A PROPOSED NEW SCORING SYSTEM FOR HYDROCARBON POISONING CASES IN CHILDREN IN GHARBIA GOVERNORATE

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ABSTRACT

Hydrocarbons toxicity still remains a contributor to childhood morbidity and mortality in developing countries. They mainly affect both respiratory and central nervous systems. In the present study we report four prognostic grades for hydrocarbon toxicity among children, to establish a rapid bedside and detailed clinical scoring system. It was carried out on 70 hydrocarbon exposed patients less than 18 years old. They were divided into two groups; test group (50 cases) and confirmatory group (20 cases). Subsequently, in the test group; detailed toxicological history, thorough medical examination and full investigations were done. Accordingly, these patients were classified into 4 different prognostic grades as follows, grade I: cases who achieved complete cure, grade II: cases who suffered chest complications (chemical pneumonitis), grade III: cases who were admitted to ICU or put on ventilator and grade IV: dead cases. A new scoring system was established to predict prognosis of the cases. The scoring system was based on the following parameters: cyanosis, PaO_2 level, CNS manifestations, pulmonary involvement, respiratory distress, and vomiting. The total scoring system number (TSN) was calculated for each patient and interpreted as follows: (TSN) less than 5: excellent prognosis and outpatient treatment is enough. (TSN) between 5-8: complete cure after hospital addmission. (TSN) between 9-11: chest complications (chemical pneumonitis). (TSN) between 12-15: ICU admission, ventilator use or death (bad prognosis). The validity of this scoring system was assessed by its application on further 20 patients (confirmatory group).

Key Words: *Hydrocarbons, Toxicological History, Medical Examination, Investigation, Grading System, Scoring System.*

INTRODUCTION

Hydrocarbons include organic compounds composed primarily from both carbon and hydrogen. Subcategories of hydrocarbons include aliphatic (saturated carbon structure), aromatic (containing one or more benzene rings) and halogenated (containing chlorine, bromine or fluoride atoms) hydrocarbons (Goto, 2006).

Young children are at high risk for

home accidents and toxicities of all kinds because of their immature respiratory and metabolic systems together with their undeveloped sense of smell and taste. They are more likely to drink kerosene in mistake for clear liquids like water, spirit or lemonade believing it to be a pleasant drink with which they are familiar (Lifshitz et al., 2003).

Kerosene is still considered the most common household poisoning agent that contribute to childhood morbidity and mortality in developing countries as India, Ghana, Nigeria, Jordan and the Caribbean. In all these countries, kerosene is the most frequent offender in young children (Tshiamo, 2009; Manzar et al., 2010).

Hydrocarbon toxicity affects mainly the respiratory system and the central nervous system. Gasping, chocking, grunting, coughing and intercostals` retractions are the earliest signs of hydrocarbones ingestion and chemical pneumonitis is the most serious pathological complication in the lung (Shotar, 2005; Mattie and Sterner, 2011). Chemical pneumonitis induced by hydrocarbons exposure is usually manifested by, increasing signs of respiratory distress in the form of tachypnea, nasal flaring, intercostals' retractions, fever and hypoxemia (Jayashree et al., 2006). Headache, dizziness, drowsiness, restlessness, seizure and coma are the commonest CNS manifestations of hydrocarbon toxicities. Gastrointestinal involvement in the form of nausea, vomiting, abdominal pain and diarrhea was also reported (Shotar, 2005).

The aim of the present study is to suggest a new proposed score and to evaluate its role in predicting the severity and prognosis of hydrocarbon poisoning in children.

MATERIAL AND METHODS

A) Subjects

The subjects of the present study were 70 children less than 18 years old with a history of pure hydrocarbon ingestion attending to The Toxicology Unit of Tanta University Emergency Hospital. Cases of mixed hydrocarbon ingestion (co-ingestion) were excluded.

The patients were classified into two main groups:

Test group: (50 patients)

Data obtained from some parameters examined in the subjects of this group were statistically studied and scheduled to establish the scoring system.

Confirmatory group: (20 patients)

Subjects of this group were used to assess the validity of the scoring system.

Parents of the included children gave a written consent for participation in this work after detailed information about the

main goal of the study and confidentiality towards the subjects were maintained by giving a code number for every patient.

B) Methods:

I) Clinical methods:

The following toxicology sheet was taken from each subject that involves the following items:

1- History:

- Personal history: name, age, sex, residence, admission date, number of siblings and parents' education.
- Use of hydrocarbon at home, place of storage, container, amount nearly ingested (more or less than 30 ml)) Gupta et al., 1992), type of hydrocarbon ingested and time & place of ingestion.
- Mode of poisoning, route of exposure, time passed since hydrocarbon exposure, past history of operations, asthma, pneumonia or chronic systemic illness (diabetes, hypertension, renal or blood disease), history of vomiting following ingestion (spontaneous or induced, blood streaked and its frequency) and any treatment given before admission.

2- Clinical examination:

Records including data of vital signs and general examination were done for each patient.

II) Laboratory methods:

Arterial blood gases analysis (ABG), liver function testes (LFT), renal function tests (RFT) and complete blood count (CBC) were done for each patient.

III) Plain chest X ray:

Was carried out twice for each patient; on admission and before discharge. Interpretation of each case was done.

Statistical analysis

Data were analyzed using SPSS, version 18 computer program. Tests were done using Pearson's correlations and two tailed-tests. P- value was considered significant at ≤ 0.05 and highly significant at ≤ 0.001.

RESULTS

Results of the test group:

In the present study, (78%) of patients were living in low socioeconomic regions, in families having more than 2 children with illiterate or low educational parents level. In (60%) of total cases, hydrocarbons were used for cleaning purposes, (30%) for lighting and cooking while, in 10% hydrocarbons were used for other purposes as machine fuel.

In (86%) of total cases, the hydrocarbon was kept in discarded soft drink bottles or water bottles and in (90%) of cases it was kept in places within the reach of the children (kitchen, bathroom and downstairs).

Eighty percent (80%) of the cases were admitted to Tanta emergency hospital during July and August (2010) while, (18%) of total cases were admitted during May and June and only 2% of the cases were admitted during October.

Table (1) shows that, the majority of cases [35 patients (70%) of total cases] were between 1 and 3 years old.

The number and percentage of cases in relation to the amount of hydrocarbons ingested and time passed after ingestion was studied; the total number of children who ingested amount less 30 ml of hydrocarbons was 37 patients (74%) while those who ingested more than 30 ml of hydrocarbons were 13 patients (26%) of the cases. The time passed after hydrocarbons ingestion showed many variations. Ninety percent of cases (45 patients) reached hospital within 6 hours, (2%) of the cases (1 patients) reached within 3 hours while, (8%) of cases (4 patients) reached within 20 minutes after hydrocarbon exposure.

The Clinical data of the test group cases are arranged according to their frequency in table 2.

In the present study, every clinical parameter had been classified into four grades according to the severity of each one. Table (3) demonstrates the different clinical grades observed in the test group cases.

Regarding the result of investigations done in this study, twenty seven patients (54%) out of the test group have normal X-ray films. 13 patients (26%) have shown increased bronchovascular markings, and hilar congestion appeared in 5 patients (10%) while, bilateral pneumonic patches was observed in 5 patients (10%). The results of complete blood count (CBC) revealed that 20 patients (40%) of total cases had leucocytosis, 22 patients (44%) had anemia and 8 patients (16%) had combined leucocytosis and anemia.

In relation to liver function testes (LFTs) and kidney function testes (RFTs), liver enzymes (AST – ALT) were high in only 9 patients (18%) of total cases and kidney function tests (urea and creatinine) had shown an increase in only (2%) of total cases who had also raised liver enzymes. In the present study, 6 (12%) out of total cases had metabolic acidosis. Metabolic acidosis was the only metabolic disturbance that was noticed in the present study.

The pulmonary involvement data among cases of the test group has shown significant correlation with vomiting, PaO_2 level and WBCs count. While, high significant correlations between CNS manifestations and cyanosis with pulmonary

involvement were observed. Meanwhile, no significant correlation was found between pulmonary involvement and fever.

Significant correlation between vomiting and CNS manifestations was observed in the present study. While, high significant correlations between CNS manifestations and pulmonary involvement, PaO_2 level, WBCs count and cyanosis were seen. However, no correlation was observed between fever and CNS manifestations.

In evaluating factors affecting prognosis of the cases in this study as shown in table (4), it was found that data of ABG analysis, cyanosis, X- ray findings, length of stay (LOS) PaO_2 level, LFT, RFT, CNS manifestations, pulmonary involvement and amount of hydrocarbon ingested have shown significant impact on prognosis. Meanwhile, WBCs count, respiratory distress (RD) and vomiting have shown less significant impact on prognosis. On the other hand, fever, time passed after hydrocarbon ingestion, history of asthma and age have shown no impact on prognosis.

In this study, four prognostic grades could be established as shown in table (5), Grade I for cases who have shown complete cure, grade II for cases who had chest troubles, grade III for cases who admitted to ICU or put on ventilator. However, grade IV for cases who died. The distribution of patients among the prognostic grades showed that 39 cases (78%) had been completely cured, 5 cases (10%) had chest troubles, 4 cases (8%) had been admitted to ICU or put on ventilator and 2 cases (4%) had died.

Data obtained from the studied parameters together with their prognostic values were used to establish the suggested scoring system for hydrocarbon poisoning among children.

Table (6) illustrated the suggested scoring system for hydrocarbon poisoning. Parameters used in the scoring system were given scores from 0- 3 according to their correlation with the prognosis. Parameters with high prognostic values were given score 3, lower prognostic values were given score 2. Score 1 was given to the lowest prognostic values. Those who showed no abnormalities were given 0 score. The total scoring system number (TSN) is calculated for each patient and interpreted as shown under table 6.

Results of the confirmatory (external) group:

The validity of the new scoring system obtained in this study was furtherly evaluated by being applied on the 20 cases of the external group as shown in table (7). In 18 cases of this group, the expected prognosis matched the actual ones. In other

two cases it deviates from the expected, one of them had shown massive hydrocarbon exposure and the other case was an asthmatic epileptic child. Thereby, the scoring system of this study could be considered valid by (90%).

DISCUSSION

Hydrocarbons exposure is a common reason for pediatric hospitalization in the developing countries (Sakr et al., 2008). Unintentional injury in low and middle income countries are up to 50 times higher than high income nations because hydrocarbons in low income regions serve as a primary fuel for lighting, cooking and heating (David et al., 2009).

Lang et al. (2008) reported that, (2%) of cases ingesting hydrocarbons die every year in Kenya. Unfortunately, there had been few studies from the developing countries focusing on the predictors of outcome in cases of hydrocarbons toxicity (Jayashree et al., 2006).

According to the best of our knowledge, this study seemed to be the first study to report four prognostic grades for hydrocarbon toxicity among children and establish a rapid bedside and detailed clinical scoring system.

In the present study, four prognostic grades for the studied cases were reported as follows:

- Grade I constituted (78%) of total cases who showed complete cure and prognosis was excellent.
- Grade II included patients who showed chest complications in the form of chemical pneumonitis. Ten percentages of total cases belong to this grade.
- Grade III for patients who were admitted to ICU or put on ventilators and they were (8%) of total cases.
- Grade IV represented patients who had died and constituted (4%) of the cases.

Jayashree et al. (2006) had constructed predictors of outcome in children with hydrocarbon poisoning receiving intensive care. They stated that hypoxemia on arrival, prior lavage, higher need for ventilation and higher frequency of secondary pneumonia and ventilator complications were associated with poor outcome. They did not show any prognostic grades and their study was limited to those admitted to ICU.

The scoring system established in this study depends mainly on clinical data. ABG analysis, X- ray findings, LFT, RFT, WBCs count were excluded from the scoring system to make it rapid, cheap, simple and bedside tool to predict the prognosis of hydrocarbons poisoning among children. Moreover, most centers in Egypt

and other developing countries may not have facilities to do such investigations. The amount of hydrocarbon ingested had been omitted because it is usually difficult to be accurately estimated as the amount stored is usually unknown and some is usually spilled. Respiratory distress, pulmonary involvement, CNS manifestations, PaO_2 levels, cyanosis and lastly vomiting constituted parameters used in the scoring system. These parameters were given scores from 0- 3 according to their correlation with the prognosis.

Most of the grading score items were classified into further degrees to insure the accuracy and reliability of the system and to accommodate the large variations of clinical presentations among the patients.

Every patient gained total scoring number (TSN) according to his / her clinical presentation that was calculated for each patient and interpreted as follows:

- (TSN) less than 5: excellent prognosis and outpatient treatment would be enough.
- (TSN) between 5-8: complete cure but have to be admitted to hospital.
- (TSN) between 9-11: chest complications (chemical pneumonitis).
- (TSN) between 12-15: ICU admission, ventilator use and may be death (bad prognosis).

In India, Gupta et al. (1992) had established a scoring system to determine the outcomes of children who had kerosene poisoning. Their scoring system was as follows,

(a) Fever if absent: score 0, if present: score 1.
(b) Severe malnutrition—if absent: score 0, if present: score 1.
(c) Respiratory distress—if absent: score 0, if present: score 2, if present with cyanosis: score 4.
(d) Neurological symptoms—if absent: score 0, if present: score 2, if present with convulsions: score 4.

(TSN) of Gupta et al. (1992) ranged from 0 to 10. They considered TSN of 4 or more is associated with prolonged hospital stay and complications. The risk of dying was increased if the (TSN) was equal to or more than 8.

In comparing such scoring system with the scoring system obtained in this study, it was found that their scoring system can be considered deficient in the clinical variations commonly seen among children involved in hydrocarbons toxicity. Additionally, severe malnutrition that was considered in Gupta et al. (1992) scoring system is a local parameter which may be important in India not in Egypt. Added to that, the validity of the scoring system they established (84%) is less than our scoring system validity (90%).

This study highly recommended the use of the new scoring system established as referral criteria to all primary health care centers as it can serve as a rapid, cheap, simple and bedside tool for early identification of the severity of illness especially in developing countries with limited resources.

Table (1): Number of male and female patients and their relation to the age.

Sex / age	<1	1-3	3- 6	6-12	12-18	Total	**Percent %**
female	3	11	1	2	2	19	38%
male	0	24	4	1	2	31	*62%
Grand Total	3	35	5	3	4	50	100%
Percent %	6%	**70%	10%	6%	8%		

** (1-3) years age group was the commonest involved age group (70%).
* (62%) of total cases were male.

Table (2): Clinical data arranged according to their frequency.

Clinical finding	**n**	**percentage**	**Percent % out of total cases**
Respiratory distress (RD):		**% out of RD**	
Cough	12	28.6%	84%
Tachypnea	10	23.8%	
Grunting, nasal flare & intercostals retraction	19	45.2%	
Apnea	1	2.4%	
Total	42		
vomiting	34		68%
Pulmonary involvement:		**% out of pulmonary involvement**	48%
Wheezes	13	52%	
Crepitations	8	32%	
Diminished air entry	3	12%	
Pulmonary edema	1	4%	
Total	25		
CNS disturbance:		**% out of CNS disturbance**	36%
Drowsiness	15	83%	
Response to verbal stimuli	0	0%	
Response to painful stimuli	2	11%	
No response (deep coma)	1	6%	
Total	18		
PaO_2 < 95%	14		28%
Fever: temperature> 38 °C.		**% out of fever**	24%
38ºC- 39ºC	10	83%	
More than 39ºC	2	17%	
Total	12		
Cyanosis	4		8%

Table (3) : Classification of clinical parameters into different grades.

Clinical parameter	Grade 1	Grade 2	Grade 3	Grade 4
RD	Free	Cough	Cough & tachypnea	Cough, tachypnea & Or accessory muscle use
Pulmonary involvement	Free chest	Wheezes	Crepitations & Or diminished air entry	
CNS manifestations	Fully conscious	Drowsiness	Coma responding to stimuli (verbal or painful stimuli)	Coma not responding to stimuli
PaO_2 level	More than 95%	80%-95%	60% - 80%	Less than 60%

Tachypnea: respiratory rate > 40 cycle / minute.

Table (4): Clinical parameters affecting prognosis arranged according to severity.

	Factor	r	p-value	
1	**ABG**	0.828	0.000	+
2	**Cyanosis**	0.784	0.000	+
3	**X ray**	0.773	0.000	+
4	**LOS**	0.758	0.000	+
5	**paO_2**	0.743	0.000	-
6	**LFT**	0.691	0.000	+
7	**RFT**	0.671	0.000	+
8	**CNS Manifestation**	0.625	0.000	+
9	**Pulmonary involvement**	0.520	0.000	+
10	**Amount ingested**	0.461	0.001	+
11	**WBCs count**	0.430	0.002	+
12	**RD**	0.401	0.004	+
12	**Vomiting**	0.274	0.050	+
13	**Fever**	0.253	0.067	
14	**Time passed after ingestion of hydrocarbon (h)**	0.099	0.495	
15	**Past history of asthma**	0.097	0.503	
16	**Age**	-0.015	0.916	

Table (5): Prognostic grades and number of patients in each grade.

Grade	n = number	Percent %
I	39	78.0
II	5	10.0
III	4	8.0
IV	2	4.0
total	50	100.0

Prognosis of cases was classified into 4 grades:

I- Complete cure II- Chest affected

III- ICU admission or ventilator use. IV- Death

Table (6): Suggested scoring system for hydrocarbon poisoning.

Parameter / score	0	1	2	3
Cyanosis	absent			√
PaO_2 level	>95%	95%- 80%	80% - above 60%	Less than or equal 60%
CNS	Fully conscious	Drowsiness	Coma responding to stimuli (verbal or painful stimuli)	Deep coma
Pulmonary involvement	Free chest	Wheezes	Crepitation and or diminished air entry	
RD	Absent	Cough	Cough & tachypnea	Cough, tachypnea and or accessory muscle use
Vomiting	Absent	√		

Total scoring number (TSN)

- (TSN) less than 5: excellent prognosis and outpatient treatment is enough.
- (TSN) between 5-8: complete cure but have to be admitted to hospital.
- (TSN) between 9–11: chest complications (chemical pneumonitis).
- (TSN) between 12–15: ICU, ventilator use and may be death (bad prognosis).

Table (7): Detailed data about application of scoring system on confirmatory group .

Serial	Cyanosis	PaO_2	CNS	RD	Pulmonary	Vomiting	Score	Predicted prognosis	Actual prognosis	Special notes
1	0	0	0	1	2	1	**4**	excellent	excellent	
2	0	2	2	3	3	1	**11**	chest troubles	ICU	Massive ingestion
3	0	0	0	1	0	1	**2**	excellent	excellent	
4	0	0	0	1	1	1	**3**	excellent	excellent	
5	0	1	0	3	1	1	**6**	complete cure	complete cure	
6	0	1	0	2	2	0	**5**	complete cure	complete cure	
7	0	2	1	3	2	1	**9**	chest troubles	chest troubles	
8	0	2	1	2	1	1	**7**	complete cure	complete cure	
9	0	1	1	1	1	1	**5**	complete cure	chest troubles	epilepsy + asthma
10	0	1	1	1	1	1	**5**	complete cure	complete cure	
11	0	0	0	2	0	1	**3**	complete cure	complete cure	
12	0	1	1	1	1	1	**5**	complete cure	complete cure	
13	0	2	1	2	0	1	**6**	complete cure	complete cure	
14	3	1	2	3	2	1	**12**	Bad prognosis	ICU	
15	3	2	1	3	2	1	**12**	Bad prognosis	ICU	
16	0	0	0	2	0	0	**3**	excellent	excellent	
17	0	1	0	2	1	1	**5**	Complete cure	Complete cure	
18	0	2	1	3	2	1	**9**	Chest troubles	Chest troubles pneumonia	
19	0	1	1	1	1	1	**5**	Complete cure	Complete cure	
20	0	2	1	2	2	1	**8**	Complete cure	Complete cure	

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مقترح نظام جديد لتقييم حالات التسمم بالهيدروكربونات في أطفال محافظة الغربية

المشتركون فى البحث

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ما يزال التسمم بالهيدروكربونات يساهم فى مرض وفيات الأطفال فى الدول النامية. وتؤثر الهيدروكربونات على كلا من الجهاز التنفسى والعصبى. هذه الدراسة تسجل اربع درجات مقترحة للأطفال المعرضين لمركبات هيدروكربونية و تقوم بإنشاء نظام تقييمي جديد وسريع و مفصل.

أجريت الدراسة الحالية على ٧٠ مريضا من الأطفال الذين تقل أعمارهم عن ١٨ سنة والذين يشتبه في تعرضهم لمواد هيدروكربونية. هذا وقد قسمت الحالات إلى مجموعتين : مجموعة الاختبار وتتكون من ٥٠ طفلا حيث تم أخذ تاريخ مرضي مفصل وتم عمل فحص طبي شامل وأبحاث طبية كاملة ثم تم تصنيف هؤلاء المرضى إلى ٤ درجات مختلفة على النحو التالي : المجموعة الأولى وتشمل هؤلاء المرضى الذين شفووا تماما أما المجموعة الثانية فتشمل الحالات التي أصيبت بمضاعفات صدرية كحدوث الالتهاب الرئوي الكيميائي الناتج عن دخول المواد الهيدروكربونية الى الرئة. المجموعة الثالثة تشمل الأطفال الذين تم دخولهم العناية المركزة أو وضعوا على جهاز التنفس الاصطناعي أما المجموعة الرابعة فتشمل هؤلاء الذين لقوا حتفهم.

و قد تم الخلوص إلى نظام جديد يهدف إلى تقييم حالات التعرض للمواد الهيدروكربونية بين الأطفال والتنبؤ بتشخيصها. وجرى تقييم هذا النظام بتطبيقه على ٢٠مريضا اخر (المجموعة التوكيدية).

جدول : النظام التقييمي المقترح لتقييم حالات التسمم بالهيدروكربونات في الأطفال

العامل السريرى	صفر	١	٢	٣
الزرقة				√
PaO_2 مستوى	> ٩٥٪	٨٠٪ – ٩٥٪ فوق	٦٠٪ – ٨٠٪	< ٦٠٪
اضطرابات الجهاز العصبى المركزى	واعى ومنتبه	مترنح أو غير كامل التركيز	غيبوبه تستجيب للمؤثرات الخارجيه	غيبوبه عميقة
الفحص الموضعى للصدر	سليم	ضيق فى المجارى الهوائية العليا	ضيق فى المجارى الهوائية السفلى أو إضطراب حويصلات الرئة وقلة نسبة الهواء الداخل	
ضيق التنفس		كحة	كحة وتسارع معدل النفس	كحة وتسارع معدل النفس بالإضافة إلى (أؤ) استخدام عضلات التنفس الثانوية
الإفياء		√		

يحسب الرقم النهائي للمريض ويترجم كالتالي:

العدد النهائي أقل من ٥ : الحالة النهائية ممتازة ويمكن الاكتفاء بالعلاج خارج المستشفى.

العدد النهائي من ٥-٨ : سوف يشفى بالكامل ولكن يجب دخول المستشفى.

العدد النهائي من ٩-١١ : مضاعفات صدرية (التهاب رئوي).

العدد النهائي من ١٢-١٥: دخول العناية المركزة، استخدام جهاز التنفس الصناعي وربما الوفاة.