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Patterns of violent deaths associated with positive ethanol finding in Eastern Province, Saudi Arabia

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Abstract *Background:* The analysis of alcohol exemplifies the principal aim of forensic toxicology worldwide. Detection of ethanol in post-mortem cases is getting more important nowadays due to the upsurge in the number of ethanol related fatalities all over the world. Toxicological analysis is mandatory to diagnose, and interpret the presence and levels of alcohol in different post mortem samples. The difficulties in the interpretation of blood alcohol concentration (BAC) are more profound when the body shows signs of putrefaction and the measured BAC is low as sometimes it is false positive due to decomposition. *Objective:* To investigate ethanol related violent deaths, whether suicidal, homicidal or accidental fatalities with positive analytical results regarding ethanol since start of January 2012, till end of December 2014 in Eastern Province, Saudi Arabia. *Methods:* Ethanol related violent deaths whether suicidal, homicidal or, accidental fatalities over the period from the start of January 2012, till end of December 2014 in the Eastern region, Saudi Arabia were retrospectively investigated. *Results:* From a total 1376 cases examined in the Forensic Medical Authority, Eastern Province over the assigned three year period, only 94 ethanol positive fatalities were detected and were investigated retrospectively. Cases with positive ethanol results, were chiefly males between 21 and 30 years of age (28.8%). Accidental causes significantly predominated (47.9%) over suicidal and homicidal causes (28.8%, and 23.3%, respectively). Most of the cases were non-Saudi (73.3%), with prevalence of Indian nationality (47.8%). *Conclusion:* The precise statistical mortality database for ethanol related violent deaths may provide an enormous support for the effect of alcohol on aggressive behavior, human health and mortality. In the current study, ethanol positive deaths were 94 in total, with predominance of non-Saudi Indian males. Majority of the studied cases were between 21 and 30 years of age. Further international studies are recommended.

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1. Introduction

Ethanol (alcohol) is a widely known central nervous system depressant. It is the most frequently detected substance in many postmortem cases. Excessive intake of alcoholic beverages and drunkenness have constantly played a major role in serious accidents, trauma related deaths, drowning, suicide, and many other crimes of aggression as documented by police as well as accident and emergency department records.[1–5]

Furthermore, heavy drinking and alcohol-induced consciousness level impairment are frequent causal factors in road-traffic accidents as well as workplace and home violent mishaps.[6,7]

Alcohol comes on top of the list of psychoactive substances discovered in postmortem toxicological analysis worldwide, and the interpretation of (BAC) in such specimens represents a huge component of the workload at forensic toxicology laboratories.[4,6,7] Positive ethanol results depend on many sociomedical factors that might change among different countries. As a general rule, the postmortem BAC needs to be interpreted regarding whether the deceased had consumed ethanol and might have been drunk at the time of death or if this concentration exceeded some threshold limit. Such conclusions are often controversial and extreme caution during interpretation is required due to diverse postmortem artefacts.[8]

The identification of alcohol toxic effects has great sociomedical impacts due to the presence of BAC limits for driving in most countries that is liable to be punished by authorities.[9] Insurance claims might be canceled if the samples of the person involved in a fatal accident were confirmed to be above the legal limit for driving.

Determination of ethanol in postmortem specimens both qualitatively and quantitatively has become a fairly simple analytical method, where precisely accurate and specific results are nowadays achievable.[10] However, interpreting postmortem BAC results and reaching accurate conclusions about antemortem levels and the person's state of drunkenness and behavioral impairment degree at the time of death are so difficult.[11,12]

The body condition, the interval between death and autopsy, the environmental circumstances (temperature and humidity), and the type of specimens collected for analysis are vital factors to be considered. Sometimes alcohol might be formed after death by microbial activity and fermentation of glucose, which is a major dilemma if the dead body has undergone decomposition.[13,14]

Antisocial and criminal behavior is known to increase among alcoholics.[15] It is of great importance to note that measuring trends in alcoholics and alcohol-related violent problems is essentially challenging, and this relates to the unreliability of data in most alcohol related violent behaviors.[16]

2. Aim of the work

The aim of this study was to investigate the prevalence of alcohol influence in medico-legal autopsies in a three year period in Eastern Province, KSA.

3. Methods

The data of alcohol related violent deaths ($N = 94$) whether suicidal, homicidal or accidental including fatal occupational injuries, accidental falls, fire related deaths, accidental drowning, and fatal alcohol poisoning using data from autopsy reports done in Department of Forensic Medicine, Eastern Province, Saudi Arabia over the period from the start of January 2012, till end of December 2014 were examined with respect to their demographic data and autopsy reports. Cadavers that had any apparent sign of putrefaction whether from external or internal examination, namely, greenish discolouration of abdomen and genitals, or abdominal distension, were categorized as cases with putrefaction and were excluded from the study. Diabetics or cases with proved infections in urine samples were excluded as well. Ethical requirements were fulfilled.

10–15 ml of peripheral blood – being the most reliable specimen for toxicological testing – was withdrawn from the femoral vein in the leg, the iliac vein, accessible from the body cavity during internal examination, or from the subclavian vein in the chest. 10–15 ml of urine was collected with a syringe, through a simple incision allowing visualization of the bladder. Vitreous was collected with a hypodermic syringe by inserting the needle into each eye. Comprehensive examination of the collected samples was done for all collected samples using the following protocol: Blood and urine samples of each subject were screened for ethanol and, drugs of abuse (Amphetamine, barbiturates, benzodiazepine, cannabis, cocaine, and opiates) using fluorescence polarization immunoassay (FPIA) principle on ARCHITECT system c4000, model i1000 SR by Abbott laboratories. Using gas chromatography – head space GC ultra-model K0C33B730000000, Milano, Italy, all samples were analyzed for all volatiles including ethanol. Extraction and analysis by gas chromatography–mass spectrometer GC–MS–QP2010, Shimadzu for weakly acidic and neutral drugs, is then performed. This includes acetaminophen, non-steroidal anti-inflammatory drugs, barbiturates, phenytoin, and Carbamazepine. Finally extraction and analysis was done by the same GC–MS for alkaloid and basic drugs, including most common centrally acting therapeutic drugs with the exception of those checked for weakly acidic and neutral extract. This includes antidepressants, stimulants, narcotics, antihistamines, decongestants, muscle relaxants, anticonvulsants, organic poisons, and antipsychotics. Finally analysis for detection of carbon monoxide, or other specific tests which would have to be specially requested or suggested by the circumstances of death might be done. Ethanol analysis was performed by a static headspace analysis.

3.1. Analysis of ethanol

As the limits for ethanol might be low, thus, a three-point calibration curve covering the ethanol concentration range between 0.01 mg/ dl and 10 mg/dl was constructed. Ethanol standards, quality control samples and internal standards (n-propanol, 10 mg/dl) were prepared in distilled water from HPLC grade solvents. A resolution mixture of ethanol, n-propanol, acetaldehyde, methanol and acetone were prepared in distilled water from HPLC grade solvents at a concentration of 100 mg/dl each.

3.2. Headspace procedure

The samples were placed in 20 ml headspace vials by adding 1.0 ml of samples, standards or quality control samples and

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