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An analysis of the length of hospital stay after acetaminophen overdose

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Abstract

Background: Acetaminophen is one of the most commonly encountered medications in self-poisoning, with a high rate of morbidity. The prevalence and characteristics of acetaminophen intoxication associated with long hospital stay in patients are not well defined. Objectives: This study aims to identify the clinical and demographic factors associated with the length of in-hospital stay (LOS), and to evaluate the effect of early treatment of acetaminophen overdose patients ($\leq$8 hours) by intravenous *N*-acetylcysteine (IV-NAC) on hospital stay. Methods: This is a retrospective cohort study of hospital admissions for acetaminophen overdose conducted over a period of 5 years from 1 January 2004 to 31 December 2008. Patients were divided into two groups: LS group patients had a long hospital stay (> median hours stay in hospital) and SS group patients had a short hospital stay ($\leq$ median hours stay in hospital). Variables were abstracted from medical records for comparison between the two groups. A total of 20 variables were identified for comparison. Parametric and non-parametric tests were used to test differences between groups depending on the normality of the data. SPSS 15 was used for data analysis. Results: Of the 305 patients, 11 factors were identified in the univariate analysis as associated with LS. Three independent factors were found to be significant predictors of LS in the multivariate analysis. The factors associated with LS were seen among patients with a history of abdominal pain after ingestion of acetaminophen ($p = 0.04$), who were on IV-NAC administration ($p < 0.001$) and had an acutely depressed mood ($p = 0.003$). Late time to NAC infusion of more than 8 hours was associated with LS rather than SS (96 patients [57%] and 6 [24%], respectively; $p = 0.003$). Conclusion: Patients with long hospital stay have different clinical characteristics compared to patients with short hospital stay. We identified time to IV-NAC administration is a potentially modifiable factor that may lead to prolonged hospital stay. When risk assessment indicates that NAC is required, it is highly recommended that NAC be started in the first hours of admission to reduce the LOS.

Keywords

acetaminophen, overdose, hospital stay, *N*-acetylcysteine

Introduction

Acetaminophen (paracetamol) is a commonly used analgesic and antipyretic drug.[1] Acetaminophen overdose has been extensively reported in the USA and UK.[2,3] It remains the most common means of pharmaceutical poisoning in the eastern nations, including Malaysia.[4,5] In fact, acetaminophen in large doses is capable of causing both hepatic[6,7] and renal failure.[8] The risk of toxicity is initially determined from the extent of acetaminophen exposure after considering the stated amount ingested and comparison of serum acetaminophen concentrations to the Rumack–Matthew nomogram.[9,10] The extent of hepatic and renal

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injury is later determined by measurement of serum liver enzyme activity, prothrombin time, and creatinine concentrations.[11]

For adults, ingestion of 150 mg/kg or more (11.5 g for a 70 kg adult [23 tablets of 500 mg]) should be considered potentially hepatotoxic.[12] Management of poisoned patients includes activated charcoal and administration of the antidote *N*-acetylcysteine (NAC), which reduces complications and provides almost complete protection against liver necrosis if given within 8–10 hours of acetaminophen ingestion.[13,14] Multiple protocols for the administration of NAC in the patient with acetaminophen overdose exist for both the oral and intravenous routes. There has been much discussion of the pros of oral versus intravenous administration of NAC in the literature and each therapeutic protocol has its supporters.[15] The intravenous preparation was approved by the US Food and Drug Administration (FDA) for use in the United States in 2004. Intravenous NAC (IV-NAC) has been the standard treatment for acetaminophen overdose in Europe, Canada, Asia, and Australia.[16,17] The current protocol in Malaysia for the management of acetaminophen overdose involves an IV NAC infusion of 150 mg/kg in 200 mL 5% dextrose over 15 minutes, followed by 50 mg/kg in 500 mL 5% dextrose over 4 hours, and 100 mg/kg in 1000 mL 5% dextrose over 16 hours.[18] The dose of NAC licensed for use in Malaysia was similar to other countries.[16,17]

Factors influencing the length of in-hospital stay (LOS) in poisoned patients have received less attention in the literature, and there are no previously published studies regarding the LOS after acetaminophen overdose. Determining the factors influencing the hospitalization period may help decrease the LOS, reduce costs, and improve the efficiency of management. The knowledge of prevalence, clinical characteristics, and predictors of prolonged hospital stay in patients after acetaminophen overdose might contribute to reducing complication rates by enhancing the application of specific therapeutic and management strategies to patients at high risk of hepatotoxicity. Furthermore, knowledge of predictors in the first hours of hospital admission still deserves special attention because even a quantitative decrease in hospital stay may be translated into substantial savings in health care costs and resources.

To improve our knowledge about hospital stay after acetaminophen overdose, we hypothesized that prolonged hospital stays after acetaminophen overdose could be predicted by clinical characteristics present in the patient upon hospital admission. Also, we hypothesized that the delay in NAC infusion after acetaminophen overdose may prolong hospital stays. To present these hypothesis, we carried out this 5-year hospital-based study with the following objectives: (1) to investigate the prevalence of prolonged hospital stay in patients admitted to hospital after acetaminophen overdose, (2) to identify the clinical and demographic factors associated with prolonged hospital stays, and (3) to evaluate the effect of early treatment of acetaminophen overdose patients ($\leq$8 hours) by IV-NAC on prolonged hospital stays.

Methods

Settings and study design

This is an observational retrospective case review of all patients with acetaminophen overdose admitted to a 1200-bed hospital located in the northern region of Malaysia. The hospital provides health care and emergency treatment for all illnesses and accidents. All aspects of the study protocol, including access to and use of the patient clinical information, were authorized by the local health authorities before initiation of this study.

Participants and data collection

Data were collected during the period of study from 1 January 2004 to 31 December 2008. A computer generated list was obtained from the Hospital Record Office. We identified our cases according to the T-codes of the International Classification of Diseases tenth revision (*ICD-10*). All patients with diagnostic code T 39.1 (acetaminophen overdose) were included in the study. The records of all patients with a discharge diagnosis of acetaminophen overdose were analyzed. Patients who were not admitted to the hospital after being assessed in the Accident and Emergency department were excluded from this study. We included patients who had a history of acetaminophen ingestion reported by either the patient or the family. We went on to confirm that the patient had substantial acetaminophen ingestion by history or by estimated serum acetaminophen level.

Patients' medical records were reviewed systematically. Specially designed data-collection forms were used to collect data. They were divided into two groups: an LS group with long hospital stays and an SS group with short hospital stays. Long hospital stay was defined as a LOS greater than the median. LOS

was calculated as the hour of discharge minus the hour of admission.

Variables were abstracted from medical records for comparison between the two groups. A total of 20 variables were identified for comparison. These included nine patient variables (age, gender, ethnicity, cause of overdose including intentional or unintentional, history of psychiatric illness, history of chronic illness, history of alcohol intake, history of suicide attempt, and acute depressed mood) and eleven acetaminophen variables (number of ingested agents, post-ingestion nausea, post-ingestion vomiting, post-ingestion diarrhoea, post-ingestion abdominal pain, reported dose ingested, the latency time [the time of ingestion to the time the patient was presented at the hospital], gastric lavage done, activated charcoal intake, NAC administration, and estimated acetaminophen level according to whether it was above or below the 'possible toxicity' treatment line [150 mg/L at four hours and 5 mg/L at 24 hours]).[19] A 'possible toxicity' line 25% below the standard Rumack–Matthew nomogram was proposed to allow for possible errors in plasma assays and ingestion times.[9,19] Acute depressed mood was defined as the presence of causes of deliberate self-harm such as depression, anxiety, and adjustment disorders; these causes were noted by the hospital psychiatric specialist report.

We therefore studied all patients who were treated with IV-NAC to determine whether a long hospital stay was more likely to occur in patients with late time to NAC administration (>8 hours). Two categories were used for time from acetaminophen ingestion to IV-NAC administration: $\leq$8 and >8 hours.

Statistical analysis

Data were entered and analyzed using the Statistical Package for Social Sciences program version 15 (SPSS). Data were expressed as means $\pm$ SD for continuous variables and as frequencies for categorical variables. Variables that were not normally distributed were expressed as medians (lower–upper quartiles). Variables were tested for normality using the Kolmogorov-Smirnov test. Either the chi-square or the Fisher exact test, as appropriate, was used to test significance between categorical variables. The student's *t* test was used to compare the means of continuous variables. If assumptions of equality of variance and normality (assumed for the *t* test) were not met, the Mann-Whitney *U* test (a nonparametric equivalent of the *t* test) was performed as appropriate. Multiple logistic regression analysis was used to identify factors associated with a length of stay greater than the median. Variables included in the regression were those with significant *p* values (<0.05) in the univariate analysis. The proportion of patients with long hospital stays in the study group was expressed as a prevalence rate with a 95% confidence interval (95% CI). The association between LS group and SS group and the variables of interest was evaluated by calculating the odds ratio (OR) with the corresponding 95% CI.

Results

Three hundred and five cases of acetaminophen overdose were identified. Table 1 shows the demographics and clinical characteristics of acetaminophen poisoning cases. Two hundred and fifty-six (83.9%) of the cases were females and forty-nine (16.1%) were males, giving a male: female ratio of 0.19: 1. The average age of the cases was 23.07 years $\pm$ 7.34. Initial management included gastric lavage, which was performed in 180 cases (59%). Activated charcoal was given while patients were in the Accident and Emergency department. It was given as single or multiple doses in 190 cases (62.3%). IV NAC was given in 146 cases (47.9%) after estimation of acetaminophen levels. Overall, two patients were admitted to the intensive care unit but no patient died or needed a liver transplant as a result of acetaminophen overdose. Also, only two patients with acetaminophen overdose were presented to the hospital with impairment in level of consciousness upon admission.

The distributions of LOS in the study population are shown in Figure 1. Across the entire study period, the median (interquartile range) LOS was 36 hours (20–61 hours). Thus, an increased length of stay was defined as longer than 36 hours. Of the 305 acetaminophen overdose cases, 156 (51.1%) patients had long hospital stays. The medians (interquartile ranges) were 20 hours (16–26 hours) and 62 hours (46–80.75 hours) in the SS and LS groups, respectively.

The results of univariate analysis in 305 patients according to demographic and clinical characteristics status on admission are shown in Table 1. Eleven significant factors were identified by the comparison of 20 variables between the SS and LS groups in univariate analysis. Long hospital stay was significantly associated with intentionally ingested drug (OR = 1.71; 95% CI = 1.1–2.65; $p = 0.005$), patients with acute depressed mood (OR = 2.32; CI = 1.73–3.11;

Table 1. Patient characteristics by categories for long and short length of stay groups ($N = 305$)

Variable	Total $N = 305$	LS group >36 hours $N = 149$	SS group $\leq$ 36 hours $N = 156$	Odds ratio with 95% CI for long hospital stay	p Value
Age[a]	23.07 $\pm$ 7.34	23.13 $\pm$ 7.43	23.01 $\pm$ 7.28	–	.892
Gender					
Male	49 (16.1)	26 (17.4)	23 (14.7)	1.1	.521
Female	256 (83.9)	123 (82.6)	133 (85.3)	(0.82–1.48)	
Ethnic group					
Malay	153 (50.2)	68 (45.6)	85 (54.5)	–	.370
Chinese	72 (23.6)	40 (26.8)	32 (20.5)	–	
Indian	72 (23.6)	36 (24.2)	36 (23.1)	–	
Other	8 (2.6)	5 (3.4)	3 (1.9)	–	
Cause of intent					
Intentional (suicide)	256 (83.9)	134 (89.9)	122 (78.2)	1.71	.005
Unintentional (accidental)	49 (16.1)	15 (10.1)	34 (21.8)	(1.1–2.65)	
History of alcohol intake[b]					
Yes	26 (8.5)	11 (7.4)	15 (9.6)	0.86	.494
No	279 (91.5)	138 (92.6)	141 (90.4)	(0.54–1.36)	
Chronic illness[b]					
Yes	11 (3.6)	4 (2.7)	7 (4.5)	0.74	.302
No	294 (96.4)	145 (97.3)	149 (95.5)	(0.34–1.63)	
History of psychiatric illness[b]					
Yes	9 (3)	4 (2.7)	5 (3.2)	0.91	.803
No	296 (97)	145 (97.3)	151 (96.8)	(0.43–1.90)	
History of suicide attempt[b]					
Yes	7 (2.3)	3 (2)	4 (2.6)	0.88	.752
No	298 (97.7)	146 (98)	152 (97.4)	(0.37–2.07)	
Acute depressed mood[c]					
Yes	164 (56.2)	110 (74.8)	54 (37.2)	2.32	<.001
No	128 (43.8)	37 (25.2)	91 (62.8)	(1.73–3.11)	
Number of ingested agents					
Single agent	26 (8.5)	15 (10.1)	11 (7.1)	1.2	.352
Multiple agents	279 (91.5)	134 (89.9)	145 (92.9)	(0.85–1.71)	
Reported dose ingested (grams)[d]					
$\geq$10 g	175 (57.6)	119 (80.4)	6 (35.9)	3.03	<.001
<10 g	129 (42.4)	29 (19.6)	100 (64.1)	(2.16–4.23)	
Latency time (hours)					
>8 h	81 (26.6)	54 (36.2)	27 (17.3)	1.57	<.001
$\leq$8 h	224 (73.4)	95 (63.8)	129 (82.7)	(1.23–1.95)	

(continued)

Table 1 (continued)

Variable	Total $N = 305$	LS group >36 hours $N = 149$	SS group ≤ 36 hours $N = 156$	Odds ratio with 95% CI for long hospital stay	p Value
Gastric lavage at presentation					
No	125 (41)	73 (49)	52 (33.3)	1.38	.005
Yes	180 (59)	76 (51)	104 (66.7)	(1.1–1.73)	
Activated charcoal intake					
No	115 (37.7)	65 (43.6)	50 (32.1)	1.28	.037
Yes	190 (62.3)	84 (56.4)	106 (67.9)	(1.02–1.6)	
N-acetylcysteine administration					
Yes	146 (47.9)	121 (81.2)	25 (16)	4.71	<.001
No	159 (52.1)	28 (18.8)	131 (84)	(3.34–6.64)	
Abdominal pain at presentation					
Yes	82 (26.9)	56 (37.6)	26 (16.7)	1.64	<.001
No	223 (73.1)	93 (30.5)	130 (83.3)	(1.32–2.03)	
Nausea at presentation					
Yes	69 (22.6)	35 (23.5)	34 (21.8)	1.05	.721
No	236 (77.4)	114 (76.5)	122 (78.2)	(0.8–1.37)	
Vomiting at presentation					
Yes	202 (66.2)	111 (74.5)	91 (58.3)	1.49	.003
No	103 (33.8)	38 (25.5)	65 (41.7)	(1.12–1.97)	
Diarrhoea at presentation[b]					
Yes	7 (2.3)	6 (4)	1 (0.6)	1.79	.038
No	298 (97.7)	143 (96)	155 (99.4)	(1.29–2.47)	
Estimated acetaminophen level[e]					
Above the 'possible toxicity' treatment line	127 (42.3)	105 (72.4)	22 (14.2)	3.58	<.001
Below the 'possible toxicity' treatment line	173 (57.7)	40 (27.6)	133 (85.8)	(2.69–4.75)	

CI: confidence interval, LS group: long hospital stay, SS group: short hospital stay.
[a] Significance of differences estimated with Student's *t* test.
[b] Significance of differences estimated with Fisher's exact test.
[c] Psychiatric illness were not identified in 13 patients.
[d] Dose ingested was not reported in one patient.
[e] Acetaminophen levels were not determined in five patients.

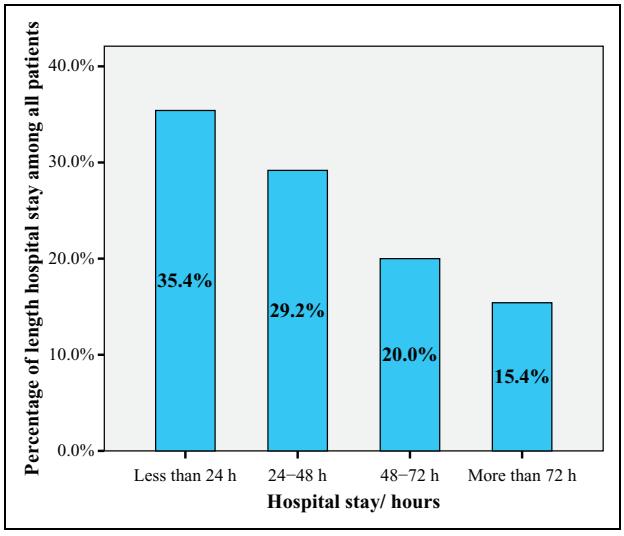

Figure 1. Distribution bar chart of length of hospital stay (LOS) among 305 patients.

$p < 0.001$), reported acetaminophen dose ingested $\geq$10 grams (OR = 3.03; CI = 2.16–4.23; $p < 0.001$), latency time of more than 8 hours (OR = 1.57; CI = 1.23–1.95; $p < 0.001$), patients without gastric lavage (OR = 1.38; 95% CI = 1.1–1.73; $p = 0.005$), patients without activated charcoal intake (OR = 1.28; 95% CI = 1.02–1.6; $p = 0.037$), NAC administration (OR = 4.71; 95% CI = 3.34–6.64; $p < 0.001$), patients with abdominal pain at presentation (OR = 1.64; 95% CI = 1.32–2.03; $p < 0.001$), patients with vomiting at presentation (OR = 1.49; 95% CI = 1.12–1.95; $p = 0.003$), patients with diarrhoea at presentation (OR = 1.79; 95% CI = 1.29–2.47; $p = 0.038$), and patients with acetaminophen level above the 'possible toxicity' treatment line (OR = 3.58; 95% CI = 2.69–4.75; $p < 0.001$).

Table 2 shows the multivariate logistic regression analysis of factors related to long hospital stay. Three significant factors were identified in the comparison of 11 variables between the SS and LS groups in multivariate logistic regression analysis. The factors associated with LS were seen among patients who had abdominal pain at presentation ($p = 0.04$), patients who had acute depressed mood ($p = 0.003$), and NAC administration ($p < 0.001$). The model was significant with a chi-square of 173.5, DF = 11; $p < 0.001$.

We further analysed and compared the time to NAC infusion associated with LOS. As shown in Figure 2, the median (interquartile range) times to NAC infusion in the LS and SS groups were 9 hours (6–12.5 hours) and 6 hours (5.25–9 hours), respectively. Time to NAC infusion greater than 8 hours was associated with long hospital stay rather than short hospital stay (96 [57%] patients and 6 [24%], respectively; $p = 0.003$)

Discussion

To the best of our knowledge, this study is the first of its kind to obtain an initial data regarding the prevalence rate of prolonged hospital stay in patients admitted to hospital after acetaminophen overdose and to identify the clinical and demographic factors associated with prolonged hospital stays. Also, this is the first study comparing late time to NAC infusion to prolonged hospital stay, revealing the effect of early treatment of acetaminophen overdose patients ($\leq$8 hours) by IV-NAC on hospital stay.

In this study, the hospital duration ranged from 4 hours to 12.5 days (mean: 46 hours). A previous study found that hospital duration ranged from 20 minutes to 111 days (mean: 26 hours).[20] In a previous retrospective study with 93 patients presenting to the emergency department after acetaminophen overdose, the mean hospital stay was 4.25 days. The hospital stay was higher in the accidental overdose group (mean 6.4 $\pm$ 6.1 days) in comparison to the suicidal overdose group (3.9 $\pm$ 2.7 days).[21]

In our study, patients with poisoning due to acetaminophen ingestion had different hospital stays in comparison to previous studies. These observed differences in hospital stay may be due in part to the quality of medical care and patient factors. These findings still deserve a special attention because a quantitative decrease in hospital stay may be translated into substantial savings in health care costs and resources.[22]

In the current study, having a history of abdominal pain after ingestion of acetaminophen, IV-NAC administration, and an acutely depressed mood were identified as predictors of long hospital stay.

Our study has found that a history of abdominal pain after ingestion of acetaminophen was an independent predictor for long hospital stay. To our knowledge, abdominal pain is considered one of the clinical signs suggestive of acetaminophen toxicity.[13] A previous study has been conducted to identify risk markers for hepatic failure in acetaminophen overdose.[23] In that brief report, Knell listed abdominal pain as associated with hepatic failure.[23] This suggests that early evaluation of serum acetaminophen

Table 2. Independent factors associated with long hospital stay after acetaminophen poisoning using multiple logistic regression analysis (enter method)

Variable	Wald test	*p* Value	Odds ratio (95% CI)
Cause of intent (intentional)	0.18	.68	0.8 (0.29–2.25)
High stated acetaminophen dose (≥10 g)	1.91	.17	1.81 (0.78–4.21)
Long latency time (>8 h)	0.05	.82	09 (0.36–2.24)
Without gastric lavage at presentation	0.73	.39	1.45 (0.62–3.37)
Without activated charcoal administration	3.64	.056	2.32 (0.98–5.5)
Abdominal pain at presentation	4.24	.04	2.3 (1.04–5.07)
Vomiting at presentation	0.07	.79	1.06 (0.68–1.65)
Diarrhoea at presentation	2.43	.12	9.71 (0.56–18.86)
Estimated acetaminophen level above the 'possible toxicity' treatment line	0.02	.90	0.92 (0.25–3.45)
N-acetylcysteine administration	19.11	<.001	19.13 (5.1–33.16)
Acute depressed mood	8.61	.003	3.5 (1.52–8.07)

CI: confidence interval.

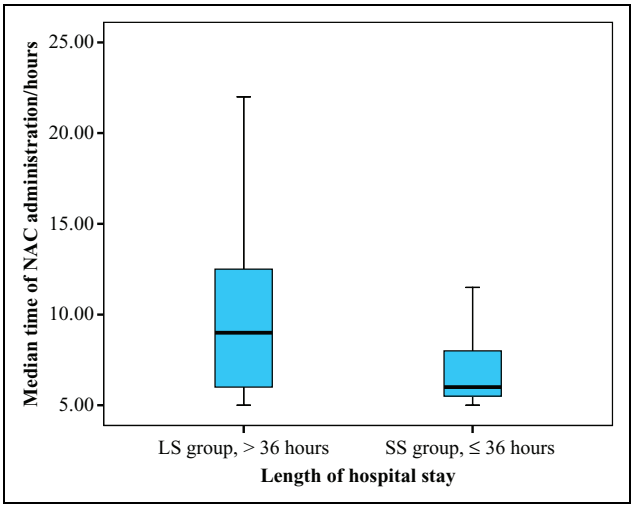

Figure 2. Boxplot times of *N*-acetylcysteine infusion to differentiate between long hospital stay (LS) and short hospital stay (SS) groups. The median time to NAC infusion was significantly higher in patients with long hospital stays when compared to patients with short hospital stays ($p = .003$).

and alanine aminotransferase (ALT) and early NAC administration among these patients with abdominal pain have the potential to improve the outcome after acetaminophen overdose.[13]

Our data showed that LOS was significantly more common in patients with NAC administration. The high prevalence of long hospital stay after acetaminophen overdose might be due to delay in NAC administration after estimation of acetaminophen levels among patients with high reported ingested doses. The current study observed that a long hospital stay was associated with a late time to NAC infusion of more than 8 hours. The delay from acetaminophen ingestion to antidote (*N*-acetylcysteine) treatment deserves close attention. *N*-acetylcysteine administration was the second most important independent risk factor in the model. A Danish study showed that all patients developing hepatic failure had a delay of at least 18 hours before receiving antidote treatment.[24] These findings contrast with a British report on 560 patients with acetaminophen intoxication, in which 20% of those treated within 12 hours after overdose died.[25] The delay in initiating the antidote may be due to delay in arrival time to emergency department (latency time), delay in estimation of acetaminophen level, unavailability of antidote, or delay in the exact diagnosis regarding the amount of acetaminophen ingested or the time of ingestion. A point of concern when using the antidote delay as a causal factor for LOS is that physicians may sometimes have difficulties obtaining an accurate and reliable history with regard to the exact time of ingestion or amount of acetaminophen ingested. This could be due to the emotional state, forgetfulness, or direct misleading by the patient. Despite these possible biases the amount of acetaminophen ingested and latency time proved valuable in the univariate model, and this information should be used in a 'positive' manner: a delayed time to antidote should increase the attention to the clinical status of the patient.

The mean time from exposure to treatment has been reported to significantly affect the prognosis and final outcome of acetaminophen toxicity. A panel of Australian and New Zealand clinical toxicologists stated that for patients who present 8 or more hours after ingestion, NAC should be commenced immediately if the

reported dose exceeds the threshold for possible toxicity or the patient shows clinical signs suggestive of acetaminophen toxicity (nausea, vomiting, right upper quadrant pain or tenderness). Evaluation of serum acetaminophen and ALT levels should then be performed as soon as possible. If the serum acetaminophen level is subsequently found to be below the nomogram line, NAC may be ceased; if above the line, it should be continued. The baseline serum ALT level assists risk assessment and provides useful baseline data if NAC is indicated. Similarly, if NAC is commenced, the baseline international normalized ratio and platelet count provide additional data to inform later risk assessments (e.g., for risk of death from hepatic failure).[13]

In the present study, acute depressed mood was an independent predictor of LOS. Several studies conducted in general hospitals have tried to determine the impact of psychiatric illness on LOS with conflicting results.[26-31] The main difficulty is evaluating whether having a psychiatric illness is an independent risk factor for increased LOS, and if so, which specific mental disorders can influence LOS. A critical review of 26 outcome studies that examined the association of psychiatric illness and LOS in the general hospital showed that impaired cognition associated with delirium and dementia, depressed mood, and other personality variables contribute to prolonged hospital stays.[32] In addition, it must be considered that LOS may be influenced in addition by the health care system itself. To our knowledge, comparative epidemiological studies investigating the influence of psychiatric morbidity in patients with acetaminophen overdose on LOS in different health care systems and use of a prospective design and comparable instruments have not been done until now. For this reason, we do not know whether our results are true for countries with health care systems different from that in Malaysia. It is recommended that patients suffering a serious psychiatric disorder and/or at high risk of suicide are likely to require in-patient treatment of the underlying psychiatric disorder.[33] In a previous study, the authors advised that all patients presenting to hospital with an episode of self-harm should have a psychosocial assessment.[34] This is because of the significant risk of completed suicide following deliberate self-poisoning and the fact that approximately half of all suicides in the United Kingdom have a history of deliberate self-harm.[35]

Although this study is the first one of its type, there were some limitations in this study. They include the retrospective nature and lack of structured interview assessment of the subjects, other variables such as social and economic factors that might affect the LOS could not be assessed. Registry data were obtained by chart review, and although the process was systematic with written data definitions and continuing quality control procedures, abstraction errors were possible to occur.

Conclusion and recommendations

Patients with long hospital stays have different clinical characteristics compared to patients with short hospital stays. Our data suggest that abdominal pain at presentation, presence of psychiatric illness, and delay in NAC administration were associated with prolonged hospital stay. We identified time to NAC administration as a potentially modifiable factor that may lead to prolonged hospital stays. When risk assessment indicates that NAC is required primarily from the stated quantity of ingested acetaminophen, it is highly recommended that NAC should be started during the first hours of admission. This potentially modifiable factor would be an ideal target for studies in future aiming to reduce the burden of illness and health care costs of acetaminophen overdose, because LOS is a major cost component of hospital budgets. This highlights the need for increased education for physicians who work in the emergency department on the proper care of patients who present with acetaminophen overdose.[36,37] In addition, all accident and emergency department staff who manage deliberate self-poisoning patients need to know how to conduct a brief psychosocial assessment, especially with regard to identifying risk factors for repetition of suicide attempts and for suicide.[34]

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Conflict of interests

We would like to declare that there is no conflict of interests in conducting this research.

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