A MEDICOLEGAL STUDY OF ADOLESCENT DEATHS IN CAIRO

BY

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ABSTRACT

Although adolescents make up about 20 percent of the world's population, they have traditionally been neglected as a distinct target group. Combination of developmental changes, risk-taking behavior and greater independence in this age group sometimes lead to undesirable consequences including death. This study aimed to evaluate adolescent death regarding age, gender, cause, manner of death, location, death scenario, perpetrator in cases referred to Institute of Forensic Medicine, Ministry of Justice at Zenhum, Cairo during the period (2003-2004).Their ages ranged between 10-19 years. Poisons detection and forensic pathology analysis were done for the studied cases. The most common manner of death was homicide followed by accident, suicide, natural and undetermined in the overall age groups. In contrast, the most common manner in the younger age group 10-14 years was accident. In homicidal death, the perpetrator was not a family member in 61.5% of deceased and stab wounds were the common cause (61.5%). The majority of accidental deaths (84.2%) were burns, drowning and traffic accidents. Suicidal deaths were common in the older age group (>14-19y) and stressful life events were the precipitating factors in all of them and insecticides ingestion was the common method (38%). Regarding natural death, cardiovascular diseases constituted the largest percent (50%). Poisons detection results were positive for 35 (31%) of cases; carbon monoxide and insecticides were the common detected poisons (85.8%).

INTRODUCTION

Mortality is conditioned by biological, political and social factors, as well as by culturally defined behaviors and attitudes that historically characterize the stage of development of a country or a region (Oliveira et al., 2007). The World Health Organization (WHO, 1998) defines adolescence as the period of life between 10 and 19 years of ages. The ages of adolescence vary by culture. In the United States, adolescence generally begins at age 13, and end at 20 years. Adolescents are an interesting group, as they enter the period as children dependent on their families and leave as self- sufficient young adults (WISQARS, 2004).

Analysis of the fatality data in adolescent deaths allows identification of high-risk groups and potential intervention

strategies (Shepherd and Schwartz, 1998). Careful understanding of adolescent deaths as a whole might provide information to aid death investigators and those certify these deaths (Batalis and Collins, 2005).

MATERIAL AND METHODS

This study was performed on 114 cases of adolescent deaths referred to the Forensic Medicine Institute, Ministry of Justice at Zenhum in Cairo during the period (2003-2004).They were32 females and 82 males. Their ages ranged between 10-19 years and subdivided into two age groups: group (1):10-14 years(n.18cases) and group(2): >14-19 years(n.96cases). The age, gender of the victims, cause and manner of death, the death scenario and location, perpetrator. All cases were investigated regarding forensic pathology examination and poisons detection. Histopathological examination of heart, lung and liver were performed. Organs were fixed in 10% buffered formalin. Gross examination of the organs was made, each organ was dissected and routine tissue sections were taken for histopathology. Tissue sections were processed; paraffin blocks were made and serial sections of 4-micron thickness were prepared. Sections were stained with Hematoxylin and Eosin (H&E) for routine light microscopic examination. Poisons detection was done by spectrophotometer HP 8452A, colour tests, and high performance liquid chromatography HP 1050; column C18 and photodiodoarray detector.

RESULTS

The common manners of death were homicide [n.39 (34.3%)], followed by accident [n.38 (33.3 %)], suicide [n.21 (18.4 %)], and natural [n.12 (10.5 %)]. Undetermined manner was [n.4 (3.5%)]. This order was different in both age groups; in the 10-14 year age group the order was accident [n.8 (44.4%)], natural [n.4 (22.2%)], homicide [n.3 (16.7%)], undetermined [n.2 (11.1%)], and suicide [n.1 (5.6%)]. The order in the >14-19 year age group was homicide [n.36 (37.5%)], accident [n.30 (31.2%)], and suicide [n.20 (20.8%) and natural [n.8 (8.4%)], and undetermined [n.2 (2.1%)].The most common gender was male [n.82 (71.9 %)] (Table, 1 and Figure, 1).

Homicide was the first leading manner of adolescent death in the >14-19 year age group and the third manner of death in the 10-14 year age group. Deaths among males were predominant [n.28 (71.8 %)], while female number was [11 (28.2%)] (Table,2). Stab wound accounted for [n.24 (61.5 %)], asphyxia due to strangulation or drowning accounted for [n.6 (15.5%)], head injuries accounted for [n.5 (12.8%)], firearm injuries accounted for [n.2 (5.1 %)], and burning by kerosene stove [n.2 (5.1 %)] (Figure, 2). The perpetrator was a

family member (father or brother) in [n.15 (38.5%)] and friend or stranger in [n.24 (61.5 %)]. The location of the homicide was outdoor (farm, street, Nile water) in [n.24 (61.5 %)], and indoor (home) in [n.15 (38.5%)](Table,3).

Accident was the most common manner of death in the 10-14 age group and was the second manner of death in the >14-19 year age group. Accidental causes of death included burns [n.14 (36.8 %)], drowning [n.12 (31.6%)], traffic accident [n. 6 (15.8 %)], fall from height [n = 4 (10.5 %)] and toxicity [n. 2 (5.3%)] (Figure, 3). Male numbers [n .26 (68.4%)] exceed female numbers [n. 12 (31.6%)](Table,2). Burns were due to accidental kerosene stove or electric burns. There was history of epilepsy in two cases of drowning. Traffic accidents include car and train accidents.

Suicide was the third manner of death in the >14-19 year group. Males accounted for [n.12 (57.1%)], and females [n.9 (42.9%)]; of whom one female only (5.6%) in the 10-14 year group (Table, 2). Suicide deaths were due to insecticides ingestion [n.8 (38 %)], kerosene stove burn [n.6 (28.6%)], falling from height [n.4 (19 %)], hanging [n.2 (9.6%)], and firearm injuries [n.1 (4.8 %)] (Figure, 4).

Natural deaths accounted for the second death manner in the 10-14 year age group and the least number of deaths in >14-19 year age group. Cardiovascular diseases was the leading cause of death in the over all group followed by pulmonary diseases and lastly liver disease.

Cardiovascular diseases included cardiomyopathy, myocardial ischemia as a result of coronary artery spasm, and congenital anomalies (Fallot tetralogy). Pulmonary diseases included pulmonary emboli and pneumonia. Liver disease was bilharzial liver cell failure. There were four cases (33.3%) with pulmonary diseases in the age group 10-14 years, six cases (50%) of cardiovascular diseases ended in heart failure and two cases (16.7%) of liver disease in the age group >14-19 years ; (Figure,5).

Results of histopathological examination:

Gross examination of the dissected organs show no gross abnormalities of lungs or livers. While the heart show characteristic changes illustrated in picture (1). Pictures (2-5) show microscopic examination of the dissected organs.

The manner of death was undetermined in four cases (3.5%) in both age groups.

Poison detection results were positive in 35(31%) of all cases of which 22 cases (62.9 %) were carbon monoxide, eight cas-

es were (22.9%) insecticides (temmick, lannate, rodenticides), two cases (5.7%) were alcohol (methyl, ethyl alcohol), two cases (5.7%) were cannabis and one case (2.8%) phenobarbitone. The alcohol, cannabis and phenobarbitone positive results were in the >14-19 years age group (Table, 4 and Figure, 6).

DISCUSSION

The World Health Organization (WHO, 1998) defines adolescents as persons between 10 and 19 years of age. Although adolescents make up about 20 percent of the world population (of whom 85 percent live in developing countries, they have traditionally been neglected as a distinct target group (Dehne and Riedner, 2001).

Adolescents are characterized by high-risk behaviors which increase their risk of injury. Major modes of injury in adolescents include motor vehicle collisions, drowning, suicide and homicide (McIntosh and Moreno, 2000).

No published study, to our knowledge has studied age, gender, causes of adolescent death in Egypt. Although, it is very crucial for medical examiners and forensic experts to be familiar with the most common circumstances, causes and manners, perpetrators and natural diseases in adolescent deaths, hoping to improve certifying, investigating adolescent death and prevention programms of future fatalities. So, this study aimed to evaluate adolescent deaths in Cairo among autopsied cases referred to the Forensic Medicine Institute, Ministry of Justice at Zenhum during the period (2003-2004). A total of 114 corpses; males accounted for 71.9 % and females were 28.1 % has been evaluated concerning cause, manner, scenario, location of death, perpetrator, poison detection and forensic pathology investigations.

Homicide was the most common manner of death [n = 39 (34.3%)] in this study which is inconsistent with McIntosh and Moreno, (2000) who reported that homicide is the third leading cause of death in adolescents in Wisconsin and the second leading cause of death in the United States. Also, Batalis and Collins, (2005) found that homicide was the second leading cause of death in his study in South Carolina.

Homicides were more common in the >14-19 year age group than the 10- 14 year age group and this coincides with WISQARS, (2004) who reported the same result. Also, homicidal deaths were predominant among males. This is consistent with the results of Runyan and Gerken, (1989) and NAHIC, (2007) who elicited that violent behavior is experienced more by male adolescents than their female peers. Males are much more likely to have been in a

physical fight and be injured with a weapon. In addition, they are more likely to carry a weapon than females. The perpetrator was a family member (Father or brother) in [15 (38.5%)] and stranger in [24 (61.5%)], in contrast to the findings of Batalis and Collins, (2005) who concluded that the perpetrator of homicide was a family member or close acquaintance in 68% of studied cases. The commonest homicide method in this study was stab wound which doesn't coincide with NAHIC, (2007) who reported that most homicide mortality among adolescents and young adults are caused by firearms. This difference is attributed to the culture and social inequality between the countries in which each study was performed.

As regards accidental death, it was the most common manner of death in the 10–14 year age group [n. 8 (44.4%)] and this is consistent with the findings of Batalis and Collins, (2005) and those of Byard, (2000).Concerning the age group >14-19 year, accidental death was the second manner of death [n. 30 (31.2%)] and in both age groups in this study [n. 38 (33.3%)]. Kochanek et al., (2004) reported similar results that the common leading cause of death is unintentional injury among adolescents' ages 15-19 year.

In contrast , Pan et al., (2005) found substantial decrease in mortality rate of unintentional injuries in Canadian adolescents which was in accordance with those reported in other countries, such as Finland(Mattila et al., 2005) ; Sweden (Johansson et al., 2005) ; England and Wales(Roberts et al., 1998) ; Israel (Morad et al., 2004) and Mexico (Celis et al., 2003) .

Burns were the common causes of accidental death in our study (burning was commonly by kerosene stove and was 2nd and 3rd degree burns followed by electric burns) followed by traffic accidents, drowning, fall from height and lastly toxicity. These results don't coincide with those of Batalis and Collins, (2005) and Pan et al., (2005) who concluded that traffic accidents were the most common causes of accidental death in their study in South Carolina and Canada respectively.

There was history of epilepsy in two cases of drowning. So, accurate autopsy must be done in drowning cases to rule out drug use, homicidal and natural causes of death.

A preventive strategy for accidental death is needed like educational campaigns, community safety programs, legislation and safety regulations, improvement of enforcement of rules, regulations and road conditions.

The third manner of death in both age groups [n. 21 (18.4%) was suicide]; twenty (20.8%) in the >14-19 years group and one

(5.6%) in the 10-14 years age group. This is consistent with the results of Agritmis et al., (2004) who reported that the high incidence of suicide was in the age group 15-19 year and its prevalence had been found to be increased two or three times in this age category according to previous literature (Hoberman and Garfinkel, 1998).

Male incidence in suicidal death was the predominant [n. 12 (57.1%)]. Also, Pan et al., (2007) found that although males were more than four times as likely to die from suicide attempts as females, females were more likely to attempt suicide, a situation similar to those in the United States (Sells and Blum, 1996) and New Zealand (Kypri et al., 2002) .The reason for the gender difference might be related to the method of suicide; females tend to use less dangerous methods. Suicidal behavior may be associated with a complex array of factors including social and educational disadvantage, childhood and family misfortune, individual and personal vulnerabilities, exposure to stressful life events and circumstances, and social isolation, substance abuse with the strongest risk factors as mental and substance abuse disorders (Beautrais, 2000).This ensures our finding that stressful life events include school problems, poverty, arguments with the family and death of a relative were important causes of suicide in both groups in this study.

The most common causes of death in adolescent suicides are insecticides ingestion and kerosene stove burns followed by falling from height, hanging and lastly firearm injuries. This finding may be due to easy access to insecticides. In Israel, USA and Turkey, firearms have been found to be the most commonly used tools in suicides (Lubin et al., 2001; Erden, 1999; Agritmis et al., 2004) respectively due to easy getting a gun license and common firearm use.

Multifaceted suicidal prevention strategies are needed focusing on behavioral change in the general school population, skill training and social support for at-risk students with priorities on improvement in recognition, treatment and management of adolescents with mental and substance abuse disorders.

Concerning natural manner of death, it accounted for the second manner in the age group 10-14 year and the least in the >14-19 year age group. This finding is similar to results of Batalis and Collins, (2005) who revealed that natural deaths had comprised a much higher percentage of the 10-14 year group. Cardiovascular diseases represented the higher percentage [n.6 (50%)] followed by pulmonary diseases [n. 4(33.3%)] and liver disease [n. 2 (16.7%)] in our study.

In many countries, these natural deaths

form the largest proportion of medico-legal autopsies (Di Maio and Di Maio 2001). While in Egypt, natural deaths are rarely referred for autopsy, as the autopsy is only performed when there is any suspicion of homicide or suicide on the part of the doctor of the medical office who issues the death certificate; or on the part of the relatives of the deceased; or if the death was un-witnessed especially in young age.

Forensic pathologists deal with a wide range of deaths from natural causes and most sudden unexpected deaths (SUDs) are caused by a lesion in the cardiovascular system. Ischemic heart disease (IHD) is the leading cause and it is defined as acute or chronic form of cardiac disability from imbalance between the myocardial supply and the demand for oxygen blood. Coronary atherosclerosis is by far the most frequent and the major cause of Ischemic heart disease, but in some situations this imbalance is caused by reduction of blood flow and oxygen supply secondary to increased coronary vascular tone (spasm). In this situation, when reperfusion occurs, pathologic findings of re-perfusion infarcts in the re-perfusion zone are detected (Schoen, 2005).

Cardiomyopathy and heart anomalies are frequent causes of SUDs especially in young age (Saukko and Knight, 2004).

Pulmonary embolism is the major cause of SUDs within the respiratory system which in fact the most under-diagnosed cause of death. In the majority of cases, the source of the embolus is in the leg veins and about 80 % of pulmonary embolism deaths have a predisposing cause such as fractures, tissue trauma, surgical operation, bed rest, forced immobility, etc., but the remainder (20%) occur unexpectedly in normal people. Pulmonary embolism was a cause of death in a case in the 10-14 years age group after tibia fracture. Other causes of SUDs in the respiratory system are airway pathology and it has been found that asthma and pneumonia are frequent respiratory diseases associated with cardiac arrest in population (Saukko & Knight, 2004).

Sudden death due to hepatic disorders is uncommon. Advanced cirrhosis of the liver from any cause may be the only finding present in cases of SUD, with or without ascitis, hepatic failure, metabolic disorders and electrolyte imbalance (Saukko and Knight, 2004). In Egypt, cirrhosis is a very common disease mostly caused by bilharziasis which is endemic.

Parham et al., (2003) reported that many natural diseases in children and adolescents present with sudden death. So, the background history of the victim of sudden death should be elicited including preceding symptoms, previous medical history, and circumstances of death, fami-

ly history including any histories of unexplained syncope, sudden death, and muscle weakness.

Health care professionals manage almost all-natural deaths with a physician signing the death certificate. Some of these deaths may be from intentional or non-intentional injury and improperly classified as natural. Some coroner's cases may be seen as injury related and with investigation changed to natural.

Poison detection results in this study were positive in 35(31) % of cases; the majority was carbon monoxide positive (62.9%) followed by insecticides (22.9%). Alcohol, cannabis and phenobarbitone were positive (14.2%) in the >14-19 year age group.

Shepherd and Schwartz, (1998) found in their study that carbon monoxide poisoning was common in accidental and suicidal deaths. On the other side, Batalis and Collins, (2005) elicited positive screens of ethanol, marijuana or cocaine in the >14-19 year group. These results were consistent with our findings.

To be concluded, adolescent deaths is a serious problem requiring intervention. Analysis of the fatality data allows identification of high-risk groups and future potential intervention. It is also considered a guide for death investigators, medical examiners and forensic pathologists for better death certification, law enforcement and epidemiologists for improving prevention strategies.

A thorough scene investigation is required in all deaths in order to collect as much information as possible to aid in death certification. A detailed medical history can provide valuable information in sudden natural deaths. Toxicology screen for drugs of abuse should be performed in every case of adolescent death to confirm causes of sudden death. Also it is helpful in understanding other deaths such as drowning and motor vehicle accidents. Complete autopsies must be performed in the majority of adolescent deaths to determine the cause and manner of death.

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Table (1) : Classification of gender, manner and causes of deaths in the studied adolescent groups.

Age groups	10-14years		>14-19years	
	n.	%	n.	%
	18	100%	96	100%
Sex:				
Male	11	61.1%	71	74 %
Female	7	38.9%	25	26%
Manner of death:				
Homicide:	3	16.7%	36	37.5 %
Stab wound	1	5.6%	23	23.9%
Asphyxia	1	5.6%	5	5.2%
Head injuries	1	5.6%	4	4.2%
Firearm injuries	-	-	2	2.1%
Burning	-	-	2	2.1%
Accident:	8	44.4%	30	31.2%
Burns	2	11.1%	12	12.5%
Drowning	2	11.1%	10	10.4%
Traffic accidents	4	22.2%	2	2.1%
Fall from height	-	-	4	4.2%
Toxicity	-	-	2	2.1%
Suicide:	1	5.6%	20	20.8%
Insecticides	1	5.6%	7	7.2%
Kerosene stove burns	-	-	6	6.3%
Fall from height	-	-	4	4.2%
Hanging	-	-	2	2.1%
Firearm injuries	-	-	1	1.0%
Natural:	4	22.2%	8	8.4%
Cardiovascular diseases	-	-	6	6.3%
Pulmonary diseases	4	22.2%	-	-
Liver disease	-	-	2	2.1%
Undetermined	2	11.1%	2	2.1%

Table (2) : Classification of gender in the different manners of adolescent deaths.

Manner	Male		Female	
	n.	%	n.	%
Homicide (n.39)	28	71.8	11	28.2
Accident (n.38)	26	68.4	12	31.6
Suicide (n.21)	12	57.1	9	42.9
Natural (n.12)	12	100	-	-
Undetermined(n.4)	4	100	-	-

Table (3) : Perpetrator and location in homicide adolescent deaths.

Homicide adolescent deaths	Perpatrator		Location	
	Family member	Non family member	Outdoor	Indoor
n. (39)	15	24	24	15
% (100%)	38.5%	61.5%	61.5%	38.5%

Table (4) : Poison detection results in the studied adolescent deaths.

Toxicological Causes	10-14years(n.18)	>14-19years(n.96)
Carbon monoxide	2 (11.1%)	20 (20.8%)
Insecticides	1 (5.6%)	7 (7.2%)
Alcohol	_	2 (2.1%)
Cannabis	_	2 (2.1%)
Phenobarbitone	_	1 (1.0%)

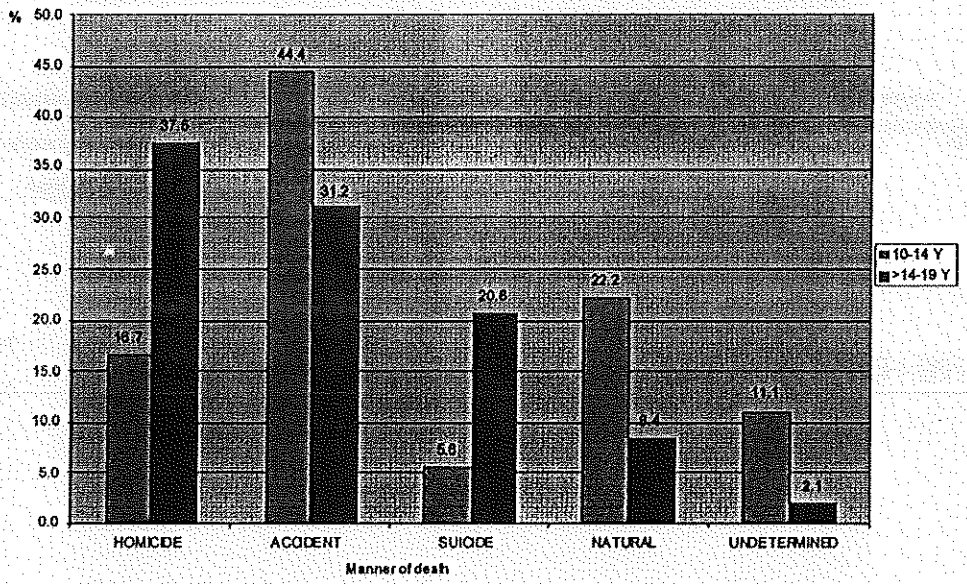

Fig. (1) : Classification of manner in all adolescent deaths.

Fig.(2) : Distribution of death causes in homicidal adolescent deaths (n.39).

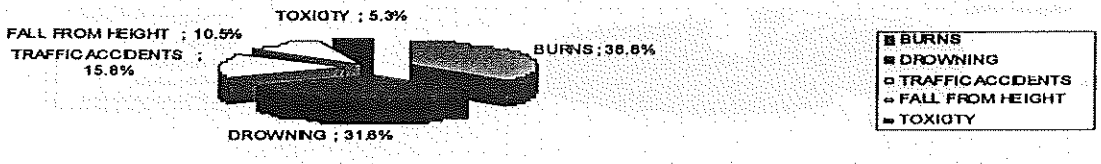

Fig. (3) : Distribution of death causes in accidental adolescent deaths (n.38).

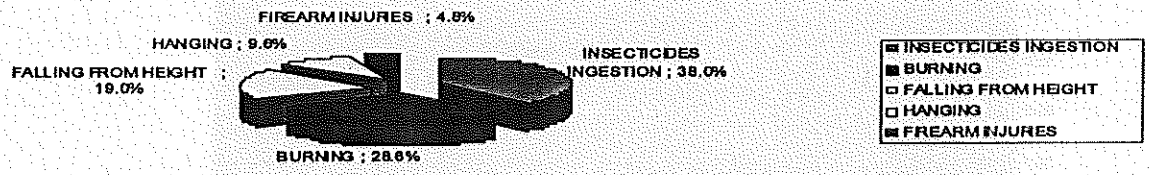

Fig. (4) : Distribution of death causes in suicidal adolescent deaths (n. 21).

Fig.(5) : Distribution of natural causes in adolescent deaths (n.12).

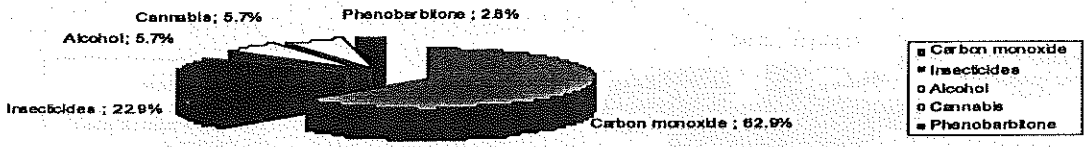

Fig. (6) : Distribution of toxicological causes in adolescent deaths (n. 35).

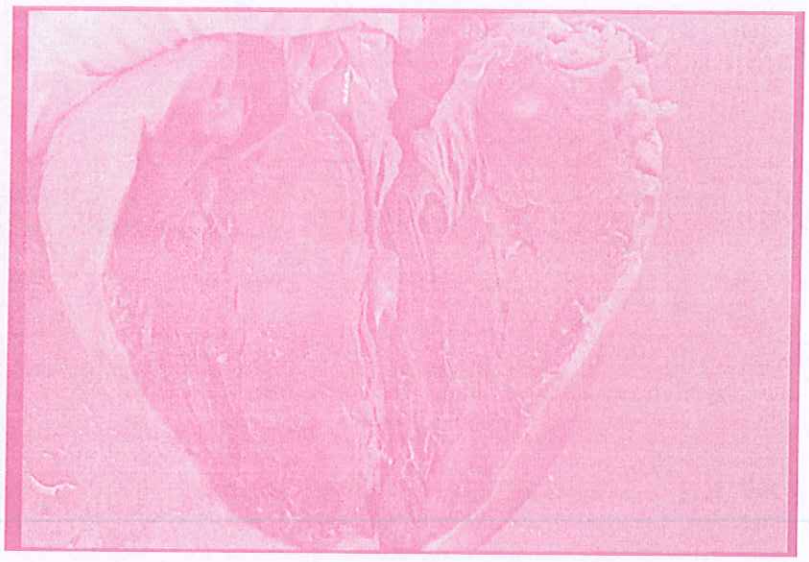

Fig. (1) : A photograph of the heart of male aged 15years died from cardiomyopathy showing hypertrophic Cardiomyopathy with marked increase in the thickness of the inter-ventricular septum in relation to the left ventricle. The cavity of the left ventricle is compressed into" banana-like" configuration by bulging of ventricular septum into lumen.

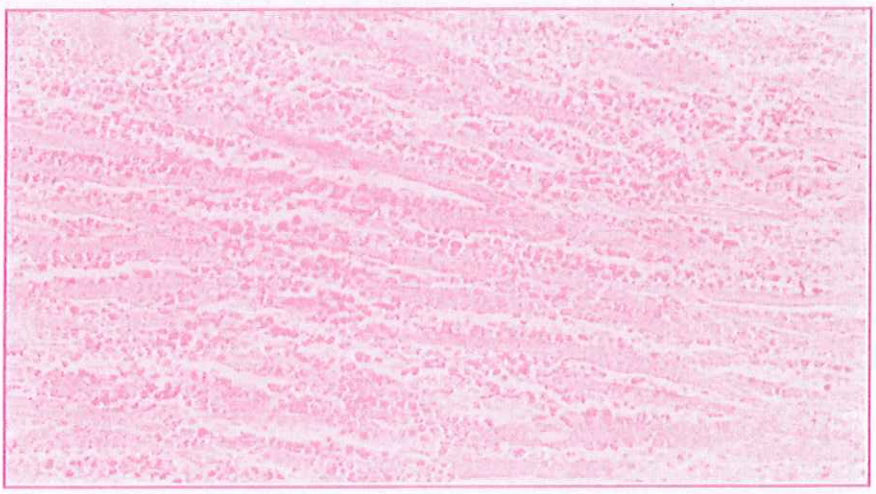

Fig. (2) : A photomicrograph of the heart of male aged 19 years died from myocardial ischemia showing myocardial Ischemia with reperfusion hemorrhage necrosis in the myocardium (H& E, x 400).

Fig. (3) : A photomicrograph of the lung tissue of male aged 14 years died from pulmonary embolus showing obstruction of one of the pulmonary arteries by an embolus.(H& E,x 400).

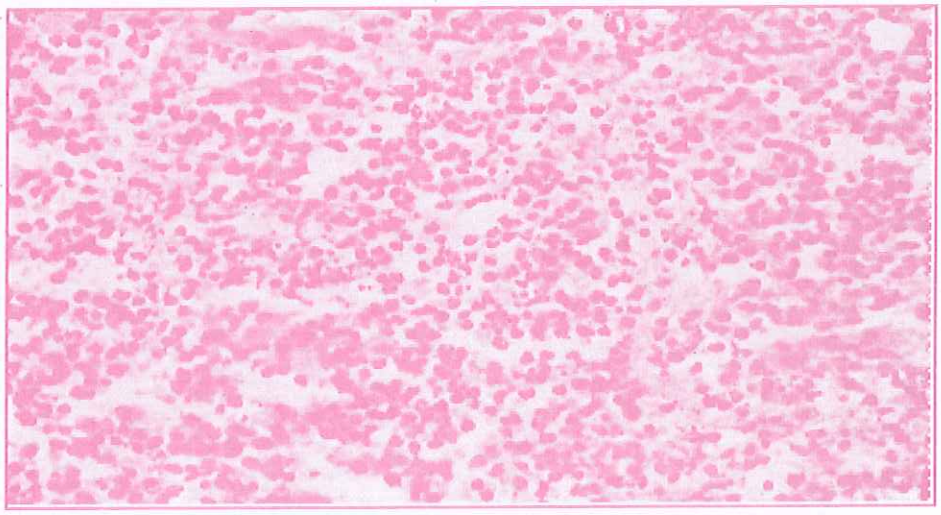

Fig. (4) : A photomicrograph of lung tissue of male aged 10 years died from acute pneuomonia showing congested septal capillaries, extensive white cell exudation mainly neutrophils with RBCs in the lung alveoli(stage of red hepatization)(H& E, x 400).

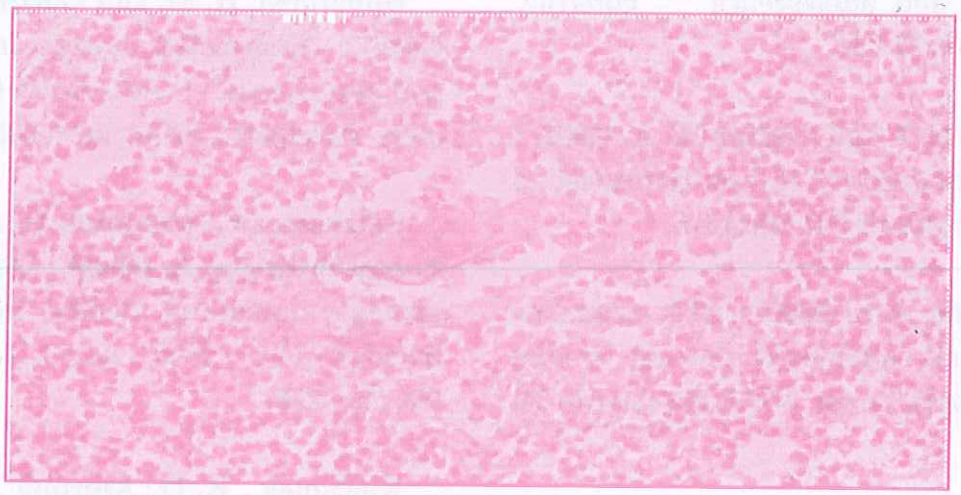

Fig. (5) : A photomicrograph of liver tissue of male aged 19 years died from bilharzial liver failure showing Bilhazial ova surrounded by chronic inflammatory cells and eosinophiles) (H& E, x 400).

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دراسة طبية شرعية لوفيات المراهقين فى القاهرة

المشتركون فى البحث

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على الرغم من أن المراهقين يمثلون ٢٠٪ من العالم، فإنهم يهملون كفئة عمرية مختلفة وواضحة وقد تؤدى التغيرات، والسلوك المتسم بالخطر والاستقلالية فى هذه الفئة إلى عواقب غير مرغوبة مثل الوفاة، تهدف هذه الدراسة إلى تقييم وفاة المراهقون من حيث العمر، الجنس، السبب، نمط، مكان، ومرتكب الوفاة فى الحالات المحالة إلى مصلحة الطب الشرعى فى زينهم، التابعة لوزارة العدل خلال الفترة (٢٠٠٣ - ٢٠٠٤)، وتم إجراء تحاليل السموم والباثولوجية الطبية الشرعية لهذه الحالات، ووجد أن أكثر نمط الوفاة شيوعاً؛ الجنائية ثم العرضية، الانتحارية، الطبيعية وغير المحددة فى المجموعة العمرية الكلية، أما فى المجموعة العمرية ١٠ - ١٤ عاماً كانت العرضية هى الأكثر شيوعاً، وكانت الجروح الطعنية هى الغالبة فى النمط الجنائى (٥ر٦١٪) ومرتكب الجريمة من غير الأقارب فى ٥ر٦١٪ من المتوفين، وأظهرت النتائج أن أكثر الأسباب حدوثاً فى الوفاة العرضية هى الحروق، الغرق والحوادث المرورية (٢ر٨٤٪)، وغلبت الوفاة الانتحارية فى المجموعة العمرية ‹١٤-١٩ عاماً، وشكلت ضغوط الحياة عاملاً رئيسياً من العوامل المسببة، وأكثر الطرق شيوعاً فى هذا النمط كانت تناول المبيدات الحشرية (٣٨٪)، أما الوفاة الطبيعية فقد مثلت الأمراض القلبية ٥٠٪، أثبتت تحاليل الكشف عن السموم إيجابيتها فى ٣١٪ من المتوفين؛ أغلبهم من التسمم بغاز أول أكسيد الكربون والمبيدات الحشرية (٨ر٨٥٪).