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Evaluation of alcohol concentrations in samples referred to the forensic Laboratory in Baghdad

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Abstract

Background: Detection of alcohol in postmortem blood and body fluids is of extreme importance in medico-legal investigation as it may affect and change the decision of the court in legal hearing. It can be a cause death or sharing a role in different modes of death.

Objectives: To evaluate the problem of alcohol intake in general and its relation to age,sex and its contribution in different causes of death.

Method: A prospective study within 6 month period on postmortem blood samples referred to the lab. For detection and measurement of alcohol.
Five to 10 ml of blood of each sample was tested using Head Space GC with flame ionization detector (FID) from Agilent 7890A.

Result: In general traumatic death was predominant among all victims.From total 1275, only 112 (8.8%) sample were positive. Males were more than 5 times than females.
There was a significant relation of alcohol intake with traumatic causes of death, yet only in 13 victims the concentration was fatal.

Conclusion: Alcohol drinking is a minor problem as it was detected in a small group of all cases yet its association with traumatic death was significantly higher than natural death and its consumption was more than 5 times in males. Only in limited number of cases the concentration was fatal.

Keywords: Alcohol, Postmortem, Ethanol, Autopsy

Introduction

Alcohol is a social drug. It is one of the world's leading risk factors for morbidity,mortality and disability. In 2012, 5.9% of all global deaths were attributed to alcohol and 5.1% of all global burden of diseases and injuries were attributed to its use as well. Its effect was more pronounced from neuropsychiatric disorders (Global Status Repost on Alcohol and Health, 2014).

Annually 88,000 people die from alcohol-related causes in USA and it is considered the fourth leading preventable cause of death. It is blamed to 31% of all driving fatalities and in 2014 it was found that 59.8% of college students ages 18- 22 years drank alcohol during the month prior to the study (National Institute on Alcohol Abuse and Alcoholoism, n.d.).

In England, there were 1,059,210 patients admitted to hospitals due to diseases or injuries related to alcohol consumption during the years 2013 -2014 and the highest were due to cardiovascular diseases and alcohol liver diseases. It was also found that men had drunk normal strength beer while the majority of women had drunk wine (Statistics on Alcohol, England, 2015).

The CDC (**Communicable Diseases Control**) links excessive alcohol use to many health risks such as RTA (**Road Traffic Injuries**), firearm injuries, domestic violence, child abuse syndrome, suicide and some other diseases like hypertension, heart disease, cancer and personality

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disorders (Impact of alcoholism and Alcohol Induced diseases on America, 2011; Zhu et al., 2009).

In Iraq there is no legal level of alcohol that permits working or driving under its effect and any positive sample is considered as an illegal offence.

Problematic alcohol uses among military personnel such as psychological impairment and Post-Traumatic Stress Disorders (PTSD) were also noted following combat military experiences. Marines and Navy branches of military services were more likely to report heavy alcohol drinks (Schumm & Charad, n.d.).

Alcohol is also related to many crimes. In 2013 -2014, 53% of violent crimes were under the effect of alcohol, these include assaults, wounds, sexual offences, homicide, criminal damage, theft and robbery (Snowdon, n.d.).

Psychiatric diseases and symptoms are also related to chronic alcohol use ranging from anxiety, bipolar disorders to frank schizophrenia (Hashimoto et al., 2013).

Objectives of the study

1- To detect the presence of alcohol and its concentration in all samples of autopsy cases referred to the lab.
2- To classify them according to age, sex, month of the year and the type of alcohol ingested.
3- To classify the postmortem samples according to the mode of death and verify its contribution to the cause of death.

Methods

A prospective study on 1275 postmortem samples for alcohol detection in blood was carried out. Blood samples were sent to the main forensic alcohol lab. of the Medico-legal Directorate in Baghdad during the second half of the year 2015 after approval by the Ethical approval committee. These samples were withdrawn from the heart of fresh autopsy cases by the forensic pathologist for alcohol detection and measurement of its concentration (Kugelberg & Jones, 2007).

Each samples contains 5-10 ml of blood in test tube containing 1% sodium fluoride to prevent fermentation by bacteria.

Only 2.5 ml of blood were used from each sample to detect alcohol,its type and measure its concentration using headspace gas chromatography (HS-GC) with automated sampling using flame ionization detector (FID) from Agilent 7890A Network Gas Chromatography with Capillary Flow Technology.

Each 100 μL of blood sample was diluted 10 times with a known concentration of aqueous solution of internal standard (which was prepared by dissolving sodium chloride in distilled water then added to propanol) and the blood sample and the internal standard were immediately ejected into a glass vial which was fitted with a Teflon-lined stopper and air tightened to be ready for HS analysis .

The concentration of alcohol in the unknown blood sample was found by interpolation using computer software and a linear regression analysis by comparing the peak area ratio for alcohol to internal standard and the known concentration of alcohol in the standard (Moffat et al., 2011). Four points of calibration curve were adopted (0.4, 0.8, 1.2 and 1.6 mg%). The cut-off point of alcohol is 40 mg/100 ml, below this level the sample was considered negative as it may be due to postmortem bacterial decomposition and any value above 40 is considered to be positive sample.

Results

During the six months selected for analysis, samples of 1275 deaths with autopsy exam were included in the

Table 1 Socio-demographic characteristics, cause of death and alcoholic status of the sample

Variable	Frequency	Percent
Age (years):[a]		
<25	156	12.3
25–34	317	24.9
35–44	304	23.9
45–54	257	20.2
≥55	238	18.7
Mean ± SD	40.1 ± 13.1	
Sex:		
Females	139	10.9
Males	1136	89.1
Month of death:		
July	165	12.9
August	326	25.6
September	232	18.2
October	176	13.8
November	210	16.5
December	166	13.0
Cause of death:		
Natural	261	20.5
Traumatic	1014	79.5
Alcohol status:		
Negative	1163	91.2
Positive	112	8.8
Mean ± SD	249.4 ± 102.8	
Total	1275	100.0

[a]There were 3 missing age values

study. They were of mean ± SD age of 40.1 ± 13.1 years ranged between 14 and 72 years old, male to female ratio was 8.2: 1, the highest rate of death happened during August month 326 (25.6%), and only one fifth of them was natural deaths 261 (20.5%) and the remaining had traumatic source. Positive alcohol consumption was found in 112 (8.8%) of the all deaths with mean ± SD alcohol concentration in their blood was 249.4 ± 102 mg/100 ml with a range between 55 and 583 mg/100 ml and one death was methanol rather than ethanol consumption was detected.

The study failed to find significant relation between consumption of alcohol among the victims and their age, their sex, and the month when the death happened. However, a highly significant relation was found with cause of death as those died traumatically had higher consumption $P = 0.007$ (Table 1 and 2).

Out of 112 positive alcohol results 13 samples were 400 mg/100 ml and above.

Regarding the relation of the cause of death with the studied variables, the study found a significant relation $P = 0.001$ with the victim age as traumatic death decrease with increasing age, highly significant relation $P = 0.00001$ with victim sex as females had more traumatic source of death than males (91.4% versus 78.1% respectively) making male to female traumatic death ration to reach 1: 1.17, while no relation was found with the month when the death happened (Table 3).

Further description of 112 deaths with positive alcohol consumption revealed that their mean ± SD age was41.5 ± 14.1 years. Male to female ratio was 5.6: 1. August was also the month with the highest rate of death36 (32.1%), and only 12 (10.7%)deaths was of natural causes among this group, with traumatic to natural deaths ratio among males and females was 10.9:1 and 3.25:1 respectively.

Discussion

Detection and Measurement of alcohol concentration is very important in forensic examination as it may affect and change the decision of the court in legal hearing.

The study aimed to reveal the impact of alcohol consumption in medico-legal autopsy examination.

The study was conducted within 6 months period (2nd half of the year 2015).

Because of known connection of alcohol to trauma and the order of the investigation authorities, many blood samples were withdrawn from autopsy cases

Table 2 Relation of alcohol consumption with the studied variables

Variable	Total No.	Alcohol Consumption				Significance
		Positive		Negative		
		No. 112	Percent 8.8	No. 1163	Percent 91.2	
Age (years)[a]:						
<25	156	13	8.3	143	91.7	$X^2 = 0.69$ df = 4 $P = 0.95$
25–34	317	27	8.5	290	91.5	
35–44	304	27	8.9	277	91.1	
45–54	257	21	8.2	236	91.8	
≥55	238	24	10.1	214	89.9	
Total	1272	112	8.8	1160	91.2	
Sex:						
Females	139	17	12.2	122	87.8	$X^2 = 2.31$ df = 1 $P = 0.128$
Males	1136	95	8.4	1041	91.6	
Month of death:						
July	165	11	6.7	154	93.3	$X^2 = 4.93$ df = 5 $P = 0.43$
August	326	36	11.0	290	89.0	
September	232	23	9.9	209	90.1	
October	176	11	6.2	165	93.8	
November	210	17	8.1	193	91.9	
December	166	14	8.4	152	91.6	
Cause of death:						
Natural	261	12	4.6	249	95.4	$X^2 = 7.18$ df = 5 $P = 0.007$
Traumatic	1014	100	9.9	914	90.1	

[a]There were 3 missing age values

Table 3 Relation of type of death with the studied variables

Variable	Total No.	Type of death				Significance
		Natural		Traumatic		
		No. 261	Percent 20.5	No. 1014	Percent 79.5	
Age (years)[a]:						
<25	156	25	16.0	131	84.0	$X^2 = 19.196$ df = 4 $P = 0.001$
25–34	317	55	17.4	262	82.6	
35–44	304	52	17.1	252	82.9	
45–54	257	57	22.2	200	77.8	
≥55	238	71	29.8	167	70.2	
Total	1272	260	20.4	1012	79.6	
Sex:						
Females	139	12	8.6	127	91.4	$X^2 = 13.43$ df = 1 $P = 0.00001$
Males	1136	249	21.9	887	78.1	
Month of death:						
July	165	31	18.8	134	81.2	$X^2 = 4.99$ df = 5 P = 0.42
August	326	56	17.2	270	82.8	
September	232	47	20.3	185	79.7	
October	176	39	22.2	137	77.8	
November	210	51	24.3	159	75.7	
December	166	37	22.3	129	77.7	

[a]There were 3 missing age value

referred the medico-legal directorate in Baghdad and sent to alcohol toxicology lab. For screening.

Most of the victims were young adults and middle age group and this is the usual and most common age for drinking (Li et al., 2017).

The vast majority of the victims were males and this was expected due to their intense engagement in different work activities including heavy and harsh jobs in every aspects in a stressful environment which ultimately make them more exposed to various types of fatalities.

Traumatic causes of death were prevailing due to many factors such as stress, overcrowding streets and poor traffic control, different accidents, terrorist attacks, difficult socio-economic circumstances as well as social and family problems resulting in violent behavior (Al-Qazzaz et al., 2012).

The highest number of death was during August probably because it is the hottest month of the year in the country and probably in the world as the temperature may exceeds 50 °C,moreover poor and interrupted power supply increasing both natural and traumatic causes of death.

Positive samples were only almost 9% as it is expected in Islamic country where Islam considers drinking alcohol is haraam (forbidden in Islam) in addition to lack of bars.

All of them were ethanol which is the usual type of alcohol for drinking and only one sample result was methanol probably because it is cheaper and more available and the victim was unaware of its toxic effect (Karadenis et al., 2011).

The study found a highly significant relation between consumption of alcohol and traumatic death as it is a well known fact that drinking alcohol increases the impact of trauma,RTA, the risk of crimes, violent behavior promoting homicide or even suicide due to personality disorders (Impact of alcoholism and Alcohol Induced diseases on America, 2011; Zhu et al., 2009; Schumm & Charad, n.d.; Snowdon, n.d.; Hashimoto et al., 2013).

Only in 13 samples of traumatic causes of death alcohol concentrations were 400 mg/100 ml and above. These concentrations are considered fatal alone regardless of their trauma due to depression of respiratory center (Di Maio & Di Maio, 2001).

The study also revealed that traumatic causes of death decreased significantly with advancing age which seems to be logic as violence and exposure to trauma are more seen in young adult and middle age groups where physical fitness and activities are stronger while older age group prefer to stay more at home and retired.

In general higher numbers of female were seen to be affected by trauma compared to male, this could be explained to be due to exposure to domestic violence, poor driving skill and domestic injuries and the protective effect of female sex hormones that lessen their natural

death. Positive male samples were more than 5 times than positive female samples, this is due to our social traditions refusing any women drinking alcohol and consider it stigma against her as well as our Islamic commitment.

Only 12 positive samples were attributed to natural causes of death. In those victims alcohol probably was sharing their diseases in precipitating death. Regarding the positive group (112 deaths), the study showed more traumatic causes of death in male than what was seen in female due to the effect of alcohol on male individual behavior and attitude in addition to the previously mentioned factors (Thompson, 1996).

Conclusion

Alcohol drinking is a minor problem as it was detected in a small group of all cases yet its association with traumatic death was significantly higher than natural death and was more common in males. Traumatic death was more common in females. The study also revealed that traumatic causes of death decreased significantly with advancing age.

Only in limited number of cases the concentration was fatal.

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Declaration
Ethical approval and consent to participate was obtained from the Ethical Approval Committee of College of Medicine- University of Al-Nahrain.

Authors' contributions
MAA-Q: Introduction, method and discussion. AJA-S: Statistical analysis and results. HkA-R: Collection of data. EMA-Q: Detection and measurement of alcohol using head space GC. All authors read and approved the final manuscript.

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Consent for publication
Author and co-authors do accept publication of the research paper.

Competing interests
The authors declare that they have no competing of interests.

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