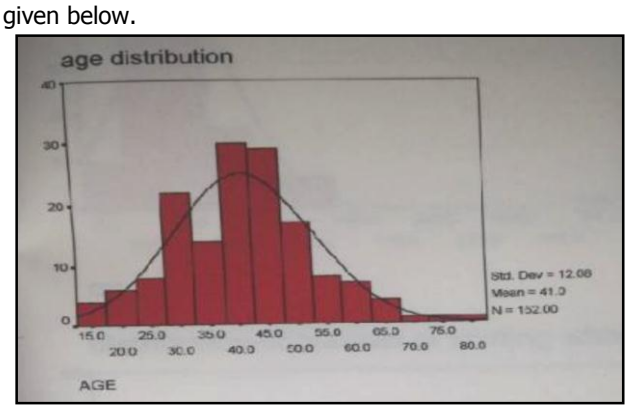

Figure 1. Distributional Property of Continuous Variable Age Showing Normal Distribution

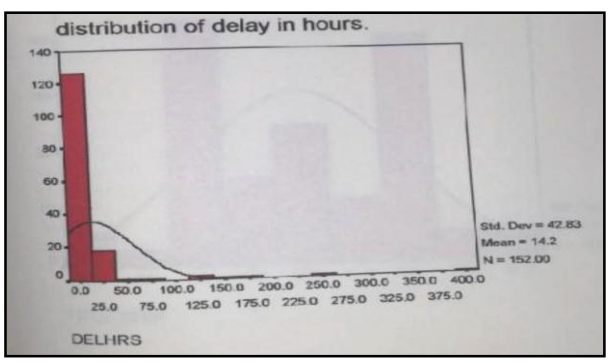

Figure 2. Delay in Hrs. Showing Skewed Distribution

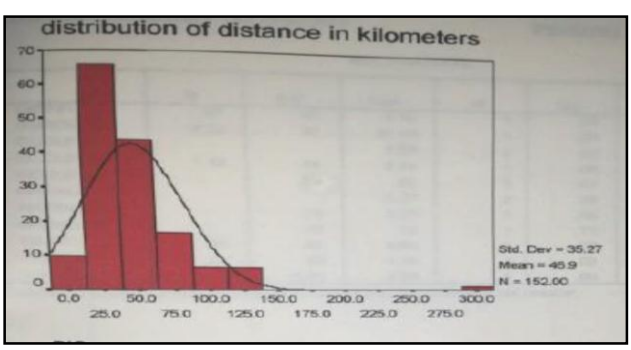

Figure 3. Distribution of Distance in Kilometres

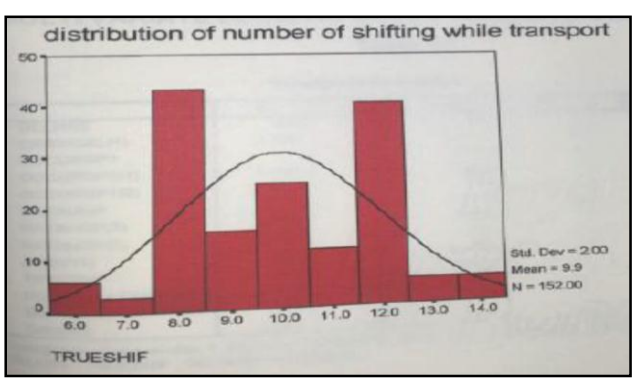

Figure 4. Distribution of Number of Shifting

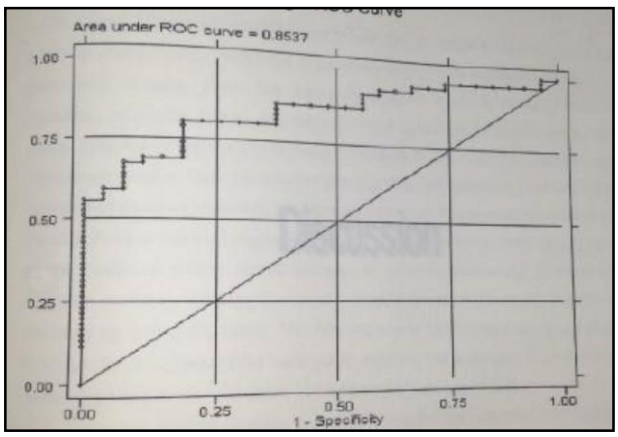

Figure 5. ROC Curve- X-Axis - Sensitivity/Y-Axis-1-Specificity

DISCUSSION

During the 4 months period, 152 spinal injury victims registered in the emergency department of medical college, Trivandrum. The descriptions are shown below.

Gender	Bad Outcome		Total
	Yes	No	
Male	69	65	**134**
Female	7	11	**18**

Table 11. The Male-Female Ratio was 7:1

Pattern	Bad Outcome		Total=152
	No	Yes	
RTA	33	16	**49**
Fall	21	23	**44**
Construction work	11	13	**24**
Head load	2	9	**11**
Fall on head	3	4	**7**
Assault	4	1	**5**
Others	2	10	**12**

Table 12. The Pattern of Injury

Of the total, 32.23% were due to RTAs. Usually, they get more attention comparing to their counterparts victims of fall from height.

Occupation	Bad Outcome		Total
	No	Yes	
Nonemployees	18	5	**23**
Manual workers	36	53	**89**
Tree climbing	8	9	**17**
Office work	14	9	**23**

Table 13. The Occupation Pattern in Our Study Group Victims were as Follows

The pattern of portion of spine that is injured showed 69 were cervical spine injuries, lumbar spine constituted 57 and thoracic 24. Along with spine, most common associated injury was cranial and upper limb constituted 21 each, lower limb constituted 8, abdomen, chest and pelvic injuries constituted 9. During the pilot study, the mortality among craniospinal injuries during the last 5 years in our hospital (1995-2000) were 18%. Spinal injuries constituted 8%. In

this study, the mortality was 10%. The rate of polytrauma also 10%. Among spinal injuries, cervical spine is the most vulnerable site to get injured, so that quadriplegia is also common. Thoracic and lumbar injuries produce usually paraplegia.

Delay in seeking medical care is one of the major factors deciding the outcome of accidents. Since, India is country of multitude of cultural groups and geographic terrains, there are many therapeutic systems rating accidents (Modern Medicine, Ayurveda and Siddha). The access to treatment facilities also varies. Most of the people are farmers inhabiting in the most inaccessible rural regions who neither have the knowledge regarding the risk factors nor the money for transportation of accident victims to the treatment centres. Therapeutic pluralism can produce delay in starting proper treatment. Spinal injuries can produce death, permanent disability and long-term morbidity either by the primary trauma or due to the second accidents produced by the shift of the victims from place to place. 86% of the victims were young working class people, so it is our social responsibility to bring down the burden caused by spinal injuries.[7]

Misclassification bias was avoided by using hard criteria to define outcome in the form of death and paralysis.

Analysis during the pilot study- It was shown that 6% of the total injuries constituted by spinal trauma. The western statistics and Kerala differs by the causes of injury. In western world, RTA constitutes a major portion along with violence and sports, but in Kerala, work-related falls constitutes a major portion along with RTAs. So, the strategic plans to reduce the burden is more complex and difficult here, because most of the people were from poor socioeconomic strata and also they do not possesses any health insurance system. Interplay of multiple factors is mandatory when complex phenomena like delay were considered as an independent risk factor. We have dichotomised the delay variable, which was taken and calculated as a continuous variable since at present management protocol even a minute is important (the platinum 10 mts. concept).

The distribution of delay was skewed, so we have taken median based on the pooled median value of cases and controls, the odds ratio obtained was 8.94 (95%, CI: 3.99-20.28), which shows a moderately good association between delay and the bad outcome. To establish the causality for delay as a major determinant bad outcome, the trend analysis was also done by taking "delay"' as 5 groups as shown in Table 8.

When we looked whether delay was confounded with distance in deciding the outcome no significant confounding was observed. The interaction term in multivariate model also was not significant.

Delay and distance group analysed-

The stratum 1- near group-OR=13.20; the stratum 2-far group-OR=4.

Crude OR=8.94; M-H weighted OR=8.05 (Chi-square=2.31, p value 0.21), since there was no difference between the crude and adjusted or no confounding was established.

People came far above from 40 kms had an odds ratio of 2.095 to contract bad outcome (p value=0.029).

Biologically, there is a possibility that as age advances the risk also increases. So, we have stratified the victims into 3 groups <=20, 21-40, =>41. The odds ratio increased from 1.83-2.28, but it was not significant (p value=0.322). The number of shifting was found to have 1.26 times higher risk for each increase in one shift. Only 15 (10%) used ambulance service. Of these 15, every one had used other modalities of transportation immediately after injury. 5 (3.2%) used cervical collar as protective measure while transportation. Nobody knew regarding the importance of care of transportation as a measure to prevent the complications. So, a well-organised emergency team in prehospital and hospital level of treatment is mandatory to reduce the sequels of burden of spinal injury.

Limitations in the Study- Referral bias, there was a chance to treat mild cases in local hospitals and severe ones referred to here.

CONCLUSION

1. The major aetiological factors found significant to contract a bad outcome following spinal injuries were- 1. Delay in seeking treatment. 2. Number of shifting after accident. 3. Distance from the site of accident to the treatment centre. 4. The nature of injury in the form of cervical spine injury. 5. The occupation of accident victims. 6. The mechanism of injury like RTA, fall from height, etc.
2. Delay more than 3.5 hrs. had an odds ratio of 8.94 (95%, CI: 3.99-20.28). Each one hour delay had 1.02 (1-1.04) odds ratio.
3. Distance more than or equal to 41 kms had OR of 2.095 (1.01-4.36). For every 1 km, excess travel had 2.56 (1.10-5.94) OR.
4. Cervical spine injury victims had an odds ratio of 5.08 (95%, CI: 2.54-10.13).
5. Employed persons are at higher odds of 4.40 (95%, CI: 1.59-12.12). Manual labourers and tree climbing had OR=3.08 (95%, CI: 0.81-11.67), since crossing 1 not significant.
6. Age, alcohol habits, gender and co-morbid conditions not came forward as significant risk factors.
7. Spinal injuries constituted 8% of the total emergency department admissions and the fatality rate was 10%.
8. Among spinal injuries, 30% were caused by Road Traffic Accidents (RTA) and 45% by fall from height.
9. The study conclusively proves by avoiding delay to get into the treatment facility, reducing the number of shifting and using protective devices like cervical collars can significantly reduce the bad outcome following spinal injury.

Public Health Recommendations- The findings of the study had given sufficient ground to come up with

recommendations to reduce the risk of bad outcome following spinal injuries. This has been forwarded to administrators to conduct training programmes for health workers to handle injured persons, injury epidemiological education programmes to the people in the community, traffic improvements, ambulance at appropriate locations, trauma care facility at major sites besides roads, awareness programmes to prevent secondary injuries following initial trauma.[8]

Impact in Our Place- "108" ambulance services at call were established to help poor people to get early treatment at affordable expenditure. This ambulance has all immobilisation facilities to protect spine. It was popularised from 2002 onwards in Kerala.

Future Scope- Further long-term interventional studies incorporated with cost effectiveness of different strategies in order to identify best methods to prevent accidents and if at all accidents occurred measures to prevent the bad outcome in the community.

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