RELIABILITY FACTOR OF DIFFERENT BREATH ANALYSER AND ITS CO-RELATION WITH BLOOD CONCENTRATION BY GLC-A PILOT STUDY

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ABSTRACT

Alcoholism is a common medico-legal problem. Studies have shown the incidence of vehicular accidents is more among the drunk drivers. The association of alcohol is also seen in homicides, suicides and assault cases. Recently in capital city of Delhi courts have directed the hospitals to use breath analyzer in cases under motor vehicular act to detect blood alcohol. Therefore a pilot study was conducted to compare the reading of breath analyzer of different makes in the same individual at same time. These readings were also compared with the Gas Liquid Chromatography (GLC) technique. Alcoholmeter of five different makes showed lot of variation then the GLC results which were also variable but at lower side. However authors are not questioning the validity and correctness of the Breath analyzers, which are used world over, they simply want to stress the need for proper use, calibration and further studies in Indian context on this subject to avoid any legal complications.

INTRODUCTION

Alcohol intake is one of the major causes of road traffic accidents and many of them turn out fatal. Actually drinking and driving do not mix. Alcohol is known to interfere the driving ability of the individuals because it affects the visual acuity, reaction time and reflexes.

Earlier, the individuals were checked for alcohol intake by Gas Liquid Chromatography (GLC). But now under section 185 Motor Vehicle Act 1988 the courts and police are introducing evidential breath alcohol analysis by using Alcoholmeter. The Alcoholmeter was introduced as it becomes easy for the police to deal with the suspect drunk driver immediately when caught. The prosecution has to prove that the suspect's blood alcohol concentration (BAC) at the time of the offense is at or above a statutory concentration. The legal limit defined by the said Act is 30mg/ml of alcohol in blood.

The intake of alcohol can be determined from suitable biological samples i.e. blood or urine or expired air at the time of arrest. The alcohol level in blood and urine are analyzed by GLC and breath alcohol concentration from expired air is obtained using Breath alcoholmeter.

METHOD

The Breath alcoholmeter measures the level of alcohol in an appropriate sample of breath expired which is in equilibrium with blood. This breath alcohol concentration is multiplied by a factor called the partition ration to convert the concentration in blood. A direct co-relation is assumed between the concentration of alcohol in the alveolar air and concentration of alcohol in blood and moreover this assumption is based on Henry's Law which states that at constant temperature the concentration of gas dissolved in a liquid is proportional to its concentration in the air directly above the liquid (2).

GLC has a disadvantage that it is time consuming and is costly procedure but the advantage is that it provides the exact or confirmatory results, as GLC is very sensitive. GLC is a separation techniques and also allows identification and quantitation of the substance. This technique is based on the principle of portioning of the chemical in its gaseous phase among the stationary (liquid) and mobile (gas) phase in contact.

Direct blood-injection method for GLC determination of alcohols and other volatile compounds are conducted routinely in the department of Forensic Medicine & Toxicology, AIIMS New Delhi. This technique is preferred as it is a rapid method to determine simultaneously methanol, ethanol, acetone, iso-propanol and low-boiling hydrocarbons associated with glue sniffing. GLC is equipped with FID and does not require any extraction, distillation and (or) sample preparation and the method is sensitive to 10µg/ml of alcohol (3). The most suitable column for the separation of volatile substance is PORAPAK Q (porous polymer beads), viz, divinyl-benzene crossed-linked polystyrene. Here, conventional "inert" support and liquid eliminated and porous polymer beads

an entirely new type of active solid for column packing.

Since alcohol diffuses freely into cells not into cellular membranes, the subtle point to keep in mind is the variability in volume of the cell debris (i.e. vol. of cell membranes after cells are analyzed) and not the actual hematocrit.

90ml of alcohol was administered to the volunteers. The expired air of volunteers was checked after different interval of time i.e. at 0min, 15min, 30min, 60min and 90min by alcoholmeter from 7different companies. The alcoholmeters were calibrated properly by the agents of the said companies and were standardized for uniform results by taking the reading of expired air from the volunteers without taking any alcohol. The exercise was conducted in the department of Forensic Medicine & Toxicology, AIIMS, New Delhi.

5ml of blood was also withdrawn from these volunteers and evaluated on GLC in the department of Forensic Medicine & Toxicology, AIIMS, New Delhi to determine the concentration of alcohol in blood. The instrument was set with optimum parameters for the gas chromatographic run of the volatile substances, viz, alcohols and periodically standardized with ethanol working standards prepared from ethanol stock solution prepared from Ethanol Absolute GR (99.8%) from Merck, Darmstadt, Germany. The quantitative analysis was made by employing the calibration curve in conjunction with peak area calculations. Peak area is obtained by multiplication of the height of the peak by the width at half height.

OBJECTIVE

The alcohol has been responsible for the loss of many lives due to accident which could have been otherwise avoided Therefore most of the developed world have introduced cut off level of blood alcohol in drivers eg. USA 100mg%, UK 80mg%, Australia 50mg%, Germany 80mg% and France 50mg%. In India also 30mg/100ml was introduced in 1988 and subsequently court order has been issued to carry out breath analysis in suspected drunk drivers, which has necessitated the application of Breath Analyzer, by Police as well as in Hospitals. Keeping this in mind this limited pilot study was conducted with the aim to educate us and others to use these instruments properly and scientifically so as to avoid legal complication later in the court of law.

RESULTS

The Breath analyzers are used world over therefore their utility and correctness is not questionable. The inconsistency of results, the variation in the readings of the breath analyzers of five different makes (4), could be due to non-standardization of the breath analyzer equipments and\or non-familiarity of the operators, as these instrument being new to them. Variation in results was also observed in blood samples when processed to determine the blood alcohol concentration by GLC technique and was at lower side.

In 12 out of 30 (40%) blood samples withdrawn after 30 min and 60 min of alcohol intake, showed similar results (Table I). It was observed that 23 out of 30 (76.6%) blood samples which were withdrawn after 90min of intake of alcohol, showed higher reading, the reason being the metabolism as well as excretion factor. 12 out of 30 (40%) blood samples which were withdrawn after 60m,in and 90 min of intake of alcohol showed the same result when processed by GLC. Blood alcohol level determined by GLC was far lower than what was analyzed by breath analyzers.

A higher body temperature of the individual will overestimate the actual BAC because of the higher volatility (or vapor pressure) of liquids like alcohol at a higher temperature.

SUGGESTION

1.The alcoholmeter used should be calibrated regularly and properly otherwise it may give incorrect results. And operator should be trained to use the instrument properly.

2.It is important to know that these reports are likely to become exhibit in the court of law. Once it is introduced for the purpose of Motor Vehicle Act in respect to the Breath Analysis of drunk drivers, its use for other alleged suspects brought to hospital eg. rape, murder, accident and would be unavoidable. In all such cases Doctor has to appear in the court of Law to verify report as per Indian Evidence Act. Variation of any kind may make the report invalid. Hence it necessitates the regular standardization and calibration of the instrument.

3.This pilot study necessitates further detailed study to establish the co-relation between GLC and breath analyzers and to evaluate the co-relation between concentration of alcohol from expire air and blood in Indian circumstances.

4. The detailed study to understand absorption and metabolism pattern after intake of alcohol in Indian population is required.

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Table I: COMPARISON OF READINGS BETWEEN DIFFERENT MAKE OF ALCOHOLMETERS AND GLC

S. No.	Name of Alco meter	Alcohol Vol administered	Time Interval	Name of Volunteer [Alco/GLC (mg%)]				
				A	B	C	D	E
1.	(I)	90ml	0min	0/0	0/0	0/0	0/0	0/0
			30min	0.54/22	73/20.9	0/8.8	54/6.6	0/22
			60min	NA/22	60/11.5	NA/8.8	40/11	NA/17.6
			90min	NA/26.4	NA/13	NA/11	NA/11	NA/17.6
2.	(II)	90ml	0min	0	0/0	0/0	0	0
			30min	47/22	53/20.9	27/8.8	29/6.6	47/22
			60min	39/22	39/11	33/8.8	31/11	36/17.6
			90min	33/26.4	37/13.2	22/11	25/11	32/17/6
3.	(III)	90ml	0min	0	0	0	0	0
			30min	0 .3/L/22	0 .35/L/20.9	0 .17/L/8.8	0.18/L/6.6	0 .37//L22
			60min	0.25/L/22	0.27//L11.5	0.18/8.8	0.22//L11	0.28/L/17.6
			90min	0.21/L/26.4	0 .25/L/13.2	0.14/L/11	0 .19//L/11	0 .26/L/17.6
4.	(IV)	90ml	0min	0	0	0	0	0
			30min	66/22	87/20.9	38/8.8	36/6.6	77/22
			60min	50/22	60/11.5	33/8.8	42/11	54/17.6
			90min	47/26.4	54/13.2	31/11	34/11	41/17.6
5.	(V)	90ml	0min	0	0	0	0	0
			30min	68/22	84/20.9	41/8.8	41/6.6	85/22
			60min	58/22	59/11.5	41/8.8	44/11	67/17.6
			90min	50/26.4	57/13.2	34/11	44/11	52/17.6
6.	(VI)	90ml	0min	0	0	0	0	0
			30min	66/22	78/20.9	34/8.8	34/6.6	74/22
			60min	52/22	60/11.5	36/8.8	43/11	57/17.6
			90min	43/26.4	50/13.2	30/11	38/11	46/17.6

A-, B-, C-, D-, E- as individuals