Original Article

Paediatric Road Traffic Injuries in Emergency Department in Malaysia: The Prevalence and Outcome

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Abstract

Background: Paediatric road traffic injuries have become an alarming health issue seen globally as well as in Malaysia. The aim of this study was to determine the prevalence, patterns of injuries, outcomes and factors associated with the outcomes of road traffic injuries among paediatric age group who attended a tertiary hospital in Malaysia. **Methodology**: This prospective cross-sectional study was conducted amongst paediatrics age group whose involved in road traffic injury in 2021. Information attained were patients' demographics, injury profiles, assessment in emergency department, and outcomes. Every patient will be scored according to three trauma scores: Injury Severity Score (ISS), Paediatric Trauma Score (PTS), and Revised Trauma Score (RTS). **Results**: A total of 240 paediatric patients were studied. Prevalence of 2.35 road traffic injuries per 100 inpatient paediatric patients was seen. Motorbike riders were most affected with 50%. Head injury was the most common injury seen (31%). There was a significant association of pain score and Injury Severity Score (ISS) with hospital admission. There was a significant association of Paediatric Trauma Score (PTS) and lower limb injury with surgical intervention. The mortality rate for paediatrics road traffic injuries was 1.3% (3 out of 240). **Conclusion**: Incorporation of trauma scores such as ISS and PTS can be used as the prognostic tools in admission and intervention aspect of paediatric road traffic injuries.

Keywords: *paediatric, road traffic injury, prevalence, outcome*

INTRODUCTION

Road traffic injuries among the paediatric age group are a common presentation seen at any emergency department. These injuries may vary from simple cuts to severe, life-threatening injuries. A road traffic injury is defined as a fatal or non-fatal injury incurring from a road traffic crash, while a road traffic crash is defined as a collision or incident that may or may not lead to injury, occurring on a public road and involving at least one moving vehicle.[1]

Globally, in 2004, injuries incurred by road traffic accidents contributed about 30% of all injury deaths among children and youth aged 0-19 years and were the leading cause of death among young people (aged 15-19 years).[2] About 720 children die from road traffic crashes every day.[2] In low- to middle-income countries, most traffic deaths occur among pedestrians, passengers in vehicles or on two-wheelers, while in high-income countries, most deaths involve novice drivers. The most common non-fatal injuries occurred among children are head injuries and limb fracture.[2] Injury, poisoning, and certain other external causes have been ranked as the sixth principal cause of hospitalisation in the Ministry of Health and private hospitals in Malaysia. Road traffic injury patients are among the top ten most frequently attended cases in operation theaters and intensive care units.[3] A local study conducted from 2007 to 2010 and extracted from the trauma registration system of the National Trauma Database revealed that road traffic injuries contributed to most unintentional injury deaths.[4] These findings highlight the vulnerability of our children to sustaining injuries secondary to road traffic accidents.

According to Malaysian statistics in 2019, children up to 14 years old constitute approximately 23.3% of the population.[5] This is the prime age for physical and mental development, with expected years of productivity for the country. Apart from causing

higher mortality, road traffic injuries may lead to lifelong disabilities that affect the social and economic potential of survivors. This can result in enormous medical treatment costs, rehabilitation needs, physical trauma and psychological impacts on both victims and their families. Furthermore, lifelong disability and mortality will cause a reduction in the country's human capital, limiting growth and development.[6]

Studies have been conducted locally on the sociodemographic factors and injury patterns observed in paediatric patients. However, to the best of our knowledge, there have been limited studies integrating the use of multiple trauma scoring systems with sociodemographic data to analyze the factors associated with injury outcomes. This study uses multiple trauma scores, namely, the Injury Severity Score (ISS), Paediatric Trauma Score (PTS), and Revised Trauma Score (RTS).

This study explores the prevalence, outcomes, and factors associated with road traffic injuries among the paediatric age group in a tertiary hospital in Malaysia. In the future, this may serve as a prognostic tool and aid in the development of better trauma resuscitation care tailored to paediatric trauma patients.

METHODOLOGY

This was a cross-sectional study conducted from January to December 2021. This study took place at a teaching hospital in Kelantan, Malaysia. A total of 240 patients were included in this study. All paediatric patients (aged 0–18 years) and their parents who consented to participate in this study were included. This involved all modes of arrival, such as walk-in, referral from health clinics or other hospitals, and ambulance calls. The information obtained included patients' demographics, injury profiles, and clinical information, such as vital signs and GCS score upon arrival at the emergency department. Patient outcomes such as interventions (surgical or conservative), admission or discharge details, and final outcomes (alive or death) were recorded. The injuries were then evaluated according to three scores based on the anatomical and physiological values: the Injury Severity Score (ISS), the Paediatric Trauma Score (PTS), and the Revised Trauma Score (RTS).

For statistical analysis, categorical data were presented as frequency and percentage, while numerical data were presented as mean and standard deviation (SD). Simple logistic regression (SLR) test was used in the univariate analysis. Variables with a p-value < 0.05 or deemed important based on the univariate analysis were selected for the multivariate analysis. A multiple logistic regression (MLR) test was used to analyse the multivariate data. For variable comparison, a p-value < 0.05 was considered significant.

RESULTS

In this study, 240 paediatric patients involved in road traffic incidents in the ED were recruited and analysed according to their sociodemographics, clinical characteristics, and outcomes. Throughout 2021, 9565 paediatric patients were admitted, 225 of whom were admitted due to road traffic accidents, resulting in a prevalence of 2.35 road traffic accidents per 100 paediatric inpatients or 2.35% (CI 2.06, 2.68).

Table 1: Sociodemographic and clinical characteristics of the study population (n=240)

Variable	n	(%)	Mean (SD)
Age			11.47 (5.32)
Gender			
Male	189	78.8	
Female	51	21.3	
Mode of arrival			
Walk-in	93	38.8	
Ambulance call	45	18.8	
Referral from health clinic	43	17.9	
Referral from other hospital	59	24.6	
Method of transportation			
Pedestrian	23	9.6	
Cyclist	34	14.2	
Motorbike rider	120	50.0	
Pillion rider	48	20.0	
MVA passenger (front)	2	0.8	
MVA passenger (rear)	13	5.4	
Restraint:			
Helmet			
Yes	78	32.5	
No	124	51.7	
Not applicable	38	15.8	
Seatbelt			
Yes	0	0.0	
No	14	5.8	
Not applicable	226	94.2	
Car seat			
Yes	0	0.0	
No	11	4.6	
Not applicable	229	95.4	
Environment:			
Time of day			
Day	189	78.8	
Night	51	21.3	
Weather			
Wet	11	4.6	

Dry	229	95.4	
Clinical			
Airway			
Normal	199	82.9	
Maintainable	15	6.3	
Unmaintainable	26	10.8	
SBP			120.13 (73.80)
DBP			69.50 (11.58)
RR			21.09 (9.86)
HR			95.42 (20.89)
O2			99.48 (6.46)
GCS			13.6 (3.36)
Pain Score			4.07 (2.05)
Injury Score			
Injury Severity Score			10.9 (9.96)
Paediatric Trauma Score			9.33 (2.41)
Revised Trauma Score			7.54 (1.26)

Table 2: Clinical outcomes (n=240) of the study population

Variable		N	(%)	Mean (SD)
Outcome				
Disposition	Discharge	90	37.5	
	Admit	150	62.5	
Intervention	Surgical	82	34.2	
	Conservative	158	65.8	
Length of stay				3.93 (7.17)
Survival	Alive	237	98.8	
	Death	3	1.3	

The sociodemographic and clinical characteristics of the study population are presented in Table 1. The mean age of paediatric patients who presented to the ED was 11.47 years. The analysis also revealed a male preponderance of 78.8%. Most of the cases seen were from walk-ins (38.8%) and motorbike riders were mostly affected in 50% of the cases. In terms of the injury scores, the mean ISS was 10.9 (SD 9.96), the mean PTS was 9.33 (SD 9.33), and the mean RTS was 7.54 (1.26). The most common injury in this study was head injury (31%), followed by lower limb injury (20%), as presented in Figure 1. Table 2 shows that out of 240 patients, 150 patients were admitted and 82 patients underwent surgical intervention. The mortality rate for paediatric road traffic accidents was 1.3% (3 out of 240).

In the multivariate analysis for factors associated with hospital admission (Table 3), the preliminary variables selected for further analysis were mode of arrival, airway, GCS, pain score, injury scoring (ISS, PTS, RTS), and injury pattern (head injury and others). The final model, presented in Table 5, consisted of the pain score and Injury Severity Score (ISS) only. There was a significant association between pain score and hospital admission. An increase in the pain score increased the odds of hospital admission by 1.22 (Adj 95% CI (1.02, 1.46), $p < 0.030$). Similarly, there was a significant association between ISS and hospital admission. An increase in ISS increased the odds of hospital admission by 1.22 (Adj 95% CI (1.15, 1.30), $p < 0.001$).

In the multivariate analysis for factors associated with surgical intervention (Table 4), the preliminary variables selected for further analysis were mode of arrival, airway, total GCS, pain score, injury scoring (ISS, PTS, RTS), injury pattern (head, face, and lower limb), length of stay, and collision object. The final model, presented in Table 5, consisted of the Paediatric Trauma Score (PTS) and lower limb injury only. There was a significant association between PTS and surgical intervention. An increase in PTS increased the odds of surgical intervention by 0.71 (Adj 95% CI (0.62-0.82), $p < 0.001$). Similarly, there was a significant association between lower limb injury and surgical intervention. Patients with minor or moderate lower limb injury were 2.10 times more likely to undergo surgical intervention than those without lower limb injury (Adj 95% CI (1.00-4.41), $p = 0.049$). In contrast, patients with serious or severe lower limb injury had a 15.05-fold greater risk of surgical intervention than those without lower limb injury (Adj 95% CI (5.26-43.05), $p < 0.001$).

DISCUSSION

Road traffic injuries among paediatric patients are an increasing concern both globally and locally. Fatal road traffic injuries among children (aged 0–18 years) accounted for 13.6% in 2007 and 15.5% in 2009 of the total fatalities caused by road traffic injuries in Malaysia.[7] This issue requires a multifaceted approach, as it may involve collaboration from various sectors.

In 2016, as reported by the Association of Southeast Asian Nations (ASEAN): Regional Road Safety Strategy, the registered number of vehicles was 20,188,565, with an index of 24 per 100,000 population in Malaysia.[8] With the rapid development of infrastructure and urbanisation in cities in Malaysia, the risk of road traffic injuries is expected to increase exponentially.

Figure 1: Injury patterns sustained by paediatric patients involved in road traffic accidents.

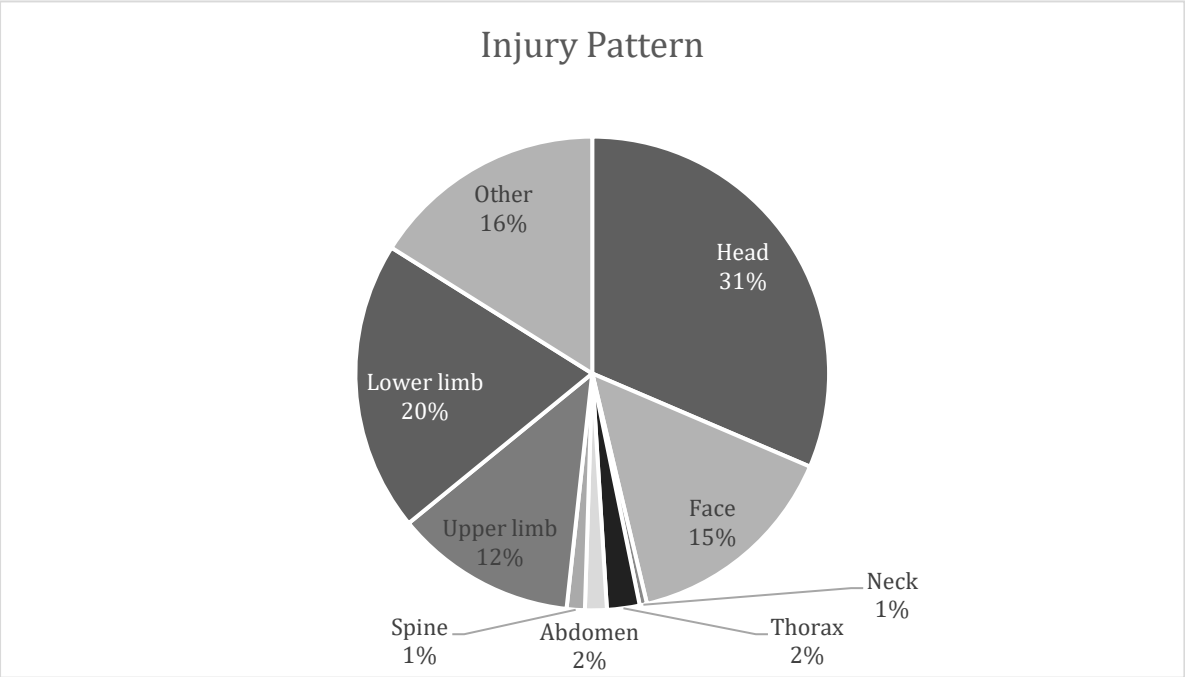

Table 3: Factors associated with admission (SLR)

Variable		Crude Odd Ratio (OR)	95% CI (Upper, Lower)		P-Value*
1.Patient's Factor					
Age		1.019	0.971	1.070	0.446
Weight		1.002	0.987	1.018	0.795
Gender	Male	1			
	Female	0.669	0.357	1.251	0.208
Mode of Arrival	Walk-In	1			
	Ambulance call	2.362	1.115	5.004	0.025
	Referral from health clinic	1.018	0.494	2.098	0.961
	Referral from other hospital	9.422	3.691	24.050	<0.001
Clinical					
Airway	Normal / Maintainable	1			
	Unmaintainable	9.514	2.189	41.350	0.003
SBP		1.001	0.996	1.006	0.666
DBP		1.013	0.990	1.036	0.283
RR		0.993	0.968	1.019	0.590
HR		0.996	0.983	1.008	0.514
O2		1.196	0.676	2.117	0.539
GCS		0.753	0.635	0.892	0.001
Pain Score		1.321	1.147	1.521	<0.001
Injury Scoring					
Injury Severity Score		1.241	1.166	1.320	<0.001
Paediatric Trauma Score		0.615	0.504	0.751	<0.001
Revised Trauma Score		0.692	0.508	0.943	0.020
Injury Pattern					
Head	None	1			
	Minor or moderate	1.662	0.846	3.265	0.140
	Serious or above	33.854	10.067	113.845	<0.001
Face	None	1			
	Minor or above	1.036	0.558	1.924	0.911
Neck	None	1			
	Minor or moderate	0.597	0.037	9.669	0.717
Abdomen	None	1			
	Minor or moderate	1.808	0.185	17.653	0.610

	Serious or above	0.603	0.037	9.758	0.722
Spine	None	1			
	Minor or above	0.610	0.038	9.868	0.728
Upper Limb	None	1			
	Minor or moderate	0.613	0.312	1.203	0.155
	Serious or above	1.672	0.328	8.514	0.536
Lower Limb	None	1			
	Minor or above	0.840	0.437	1.614	0.601
Other	None	1			
	Minor or moderate	0.228	0.125	0.416	<0.001
2. Vehicle's Factor					
Method of transportation	Pedestrian	1			
	Two wheels	1.066	0.440	2.581	0.888
	Four Wheels	1.286	0.330	5.017	0.718
Restraint:					
Helmet	Yes	1			
	No	1.158	0.647	2.074	0.622
	Not Applicable	1.131	0.508	2.517	0.763
Seatbelt	Yes				
	No	1			
	Not Applicable	1.085	0.352	3.345	0.887
Car Seat	Yes				
	No	1			
	Not Applicable	1.634	0.422	6.324	0.477
3. Environment					
Time of day	Day	1			
	Night	0.604	0.323	1.129	0.114
Weather	Wet	1			
	Dry	1.412	0.418	4.766	0.579

Table 4: Factors associated with surgical intervention (SLR)

Variable		Crude Odd Ratio (OR)	95% (Upper,	CI Lower)	P-Value*
1.Patient's Factor					
Age		1.045	0.992	1.101	0.095
Gender	Male	1.174	0.605	2.277	0.636
	Female	1			
Mode of Arrival	Walk-in	1			
	Ambulance call	2.286	1.059	4.934	0.035
	Referral from health clinic	1.837	0.831	4.061	0.133
	Referral from other hospital	3.097	1.530	6.269	0.002
Clinical					
Airway	Normal	1			
	Maintainable	0.842	0.258	2.752	0.776
	Unmaintainable	5.212	2.149	12.644	<0.001
SBP		1.002	0.998	1.006	0.385
DBP		0.988	0.965	1.011	0.310
RR		1.008	0.982	1.034	0.567
HR		0.994	0.981	1.006	0.331
O2		1.661	0.740	3.732	0.219
GCS		0.887	0.819	0.960	0.003
Pain Score		1.223	1.067	1.402	0.004
Injury Scoring					
Injury Severity Score		1.057	1.026	1.090	<0.001
Paediatric Trauma Score		0.671	0.580	0.776	<0.001
Revised Trauma Score		0.687	0.544	0.868	0.002
Injury Pattern					
Head	None	1			
	Minor or moderate	0.330	0.141	0.770	0.010
	Serious or above	1.176	0.651	2.123	0.591
Face	None	1			
	Minor or moderate	2.022	1.094	3.738	0.025
	Serious or above	2.333	0.320	16.997	0.403
Thorax	None	1			
	Minor or moderate	0.962	0.172	5.367	0.965
	Serious or above	0.962	0.086	10.773	0.975

Abdomen	None	1			
	Minor or moderate	1.925	0.266	13.921	0.516
	Serious or above	0.000	0.000		0.999
Spine	None	1			
	Minor or moderate	0.000	0.000		
	Serious or above	3.875	0.346	43.385	
Upper Limb	None	1			
	Minor or moderate	1.625	0.820	3.219	0.164
	Serious or above	2.167	0.524	8.957	0.286
Lower Limb	None	1			
	Minor or moderate	2.138	1.067	4.285	0.032
	Serious or above	19.289	6.946	53.565	<0.001
Other	None	1			
	Minor or moderate	0.734	0.396	1.361	0.327
Length of Stay		1.414	1.271	1.574	<0.001
2. Vehicle's Factor					
Method of Transportation	Pedestrian	1			
	Two wheels	1.994	0.711	5.595	0.190
	Four Wheels	1.800	0.418	7.757	0.430
Restrain:					
Helmet	Yes	1.429	0.629	3.247	0.394
	No	0.994	0.455	2.173	0.988
	Not Applicable	1			
Seatbelt	Yes				
	No	0.759	0.231	2.499	0.650
	Not Applicable	1			
Car Seat	Yes				
	No	1.106	0.314	3.894	0.875
	Not Applicable	1			
3. Environment					
Time of day	Day	1			
	Night	0.523	0.257	1.065	0.074
Weather	Wet	1			
	Dry	1.404	0.362	5.442	0.623

Table 5: Associated factors for the outcome of paediatric patients involved in road traffic injuries (MLR)

Variable		**Adjusted OR**	**95 % (Upper,**	**CI Lower)**	**P-Value***
Admission					
Pain Score		1.218	1.019	1.456	0.030
Injury Severity Score		1.221	1.148	1.298	<0.001
Surgical intervention					
Paediatric Trauma Score		0.709	0.617	0.816	<0.001
Lower limb Injury	None	1			
	Minor or moderate	2.104	1.004	4.410	0.049
	Serious or above	15.051	5.262	43.053	<0.001

The mean age of the patients in this study was 11.47 years, which was younger than the mean age of 14.30 years reported in a previous study performed in Kelantan.[9] Currently, children are more exposed to road use, as some may have started riding motorcycles at a younger age than they did in the past because of easy accessibility and peer influence. The greater proportion of boys involved in road traffic injuries in this study is also observed in studies conducted in Singapore and India.[10-12] The most common mode of transportation involved in injuries was motorbike riding, followed by pillion riding, as reflected in previous studies conducted in Kelantan and India.[9,11] In contrast to our data showing a higher rate of road traffic injuries among motorcyclists, a study from Singapore revealed that the majority of injuries involved motor vehicle passengers.[10] This difference might be due to the lower cost of fuel and motorcycle maintenance, which makes them more affordable for the majority of households. A study by Rahman et al. reported that motorcyclists were the most affected group in paediatric road traffic injuries, which

occurred on busy road networks and almost equally in urban and suburban areas.[9] There are few possible mechanisms for motorcycle injuries to occur: first, frontal impact or ejection when part of the motorcycle is abruptly stopped upon impact while the rest continue to move; second, lateral impact or ejection, which can cause injury to the extremities; and third, when motorcyclists attempt to slow down or turn sideways to avoid impending impact.

Trauma scores may help in providing information regarding the prognosis of patients. In this study, hospital admission was closely associated with both the pain score and the ISS. This finding correlates with a study conducted by Huang et al. on children under 6 years of age with various types of traumatic injuries who were admitted to the hospital. The study examined the outcomes of mortality, ICU stay and length of hospital stay by using the ISS, GCS, and RTS. All three scores were statistically significant, and ISS was found to be the strongest predictor.[13] Ghag et al. also concluded that in a study on the prediction of length of stay in paediatric trauma patients, the ISS is a better predictor than other scores are, as it has a positive correlation with length of stay.[14] This score is also widely used among adult patients.

The outcome of surgical intervention in this study was associated with the PTS and an increase in the trauma score of lower limb injuries. Essa et al. reported that the PTS had the highest specificity and sensitivity (98.6% and 95.8%, respectively) among the other factors studied as prognostic predictors in polytraumatised children.[15] On the other hand, Narci et al. reported no correlation between PTS and duration of hospitalisation, need for intensive care or operation and/or morbidity. They reported that the AIS and ISS had greater prognostic importance in paediatric patients.[16] PTS is a combined anatomic and physiological injury score. It may help in triaging paediatric trauma patients during pre-hospital care, particularly in health clinics and district hospitals. This will help in anticipating the need to transfer patients to a trauma centre for better access to intervention and care. Our study revealed no significant relationships between restraint use in vehicle factors, environmental factors, and patient outcomes.

Gicquel et al. studied the various factors contributing to traffic accidents in youth and noted that two major factors, the traffic environment and human behaviour, played the most important role. Adolescents are vulnerable to accidents, as their risk-taking behaviour and poor knowledge increase their hazard exposure. These behavioural changes may be associated with major brain organisation that selectively affect the prefrontal cortex and impair cognitive control.[17]

In Malaysia, the increase in road traffic injuries can be attributed to rapid population growth, economic expansion, and industrialisation. As the population grows and the economy thrives, there is a higher demand for transportation, resulting in increased road usage. This leads to congestion, more vehicles on the road, and a higher probability of accidents. The road transport system involves three key components: road users (drivers, pedestrians, cyclists, etc.), vehicles, and the environment (road conditions, weather, and infrastructure).[18] The Ministry of Works has highlighted four approaches to improve road traffic safety programme: accident prevention, accident reduction, road maintenance, and construction of new roads.

Lastly, as this study was conducted at a single centre, the number of participants is limited to the patients treated by the specific hospital, and it may not represent the broader population, or the variability found in other centres. This single-centred study may also have few biases in its findings, as it follows the treatment protocols of that institution, which may differ from national or international standards. To minimise bias, we increased the sample size and used multivariate analysis to control the confounding variables in the statistical analysis. In this study, we analysed the factors affecting outcome by using simple and multiple logistic regression. In addition, the study was conducted amid the COVID-19 pandemic, which severely impacted Malaysia, where we faced multiple lockdowns and a reduction in trauma cases during certain months.

Other aspects for future research could include the follow-up of patients to capture data on true mortality and determine outcome levels via the Glasgow Outcome Scale (GOS) score upon discharge. Another clinical variable, the Shock Index Paediatric Adjusted Age (SIPA), can also be evaluated to determine the severity of injury in children in future studies. The data could also include the demographic data of the area where the accident occurred. A new study involving additional hospitals across Peninsular Malaysia to gather a larger data sample and capture a more diverse demographic pattern will soon be conducted. The results will be shared with the public through an educational outreach program aimed at school students.

CONCLUSION

Road traffic injuries are an urgent matter that needs to be addressed at all levels of government and health agencies. This includes awareness among parents and at the school level. It is vital to instil the importance of road safety from a young age so that children will not

grow into reckless road users, especially motorbike riders. Safety features such as more motorcycles and pedestrian lanes can be implemented. Tight legislation in suburban areas helps reduce the number of accidents. For acute trauma care, the incorporation of trauma scores such as the ISS and PTS can serve as prognostic tools to predict the need for admission and surgical intervention, respectively. To conclude, road safety should be accessible in parallel with the development and urbanisation of a country.

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AUTHORS' CONTRIBUTIONS

WAWMZ - data gathering and analysis; ASS and AYMN – study design and supervision; MAAB – analysis; NY – drafting.

DECLARATION OF CONFLICTING INTERESTS

We declare that there are no conflicts of interest related to the study, authorship, and/or publication of this article.

ETHICAL APPROVAL

This study was ethically approved by JEPeM, the local ethics committee of Universiti Sains Malaysia (JEPeM code: USM/JEPeM/20100527). Written informed consent was obtained from all patients involved in this study.

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