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Epidemiology, Clinical Characteristics, and Management of Acute Hydrocarbons Poisoning at Benha Poisoning Control Unit: A One-Year Prospective Clinical Study

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Abstract Hydrocarbons poisoning is an important cause of morbidity and mortality in the developing countries. The aim of this work is to investigate the pattern and management of acute hydrocarbons poisoning at Benha Poisoning Control Unit, Benha University Hospitals, Egypt, from 1st February 2013 to 31th January 2014. Of the total 72 hydrocarbons exposures, kerosene consititued the majority (66.7%), followed by gasoline (27.8%) and thinner (5.5%). Males represented 56.9% and females 43.1% of cases, 76.4% were below age of five, and 63.9% came from rural areas. Accidental manner predominate (93.1%), the majority (84.7%) was home exposures, and during summer months (37.5%). All patients were exposed orally; combined dermal exposure occurred in 44.4% of them. Commonly observed symptoms were cough (72.2%), dyspnea (50%), wheezy chest (40.3%), respiratory distress (12.5%), vomiting (45.8%) drowsiness (36.1%), agitation (11.1%), convulsion (2.8%), and fever (26.4%). According to the poisoning severity score, 13.9% were asymptomatic, 61.1% were minor, 16.7% were moderate and 8.3% were severe, with no fatal cases. There was a significant relation between vomiting and clinical severity and pneumonia. Radiological findings of pulmonary pathology occurred in 70.8%; increased broncho-vascular markings were the most common (51.2%), followed by pneumonia (19.4%). No specific treatment was used; supplemental oxygen in 86.1% of patients, and only 5.6% were put on mechanical ventilation. In conclusion, acute hydrocarbons poisoning is a prevalent household accidental toxic hazard among rural male children <5years old. Patients must be monitored both clinically and radiologically to recognize potential pulmonary complications, and symptomatic treatment is effective.

Keywords Hydrocarbons, Clinical study, Poisoning Severity Score, Benha, Egypt

Introduction

Hydrocarbons comprise a heterogeneous collection of compounds, composed primarily of carbon and hydrogen molecules, with widespread uses in industry and households (Mickiewicz and Gomez, 2001). Hydrocarbons include organic compounds derived from petroleum distillation, plant oils, animal fats, and coal. Subcategories include aliphatic, aromatic and halogenated hydrocarbons, alcohols, glycols, ethers, ketones and many others (Goto, 2007).

The principal commercial source of hydrocarbons involves distillation of crude oil. Exposures are ubiquitous in many occupations and even in everyday life. Three groups appear to be at risk for hydrocarbon-related illness: children with unintentional exposures; workers with occupational exposures and adolescents/young adults who intentionally abuse solvents (Hoffman et al., 2007).

Most of hydrocarbons are involved in everyday use, such as gasoline, kerosene, and fuel oils. They have numerous consumer and household applications (Gummin and Hryhorczuk, 2006). Shusterman et al. (1999) stated that hydrocarbon intoxication is frequently noted in domestic or industrial accidents, as well as instances of attempted suicide.

The morbidity and mortality of hydrocarbon ingestion are mainly due to pulmonary aspiration (Thalhammer et al., 2005). The lung is the primary target organ affected by aspiration of the hydrocarbon,

resulting in respiratory symptoms. Pulmonary damage is probably due to the chemical destruction of surfactant in the alveoli and distal airways. The hydrocarbon also increases permeability of the vascular endothelium with subsequent diffuse hemorrhagic alveolitis culminating in a chemical pneumonitis (Tucker, 2001).

Cardiotoxicity generally manifests as dysrhythmias, secondary to hydrocarbon sensitization of the myocardium to the circulating catecholamines (Roberge et al., 2001). Systemic manifestations often include confusion, ataxia, lethargy and coma. Ingestion often causes abrupt nausea and vomiting (Goto, 2007).

No specific antidotes for hydrocarbons poisoning, therefore treatment is usually symptomatic and supportive. All contaminated clothing must be removed and exposed skin needs scrubbing with soap and water. Gut decontamination remains a controversial area, but it is indicated in large-volume (> 30 mL) ingestions or in hydrocarbons with inherent systemic toxicity. Severe lung injury may require intubation and mechanical ventilation (Mickiewicz and Gomez, 2001 and Facon et al., 2005).

Hydrocarbons poisoning continues to be an important cause of poisoning related morbidity and mortality in the developing countries, especially among young children of low socioeconomic groups (Reed and Conradie, 1997; Shotar, 2005 and Jayashree et al., 2006).

Therefore, the aim of this work is to investigate the incidence, demographics, clinical manifestations, radiological findings, lines of treatment, and clinical outcome of acute hydrocarbon intoxicated patients presented to Benha Poisoning Control Unit (BPCU), Benha University Hospitals, Egypt, in order to establish evidence-based measures to control and manage these preventable exposures.

Patients and methods

Patients

This is a prospective clinical study that was carried out on all patients presented with “pure” acute hydrocarbon poisoning; (patients with mixed or multiple exposures are excluded from the study), to Benha Poisoning Control Unit (BPCU), Benha University Hospitals, Egypt, over a one-year period from 1st February 2013 to 31th January 2014.

Diagnosis of acute hydrocarbons poisoning was based on:

1. history of intake or exposure to hydrocarbons, combined with complaint of the characteristic symptoms as coughing, dyspnea, etc..,
2. clinical examination to detect the characteristic odor and signs of respiratory distress, etc.., and
3. radiological assessment: plain chest X-ray was performed for all patients.

The clinical severity of all patients was classified according to the poisoning severity score (PSS), which is a standardized scale for grading the severity of acute poisoning. Severity was classified into: none (0); no poisoning related symptoms or signs, minor (1); transient and spontaneously resolving symptoms within 24 hours of exposure, moderate (2); pronounced more prolonged symptoms for 24 hours or more after exposure, severe (3); severe or life threatening poisoning and fatal (4); means death (Persson et al., 1998).

Asymptomatic patients were observed for up to 6-12 hours in the emergency room (ER), and then discharged without any complaints. Symptomatic patients were treated with standard pulmonary support (supplemental oxygen, bronchodilator nebulizer and mechanical ventilation, if needed). Intravenous fluids, antipyretics, antibiotics and corticosteroids were given when needed. Diazepam was given to treat agitations and convulsions if occurred. This treatment was done after initial stabilization of patient and concomitant proper decontamination (removal of contaminated cloths, and washing the exposed skin with soap and water) (Mickiewicz and Gomez, 2001; Tucker, 2001 and Thalhammer et al., 2005). Gut decontamination was not performed for any patient, as there were no indications for it among the studied patients. Patients who were discharged were advised to present to BPCU for next-day follow up measures; (clinical and radiological assessments) (Gummin and Hryhorczuk, 2006).

METHODS

A valid informed consent was taken from each patient (from adults or from caretakers of minors) for obtaining medical history, clinical examination, performing plain chest X-ray and other lines of treatment.

The study was approved by Benha Research Ethical Committee, as well as from the general manager of BPCU.

All results obtained from patients were registered in special sheets of study, which were confidential. Any patient had the right to withdraw from the study any time he\she want. Before patients discharged on demand (against medical advice) from BPCU, they had signed a special form.

The incidence rate of acute hydrocarbons exposure was estimated in relation to the total toxic exposures over the peroid of the study as well as the incidence of each type of hydrocarbons.

Demographic data including the following characters (age, gender, residence, place of exposure, type of container in which hydrocarbon was kept, seasonal variation, manner of exposure and rout of exposure to hydrocarbons) were studied.

All patients were **clinically studied** according to the followings:

- Characteristic symptoms and signs of hydrocarbons poisoning: Cough dyspnea, wheezy chest, respiratory distress, vomiting, abdominal distention, drowsiness, agitation, convulsion and fever. Relation between vomiting either spontaneous or induced and both (the clinical

severity, and pneumonia in plain chest x-ray) was studied.

- Clinical severity: according to the PSS.
- Home (pre-hospital) treatment: relation between home (pre-hospital) treatment and both (the clinical severity of hydrocarbons poisoning, and pneumonia in plain chest x-ray) was studied.
- Hospital treatment: supplemental oxygen, bronchodilator nebulizer, antibiotics, antipyretics, steroids and mechanical ventilation.
- Admission place: observation in ER ranging from 6-12 hours or admission in inpatient unit, and in intensive care unit (ICU).
- Clinical outcome and follow up: full recovery, unknown (patients discharged on demand; against medical advice) and death.

Radiological assessment: a plain chest X-ray was performed for all patients participated in the study, either symptomatic or not, usually after ≥6 hours of exposure; as early radiography is not cost-effective, and it was only performed in severely symptomatic patients (Gummin and Hryhorczuk, 2006). The pattern of plain chest x-ray findings was studied.

Statistical analysis of the data

The collected data were organized, tabulated and analyzed using SPSS version 16 software (Spss Inc, Chicago, ILL Company). Data were presented as number and percentages. Chi square test (X^2) of significance was used. The accepted level of significance in this work was stated at 0.05, ($P < 0.05$ was considered significant) (Dawson & Trapp, 1994).

Results

I- Incidence

A total of 72 hydrocarbons intoxicated patients were received at BPCU, Benha University Hospitals, Egypt, representing 6.4% of the total intoxicated patients (1124), over the peroid of the study. The majority of them were poisoned by kerosene (66.7%), followed by gasoline (27.8%) and thinner (5.5%), as shown in Fig. (1).

II- Demographic results

Out of 72 patients enrolled in the study, 41 (56.9%) were males and 31 (43.1%) were females. They were aged from 1 to 55 years, with the majority (76.4%) of cases aged ≤5 years. Forty six (63.9%) came from rural areas, whereas 26 (36.1%) came from urban areas. Majority (84.7%) of exposures occurred at home as a result of exposure to household products containing hydrocarbons. The vast majority (88.9%) of hydrocarbons were stored in non-original containers, as illustrated in Fig. (2).

All patients were exposed to hydrocarbons orally {either alone or combined with dermal exposure (44.4%)}. The vast majority (93.1%) of patients exposed to hydrocarbons accidentally. There was a seasonal variation with majority (37.5%) of exposures occurred during summer months, followed by autumn months (26.4%), as shown in Fig. (3).

III- Clinical results

Patients presented mainly with respiratory manifestations {cough (72.2%), dyspnea (50%), wheezy chest (40.3%), and respiratory distress (12.5%)}, gastrointestinal manifestations {vomiting (45.8%) and abdominal distention (34.7%)}, and CNS manifestations {drowsiness (36.1%), agitation (11.1%) and convulsion (2.8%)}. Fever occurred in 26.4% of cases, as highlighted in Fig. (4).

According to the poisoning severity score (PSS), out of 72 patients, 10 (13.9%) were asymptomatic (Grade 0), forty four (61.1%) were minor (Grade 1), twelve (16.7%) were moderate (Grade 2) and six (8.3%) were severe (Grade 3), with no fatal cases (Grade 4), as shown in Fig. (5).

There was a highly significant relation *($p < 0.001$)* between vomiting either spontaneous or induced and both {the clinical severity and pneumonia in plain chest x-ray}, as shown in table (1).

Fifty (69.4%) of patients did not receive any pre-hospital treatment measures, meanwhile twenty two (30.6%) received home treatment; all were for induction of vomiting; (15.3% salty water, 12.5% milk with raw eggs and 2.8% mechanical emesis). There was a highly significant relation *($p < 0.001$)* between home treatment and both {the clinical severity and pneumonia in plain chest x-ray}, as shown in Fig. (6) and table (2).

As regard hospital treatment; 86.1% of patients were treated with supplemental oxygen, 47.2% with bronchodilator nebulizer, 31.9% with antibiotics, 26.4% with antipyretics, 12.5% with steroids and only 4 patients (5.6%) were put on mechanical ventilation. Shower with soap and water after removal of contaminated cloths was performed for 32 patients (44.4%) to treat dermal exposure, as shown in Fig. (7).

Twenty five patients (34.7%) were observed in the ER for about 6-12 hours without admission, thirty eight (52.8%) were admitted in inpatient unit; the admission period ranging from 1-3 days, and nine (12.5%) of patients were admitted in ICU; the admission period ranging from 1-7 days, as shown in Fig. (8).

The vast majority of patients (66= 91.7%) had full improvement outcome and discharged without any complications, the remaining 6 patients (8.3%) discharged before full recovery on patient caretaker demand and against the medical advice. No deaths were recorded.

IV- Radiological results

Fifty one (70.8%) of patients had radiological findings of lung pathology, meanwhile 21 (29.2%) of them were radiologically free. Increased broncho-vascular markings were the most common (51.2%), followed by pneumonitis (19.4%), either basal or diffuse. The more common affected side was the right side (43.3%), and the lower lobes of lungs were the most affected lung zones (48.8%), as shown in Fig. (9, 10, 11, 12, and 13).

Radiological findings of pulmonary pathology were recorded among the asymptomatic (PSS=0) patients, as 50% of them had perihilar densities with increased bronchovascular markings, despite being completely free of any clinical manifestations. Also 36.4% of symptomatic minor patients (PSS=1) were radiologically free (normal), in spite of having obvious clinical manifestations, as shown in table (3).

Table (1): Relation between vomiting and both (Poisoning Severity Score "PSS" and pneumonia in x-ray) among the studied patients (No. =72).

Vomiting		No (N=39)	Yes (N=33)	Total (N=72)	X^2 & P
PSS	Asymptomatic (grade 0)	10 (25.6%)	0 (0.0%)	10 (13.9%)	27.3 & <0.001
	Minor (grade 1)	28 (71.8%)	16 (48.5%)	44 (61.1%)	
	Moderate (grade 2)	1 (2.6%)	11 (33.3%)	12 (16.7%)	
	Severe(grade 3)	0 (0.0%)	6 (18.2%)	6 (8.3%)	
Pneumonia	Without pneumonia	39 (100.0%)	19 (57.6%)	58 (80.6%)	20.5 & <0.001
	With pneumonia	0 (0.0%)	14 (42.4%)	14 (19.4%)	

Table (2): Relation between home treatment and both (Poisoning Severity Score "PSS" and pneumonia in x-ray) among the studied patients (No. =72):

Home treatment		No (N=50)	Yes (N=22)	Total (N=72)	X^2 & P
PSS	Asymptomatic (grade 0)	10 (20.0%)	0 (0.0%)	10 (13.9%)	33.65 & <0.001
	Minor (grade 1)	37 (74.0%)	7 (31.8%)	44 (61.1%)	
	Moderate (grade 2)	3 (6.0%)	9 (40.9%)	12 (16.7%)	
	Severe(grade 3)	0 (0.0%)	6 (27.3%)	6 (8.3%)	
Pneumonia	Without pneumonia	49 (98.0%)	9 (40.9%)	58 (80.6%)	31.8 & <0.001
	With pneumonia	1 (2.0%)	13 (59.1%)	14 (19.4%)	

X^2 =39.6; P<0.001means highly significant correlation

Table (3): Relation between the plain chest X-ray findings and the severity of poisoning among the studied patients (No. =72):

X-ray findings		Poisoning severity score (PSS)				Total
		Asymptomatic	Minor	Moderate	Severe	
Free (Normal)	No (%)	5 (50.0%)	16 (36.4%)	0 (.0%)	0 (.0%)	21(29.2%)
++ BVM	No (%)	5 (50.0%)	25 (56.8%)	7 (58.3%)	0 (.0%)	37(51.4%)
Pneumonia	No (%)	0 (.0%)	3 (6.8%)	5 (41.7%)	6 (100.0%)	14(19.4%)
Total	No (%)	10 (100.0%)	44 (100.0%)	12 (100.0%)	6 (100.0%)	72 (100.0%)

++BVM, increased bronchovascular markings

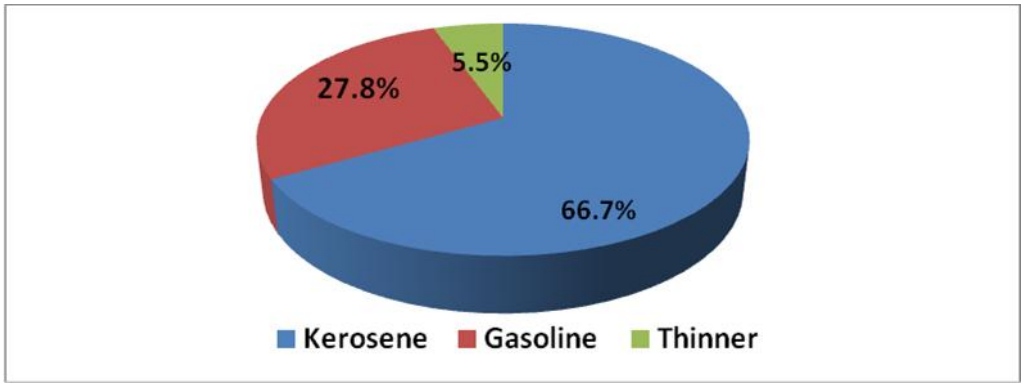

Figure (1): Pie chart illustrating the distribution of hydrocarbons intoxicated patients (No. =72) according to type of hydrocarbon, over the peroid of the study.

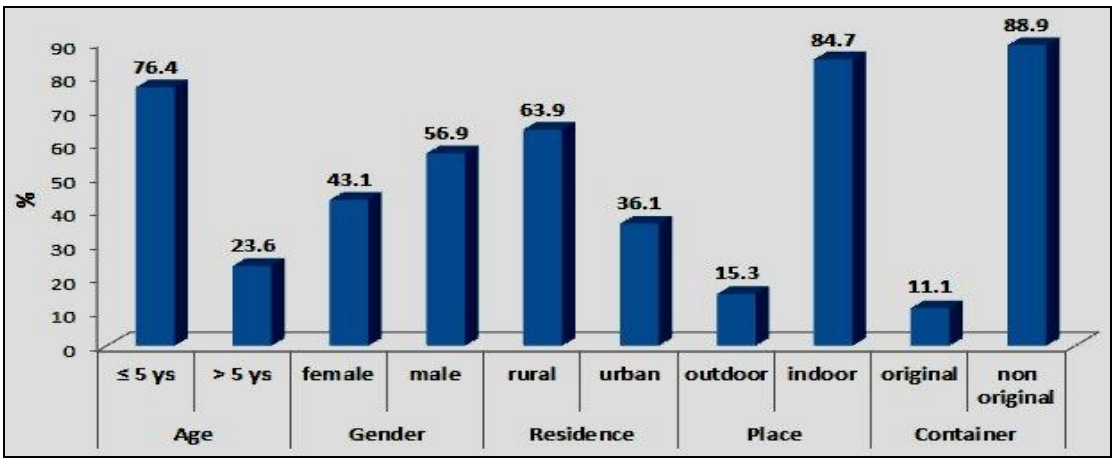

Figure (2): Bar chart showing the distribution of the studied patients (No. =72), according to mean age, gender, residence, place of exposure and container of hydrocarbons.

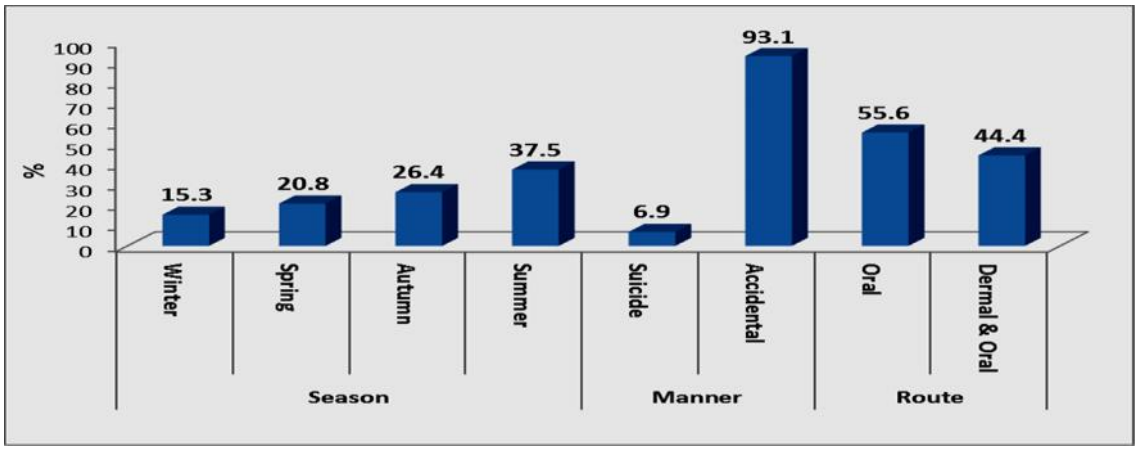

Figure (3): Bar chart illustrating the distribution of the studied patients (No. =72), according to season, manner and route of exposure to hydrocarbons.

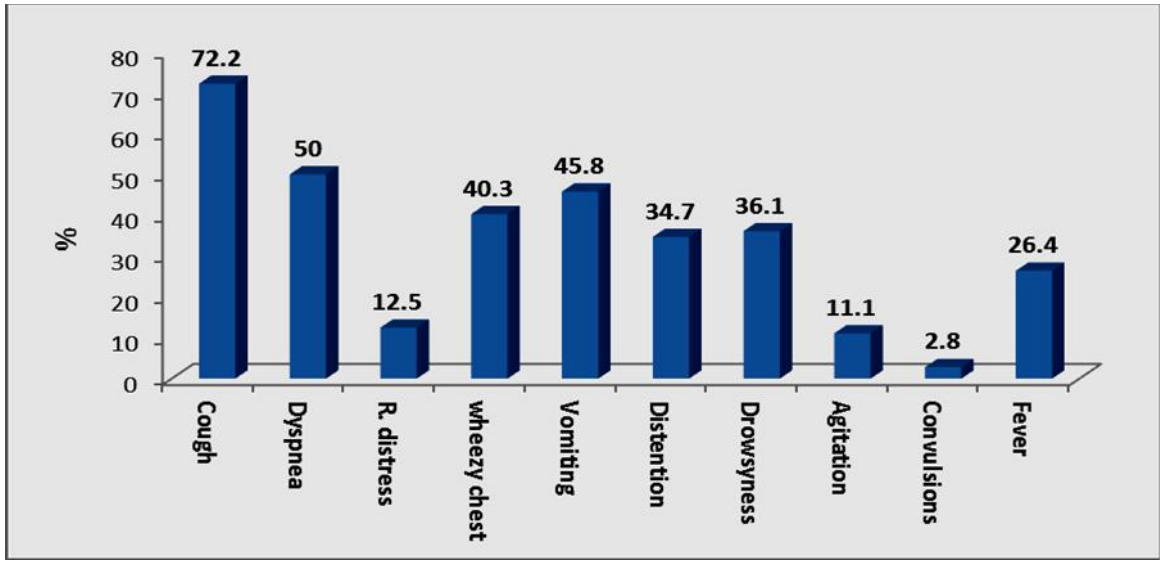

Figure (4): Bar chart highlighting the distribution of the studied patients (No. =72), according to the symptoms and signs of acute hydrocarbons poisoning.

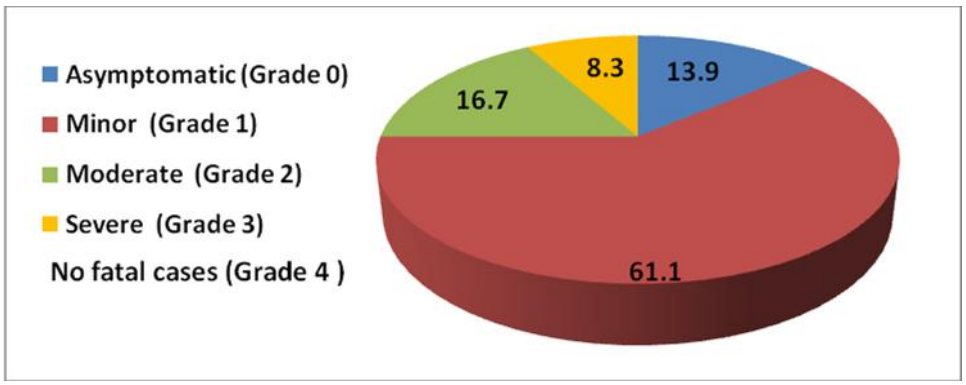

Figure (5): Pie chart showing the distribution of the studied patients (No. =72) according to the poisoning severity score (PSS).

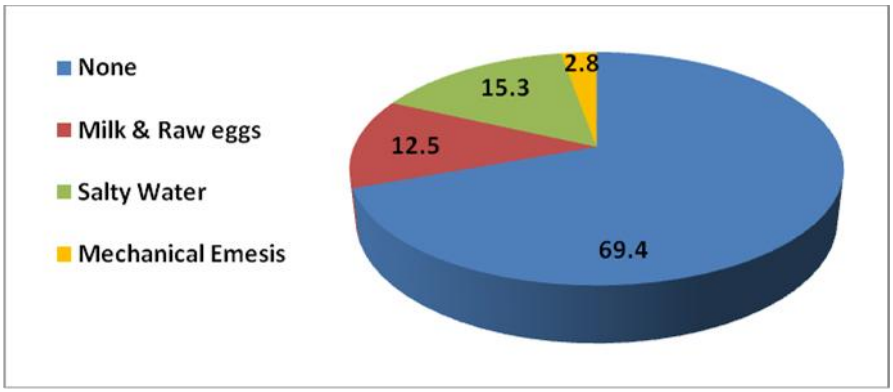

Figure (6): Pie chart showing the distribution of the studied patients (No. =72) according to the type of home (pre-hospital) treatment.

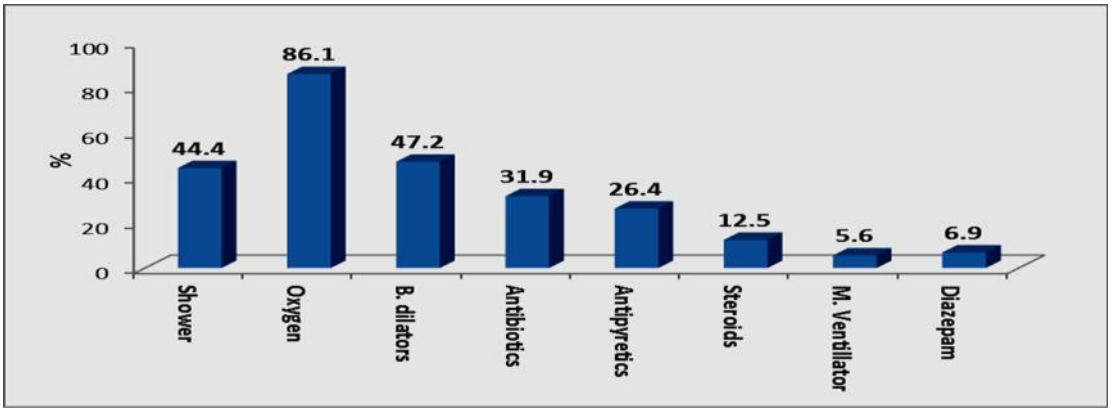

Figure (7): Bar chart illustrating the distribution of the studied patients (No. =72) according to the hospital treatment.

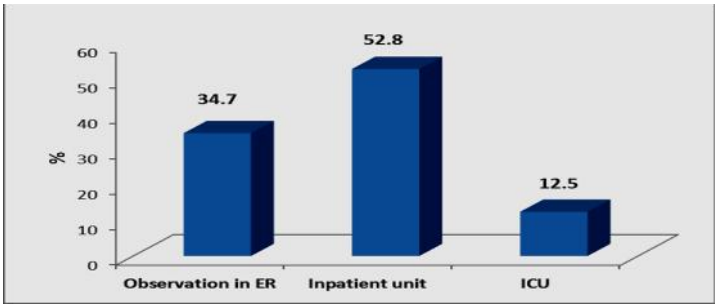

Figure (8): Bar chart illustrating the distribution of the studied patients (No. =72) according to the hospital admission place.

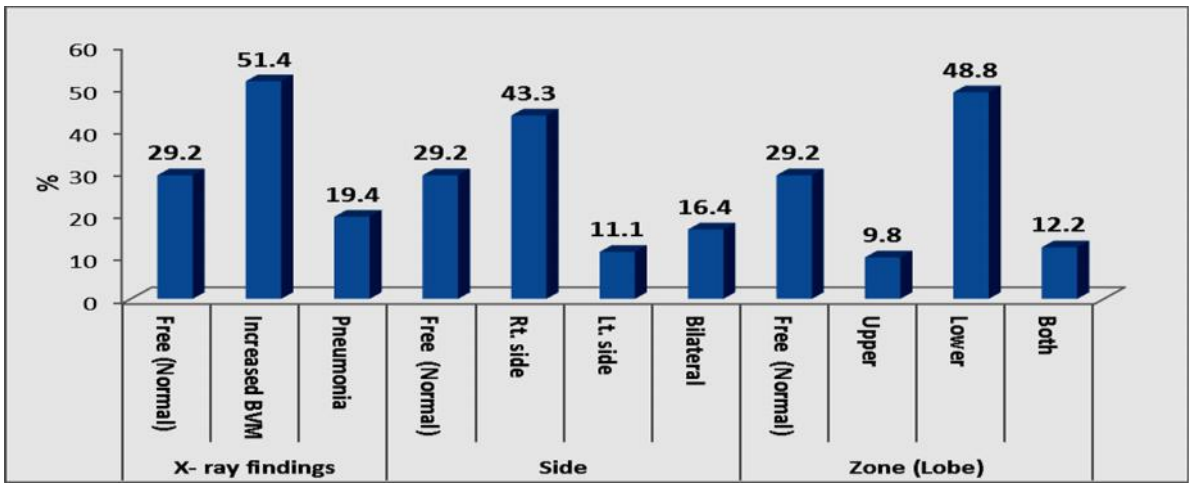

Figure (9): Bar chart showing the distribution of the studied patients (No. =72) according to plain chest X-ray findings (BVM = increased bronchovascular markings).

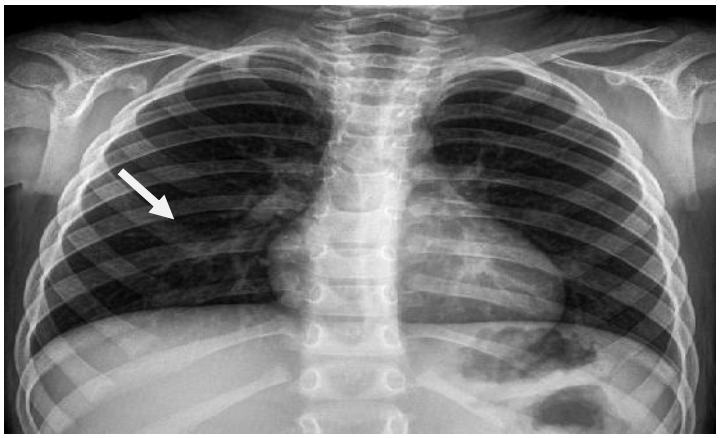

Figure (10): Plain chest x-ray (antero-posterior view) showing perihilar densities with increased bronchovascular markings at the right side.

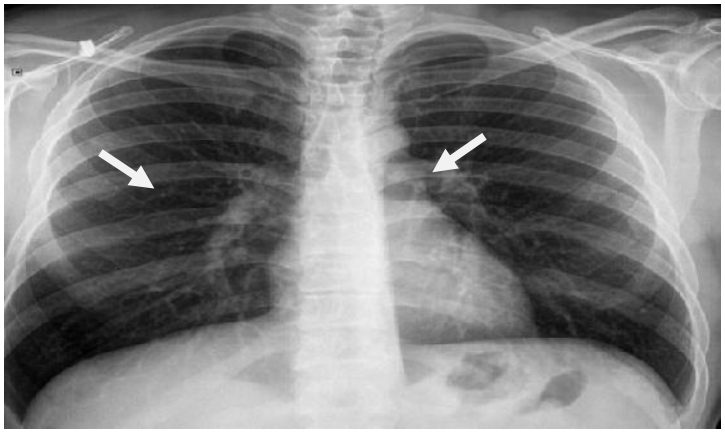

Figure (11): Plain chest x-ray (antero-posterior view) showing perihilar densities with bilateral increased bronchovascular markings.

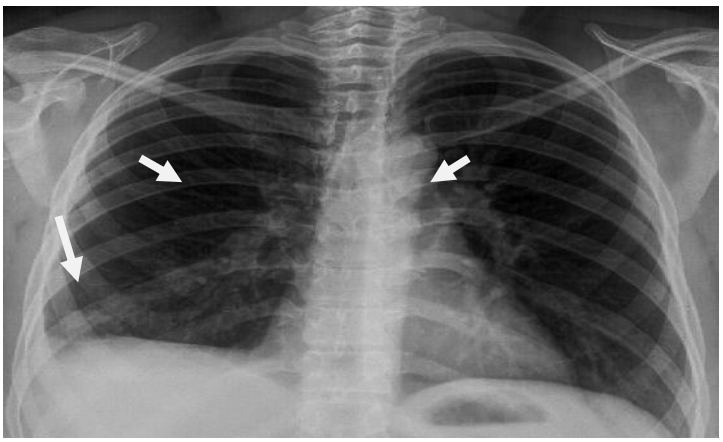

Figure (12): Plain chest x-ray (antero-posterior view) showing right basal pneumonic infiltration with bilateral increased bronchovascular markings.

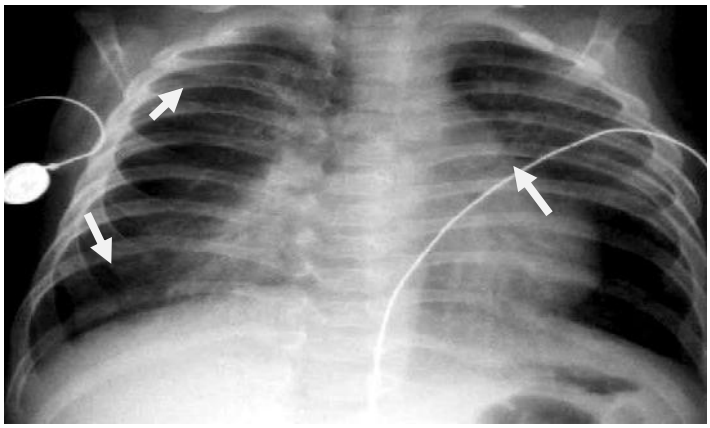

Figure (13): Plain chest x-ray (antero-posterior view) showing pneumonic infiltration (consolidation) at upper and lower right lung lobes and at the upper left lung lobe.

Discussion

I- Incidence

Reported exposures of hydrocarbons likely represent only a fraction of the true incidence (Mickiewicz and Gomez, 2001). The present study reported 6.4% hydrocarbon exposures of the total toxic exposures during the peroid of the study, which is higher than those reported by Watson et al. (2004) and Watson et al. (2005); they stated that "pure" hydrocarbon exposures of the reported cases by the American Association of Poison Control Centers (AAPCC) in 2003 represented 2.3% of all toxicities, while in 2004 they were 2.2 % of total toxicities. On the other hand, Jayashree et al. (2006) found that hydrocarbon ingestion constituted up to 35% of all poisonings admitted to the Advanced Pediatrics Center, Chandigarh, India, during the period of the study.

The present study showed that the majority (66.7%) of patients were poisoned by kerosene, followed by gasoline (27.8%) and thinner (5.5%). These results are in agreement with Lifshitz et al. (2003) who found that 96% of hydrocarbon intoxicated patients admitted to Soroka University Medical Center, Beer-Sheva, Israel, were poisoned by kerosene, and only 4% of patients were poisoned with other hydrocarbons (gasoline, acetone, turpentine, and thinner). Tsujino et al. (2003) and Hieda et al. (2004) stated that kerosene is widely used as a fuel for motors or heating devices all over the world especially in the developing countries. On contrast, Litovitz et al. (2000) found that gasoline alone represented the majority (one-third) of the total hydrocarbons exposures reported by the American Association of Poison Control Centers (AAPCC) in 1999, followed up by motor oils, mineral oils and kerosene.

II- Demographic results

Various social and demographic factors significantly influence the acute poisoning cases (Nhachi and Kasilo, 2006 and Manzar et al., 2010).

The present study illustrated that the majority (76.4%) of hydrocarbons poisoned patients aged ≤5 years. These results are in accordance with Jayashree et al. (2006) who found that 95% of hydrocarbons poisoned patients in the Advanced Pediatrics Center, Chandigarh, India were ≤ 5 years of age. Meanwhile Shotar (2005) found that the majority (80.1%) of kerosene poisoned patients who were hospitalized in Princess Rahmat Hospital, northern Jordan, were below 2 years. Rathnapala et al. (2012) stated that hydrocarbon poisoning is rarely reported among adults.

The present study showed that 56.9% of patients were males while females represented 43.1% of patients. These results are in agreement with Lucas (1994) who showed that males constituted the majority (62.5%) of kerosene poisoned patients, and females

constituted 37.5% of cases admitted to Lady Ridgeway Hospital, Colombo, Sri Lanka. Kamel et al. (2008) reported that the majority (63.9%) of kerosene poisoned patients admitted to the Poison Control Center of Ain Shams University Hospitals, Egypt, were males; meanwhile females comprised 36.1% of cases. Also, Abd-Elsalam et al. (2011) in their study of acute hydrocarbons poisoned patients admitted to Poisoning Center in the Alexandria Main University Hospital (AMUH), Egypt, found that (58%) patients were males and 42 patients (42%) were females. Carolissen and Matzopoulos (2004) stated that prevalence of the accidental nature among male children may engage them in risky exploratory behavior than females.

The present work highlighted that 63.9% of patients came from rural areas, whereas 36.1% came from urban areas. These results are in accordance with those achieved by Shotar (2005) who found that 94% of kerosene poisoned patients who were hospitalized in Princess Rahmat Hospital, northern Jordan, live in rural regions with low economic level. Akhtar et al. (2006) stated that kerosene is commonly used in rural areas as a source of energy in lightening, cooking and for cleaning. In contrast Manzar et al. (2010) reported that the majority (80%) of kerosene intoxicated children presented to Civil Hospital Karachi (CHK), Pakistan, were living in urban area, and explained that to the advent of careers for their mothers leading to neglect of their children.

The present study illustrated that all patients were exposed to hydrocarbons orally, either alone or combined with dermal exposure which occurred due to vomiting in 44.4% of patients. These results are in accordance with Kamel et al. (2008) who found that all patients admitted to the Poison Control Center of Ain Shams University Hospitals, Egypt, exposed to kerosene orally, and 57% of them were also poisoned through dermal exposure. Meanwhile Lifshitz et al. (2003) showed that 98% of hydrocarbon intoxicated patients admitted to Soroka University Medical Center, Beer-Sheva, Israel, ingested the hydrocarbon, and 2% were poisoned by inhalation.

In the present work, the vast majority (93.1%) of patients exposed to hydrocarbons accidentally, meanwhile suicide represented only 6.9% of cases, with no homicidal exposures. These results are in agreement with Mickiewicz & Gomez (2001) who stated that most of hydrocarbon exposures (95%) result from accidental ingestion, but significant intentional abuse of these substances exists in the United States and abroad at likely under-recognized levels. Pande et al. (1995) and Bray et al. (1998) stated that the use of hydrocarbons for suicidal and homicidal purposes is quite infrequent with the increased availability of pesticides and other toxic substances.

The present study found that majority (84.7%) of exposures occurred indoor as a result of exposure to household products containing hydrocarbons. These results are in accordance with Lucas (1994) who found that the vast majority (96.3%) of kerosene exposures admitted to Lady Ridgeway Hospital, Colombo, Sri Lanka, occurred within the house, 1.9% occurred in the garden shed, and 1.7% occurred in a boutique. Singh et al. (1995) and Rathnapala et al. (2012) stated that kerosene is a freely accessible in the households and usually stored in the living area, which presents a serious risk factor for toxicity especially among young children.

The present study illustrated that there was a seasonal variation as 37.5% of exposures occurred during summer months, followed by autumn months (26.4%), spring months (20.8%), and winter months (15.3%). These results are in agreement with those achieved by Lifshitz et al. (2003) who found that there was a significantly higher prevalence of hydrocarbon poisoning in the summer (39%) than in the autumn (24%), spring (23%) or winter (14%) among patients admitted to Soroka University Medical Center, Beer-Sheva, Israel. Later, Paudyal (2005) in the Central Nepal Hospital, and Jayashree et al. (2006) in the Advanced Pediatrics Center, Chandigarh, India, reported that there was a clear seasonal variation with more hydrocarbon cases in summer months. The most probable explanation is that during hot seasons the child is likely to be thirsty and may mistake hydrocarbons for water or another cold drink (Gupta et al. 1992 and Nagi & Abdulallah, 1995). In contrast, Tagwireyi et al. (2006) in their study of hydrocarbons poisoning in Zimbabwe, reported that there was no major notable seasonal variation, as there were peaks in admission in months of January, April and August.

The present study showed that the vast majority (88.9%) of hydrocarbons were stored in non-original containers. These results are in accordance with Shotar (2005) who found in their study in Princess Rahmat Hospital, northern Jordan, that in 52.3% of poisoned patients, kerosene was stored in non-original containers (familiar household containers like water jugs and soft drink bottles). Mickiewicz and Gomez (2001) and Abu-Ekteish (2002) stated that many household hydrocarbons attract toddlers as they may be stored in familiar bottles -a relatively common household practice- increasing the risk of inadvertent ingestion by mistaken identity.

III- Clinical results

In hydrocarbons poisoning respiratory signs and symptoms predominate; other manifestations (GIT and CNS) may occur but tend to be less important (Brander et al., 1992 and Thalhammer et al., 2005).

The present work highlighted that patients presented mainly with respiratory manifestations {cough (72.2%), dyspnea (50%), wheezy chest (40.3%), and respiratory distress (12.5%)}, gastrointestinal manifestations {vomiting (45.8%) and abdominal distention (34.7%)}, and CNS manifestations {drowsiness (36.1%), agitation (11.1%) and convulsion (2.8%)}. Fever occurred in 26.4% of cases. In their study Lifshitz et al. (2003) found that the most commonly observed clinical manifestations of hydrocarbon intoxicated patients admitted to Soroka University Medical Center, Beer-Sheva, Israel, were tachypnea (73.7%), fever (63.5%), vomiting (51.1%), and cough (38.0%), and about one third of the patients showed signs of CNS impairment, including drowsiness, restlessness, stupor, and convulsions.

Hoffman et al. (2004) reported that among patients exposed to paraffin lamp oil admitted to the Regional Poison Control Center, New York City, United States, 87% experienced cough, 20% experienced lethargy or somnolence, and 13% experienced vomiting.

In the present study, and according to the poisoning severity score (PSS), (13.9%) were asymptomatic (Grade 0), (61.1%) were minor (Grade 1), (16.7%) were moderate (Grade 2) and (8.3%) were severe (Grade 3), with no fatal cases (Grade 4). Kamel et al. (2008) reported that among kerosene poisoned patients admitted to the Poison Control Center of Ain Shams University Hospitals, Egypt, 2.4% were asymptomatic, 79.1% were of mild severity, 12.3% of moderate severity, 5.1% of severe toxicity and 1.2% of cases died. Meanwhile Abd-Elsalam et al. (2011) found that among acute hydrocarbons poisoned patients admitted to Poisoning Center in the AMUH, Egypt, 32% were asymptomatic, 50% were of mild severity, 14% of moderate severity, 4% of severe toxicity of which 3 cases died. Sahasrabudhe et al. (2004) stated that the high incidence of minor toxicity can be explained by the fact that hydrocarbons have a disagreeable taste and odor, so most children do not consume it in a large volume and spit it rapidly after tasting it.

The major hazard after ingestion of hydrocarbons is pneumonitis which resulted from pulmonary aspiration that occurs while swallowing the liquid, and/or during vomiting (Rauber-Luthy & Kupferschmidt, 2010).

The present study illustrated that there was a highly significant relation ($p < 0.001$) between vomiting either spontaneous or induced and both {the clinical severity and pneumonia in plain chest x-ray}. These results are in agreement with those obtained by Dice et al. (1982) in Madigan Army Medical Center, Washington, United States; Truemper et al. (1987) in *Houston*, Texas, United States, and Lifshitz et al. (2003) in Beer-Sheva, Israel, who reported that vomiting after ingestion of hydrocarbons was significantly correlated with the clinical severity of cases and chemical pneumonitis. In contrast to these findings, Dudin et al. (1991) in their study of kerosene intoxicated patients in Makassed Islamic Charitable Hospital, Jerusalem, Israel, did not find an increased risk of respiratory complications related to vomiting after kerosene ingestion. This might be due to the relatively small number of patients in their study.

The present study showed that 30.6% of patients received home treatment; all were for induction of vomiting; (15.3% salty water, 12.5% milk with raw eggs and 2.8% mechanical emesis), and there was a highly significant relation ($p < 0.001$) between home treatment and both {the clinical severity and pneumonia in plain chest x-ray}. These results are in agreement with those achieved by Shotar (2005) who reported that vomiting was induced by parents at home in 30.3% of kerosene poisoned patients who were hospitalized in Princess Rahmat Hospital, northern Jordan, and the severity of poisoning was influenced by this type of home remedy (treatment).

The present work highlighted that 86.1% of patients were treated with supplemental oxygen for respiratory dyspnea and distress, 47.2% with bronchodilator nebulizer for bronchospasm, 31.9% with antibiotics for suspected secondary bacterial infection and to whom steroid were given, 26.4% with antipyretics for fever, 12.5% with steroids for respiratory distress, and only 4 patients (5.6%) were put on mechanical ventilation for severe respiratory distress. Shower with soap and water after removal of contaminated cloths was performed for 32 patients (44.4%) to treat dermal exposure. Goto (2007) stated that patients with hydrocarbon exposures should be treated with supplemental oxygen, bronchodilators, and assisted ventilation if necessary. Gummin and Hryhorczuk (2006) confirmed that decontamination of the skin should have a high priority in hydrocarbon exposures, exposed clothing should be removed and safely discarded. Thalhammer et al. (2005) in their study of hydrocarbon poisoned patients admitted to Pediatric Department, Medical University of Graz, Austria, concluded that the use of antibiotics and corticosteroids in hydrocarbon poisoning appears justified in patients who have a pre-existing respiratory illness or who develop complications.

The present study showed that 34.7% of patients were observed in the ER without admission for about 6-12 hours, 52.8% were admitted in inpatient unit; the admission period ranging from 1-3 days, and 12.5% of patients were admitted in ICU; the admission period ranging from 1-7 days. In (2003) Lifshitz et al. found that, among hydrocarbon intoxicated patients admitted to Soroka University Medical Center, Beer-Sheva, Israel, about 32% of patients were observed in the ER, 68% were hospitalized in inpatient wards, of hospitalized patients 6.5% were treated in the ICU. Hoffman et al. (2004) during their study on paraffin lamp oil exposures admitted to the Regional Poison Control Center, New York City, United States, found that 65% of patients were evaluated in ER and released after observation, 35% were admitted to the hospital. Of admitted patients, 86% were admitted to ICU, and 14% was admitted to a general pediatric floor.

The present study illustrated that the vast majority (91.7%) of patients had full improvement outcome and discharged without any complications, the remaining 8.3% of patients discharged before full recovery on patient caretaker demand and against the medical advice. No deaths were recorded. These results were in agreement with Anas et al. (1981) in United States, De Wet et al. (1994) in South Africa and Shotar (2005) in Princess Rahmat Hospital, northern Jordan, who reported that among children hospitalized for kerosene poisoning all cases showed improvement with no fatalities. On the other hand Gupta et al. (1992) reported a 4.3% mortality rate among kerosene poisoned patients admitted to the Department of Pediatrics, University College of Medical Sciences, Delhi, India. Meanwhile Ellis et al. (1994) in their study of paraffin intoxicated patients in Department of Pediatrics and Child Health, Pretoria, South Africa, reported a low fatality rate (0.74%) and Lucas (1994) recorded 3 deaths (0.57%) in his study of 526 patients

admitted to Lady Ridgeway Hospital; Colombo, Sri Lanka. Abd-Elsalam et al. (2011) found that among acute hydrocarbons poisoned patients admitted to Poisoning Center in the AMUH, Egypt, 97% of patients had complete recovery outcome and only 3% of patients died.

IV- Radiological results

Radiographic evidence of pneumonitis develops in 40-88% of patients. A small percentage (<5%) are completely asymptomatic but may have radiographic findings. Chest radiographs performed immediately on initial presentation are not useful in predicting infiltrates in either symptomatic or asymptomatic patients (Gummin and Hryhorczuk, 2006).

Radiological findings of hydrocarbon toxicity may be present as early as 20 minutes after exposure (even before the onset of the clinical symptoms), but in the majority of cases they develop within 12 hours after exposure and may be delayed as late as 24 hours (Thalhammer et al., 2005 and Rauber-Luthy & Kupferschmidt, 2010).

The present study showed that 70.8% of patients had radiological findings of lung pathology; meanwhile 29.2% of them were radiologically free. Abd-Elsalam et al. (2011) found that positive radiological pulmonary changes observed in 31% of acute hydrocarbons poisoned patients admitted to Poisoning Center in the AMUH, Egypt, and 69% of patients were radiologically free.

In the present work, increased broncho-vascular markings were the most common radiological findings (51.2%), followed by pneumonitis either basal or diffuse (19.4%), the most common affected side was the right side (43.3%), and the lower lobes of lungs were the most affected lung zones (48.8%). These results are in agreement with Kamel et al. (2008) who reported that the most common radiological findings among kerosene poisoned patients admitted to the Poison Control Center of Ain Shams University Hospitals, Egypt, were increased bronchovascular markings (45%) followed by pneumonia (29%) and only one patient had pnumothorax (0.3%). On the other hand Lucas (1994) in Lady Ridgeway Hospital, Colombo, Sri Lanka, and Khanna et al. (2004) in Vallabhbhai Patel Chest Institute, Delhi, India reported that the most common radiological pattern following hydrocarbons exposure is bilateral basal infiltrates. Meanwhile, Gupta et al. (1992) recorded that the most common radiological findings among kerosene poisoned patients admitted to the Department of Pediatrics, University College of Medical Sciences, Delhi, India, were right basal infiltrations.

The current study confirmed that there were radiological findings of pulmonary pathology among the asymptomatic (PSS=0) patients, as 50% of them had perihilar densities with increased bronchovascular markings, despite being completely free of any clinical manifestations. Also 36.4% of symptomatic minor patients (PSS=1) were radiologically free (normal), in spite of having obvious clinical manifestations, indicating that radiological findings in acute hydrocarbons poisoning were not always related to the clinical severity. Klein and Simon (1986) in Children's National Medical Center, Washington, DC., United states; Khanna et al. (2004) in Vallabhbhai Patel Chest Institute, Delhi, India and Thalhammer et al. (2005) in the Pediatric Department, Medical University of Graz, Austria, confirmed that chest film abnormalities actually correlate poorly with clinical symptoms of hydrocarbons poisoning, as asymptomatic patients may have abnormal chest films (e.g., increased bronchovascular markings were reported in completely asymptomatic patients) that clear without the patient ever developing symptoms. Also, Gad (2005) stated that the clinical severity of hydrocarbon poisoning does not correlate well with the degree of X-ray findings and the decision for hospitalization should be based on clinical criteria rather than on X-ray findings alone.

Conclusion

This study concluded that:

1. Acute hydrocarbons poisoning is a prevalent household accidental toxic hazard among rural male children under five years old, and during the hot months of the year.
2. Vomiting either spontaneous or induced during home (pre-hospital) treatment is significantly related to the clinical severity and development of pneumonia.
3. Patients must be monitored both clinically and radiologically to recognize potential pulmonary complications.
4. No specific treatment, symptomatic treatment is effective.
5. Preventive measures need to be adopted to spread awareness among parents about this toxic hazard; child-resistant packaging for products that contain low viscosity hydrocarbons is warranted, to protect children from serious injury associated with hydrocarbon aspiration.

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الملخص العربي

معدل الانتشار والخصائص السريرية وعلاج التسمم الحاد بالهيدروكربونات في وحدة بنها لعلاج التسمم: دراسة سريرية مستقبلية لسنة واحدة

عبد المنعم جودة مدبولي وفاروق صادق الجندي[١]

التسمم بالهيدروكربونات هو أحد أهم أسباب الاعتلال والوفاة في البلدان النامية. والهدف من هذه الدراسة هو فحص نمط وعلاج حالات التسمم الحاد بالهيدروكربونات في وحدة بنها لعلاج التسمم بمصر من ١ فبراير ٢٠١٣ إلى ٣١ يناير ٢٠١٤. من مجموع ٧٢ حالة تعرضت للهيدروكربونات، شكل الكيروسين الغالبية ٦٦,٧% و البنزين ٢٧,٨% ومادة التينر ٥,٥%. كانت نسبة الذكور ٥٦,٩% والإناث ٤٣,١% من الحالات، وكانت نسبة ٧٦,٤% دون سن الخامسة، وجاءت نسبة ٦٣,٩% من المناطق الريفية. سادت الطريقة العرضية بنسبة ٩٣,١%، وكان التعرض بالمنزل هو الشائع بنسبة ٨٤,٧%، وحدثت خلال أشهر الصيف بنسبة ٣٧,٥%. وتعرض جميع المرضى للتسمم عن طريق الفم وحدث التعرض عن طريق الجلد والفم معا في ٤٤,٤% منهم. كانت أكثر الأعراض التي لوحظت السعال بنسبة ٧٢,٢% و ضيق التنفس بنسبة ٥٠% و أزيز الصدر ٤٠,٣% و ضيق التنفس ١٢,٥% و التقيؤ ٤٥,٨% والنعاس ٣٦,١% والإثارة والتهيج ١١,١% والتشنج ٢,٨% والحمى ٢٦,٤%. وفقا لدرجة خطورة التسمم، كانت نسبة ١٣,٩% غير متناظرة لا أعراض لها و ٦١,١% كانت طفيفة و ١٦,٧%كانت معتدلة و ٨,٣%كانت شديدة، مع عدم وجود حالات وفاة. وكانت هناك علاقة ذات دلالة إحصائية بين القيء وشدة الأعراض السريرية والالتهاب الرئوي. وجدت النتائج الإشعاعية الرئوية المرضية في ٧٠,٨%، وكانت الأكثر شيوعا زيادة العلامات الشعبية الوعائية الدموية ٥١,٢% يليها الالتهاب الرئوي ١٩,٤%. لم يتم استخدام أي علاج محدد، واستخدم الأكسجين الإضافي في ٨٦,١%من المرضى لعلاج ضيق التنفس والعوز الاوكسجيني، وفقط ٥,٦% وضعت على التهوية الميكانيكية لحالات الضائقة التنفسية الحادة. في الختام، يجب متابعة مرضى التسمم بالهيدروكاربونات سريريا وكذلك فحصهم بالأشعة للتعرف على المضاعفات الرئوية المحتملة، كما أفادت النتائج فاعلية علاج الأعراض.

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