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Evaluation of electronic breath alcohol analyser

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At present alco-measure tubes are being used for qualitative analysis of the breath during the pre-flight examination of the flying crew. This study evaluates an indigenous electronic breath analyser. The instrument detected alcohol levels as low as 17.5 mg% and was found suitable as a qualitative screening test.

Introduction

At present, alco-measure tubes are being used for qualitative analysis of the breath during the pre-flight examination of the flying crew. This system is based on chemical method of reduction of dichromate crystals. Electronic breath analysers which are now available in the country are being evaluated to assess the feasibility in the pre-flight medical check up.

Ten healthy adult volunteers were given alchoholic drink and the breath was analysed by Electronic Breath Alcohol Analyser, supplied by M/s. Kasy Radha Krishnan & Company Private Limited, 1, Cenotaph First Street, Post Box No. 6902, Teynampet, Madras—600 018. Their blood was drawn and tested for alcoholic content in Forensic Science Laboratory, Madras. The results are compared.

Materials & Methods

Ten adult male subjects in the age group of 28 to 46 years were selected, of whom one dropped out leaving nine subjects. They were given the choice of drink. One chose Rum and the rest Whisky. Time taken to consume the first drink was noted after which some were requested to refrain. Their breath was analysed by Electronic apparatus. The instrument (ED—308/308M) can work either with a Battery or on Mains. It has a special Semiconductor Sensor device maintained at an elevated temperature, The variation of the Sensor characteristic with the concentration of ethanol in the exhaled air is utilised to actuate the indication. The instrument can give an Audio visual signal with an Audio beep and a simultaneous flashing light. Model ED—408 has a visual indicator of the pointer moving over a dial.

The subjects were asked to wash their mouth, rinse and abstain from smoking before blowing into

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the apparatus. Three instruments were used which were set to different sensitivities (arbitrarily)—50 mgm%, 75 mgm% and 100 mgm% (Blood levels).

The party continued for about 2 hours and 20 minutes when the dinner was served. The subjects were tested after dinoer again and the blood was drawn.

The blood was analysed by the Tamil Nadu Forensic Science Laboratory, Madras, by chemical method (Micrometry). The principle is to reduce the Potassium Dichromate by Ethyl alcohol. Unused dichromate is titrated against Sodium Thiosulphate. Ten normal persons who had not consumed alcohol were tested by Electronic instrument.

Observation & Results :

Sample 8A showed +ve results in all the three apparatus when corresponding Blood alcohol was 17.25 mgm% whereas 2A, 3A and 5A showed +ve in one apparatus and —ve in 2nd and 3rd apparatus —Blood alcohol was 25.87 mgm%, 28.75% and 23.00 mgm%.

As the environment of the room itself contained lot of alcoholic vapour, the apparatus was moved to a different room after sample 8A was taken. Even though subject 8B and 1 consumed 240 ml, there is a difference of 17.25 mgm% in blood alcohol. There is no linear co-relation between the quantity of alcohol taken and the blood alcohol. Multiple factors like the amount of food consumed, time lapsed from last drink would affect absorption pattern of ethanol, excretion pattern affected mainly by the state of liver.

Discussion

Cecil Loeb[3] (1967) states

'No clinical signs of drunkenness usually accompany a blood alcohol level of 50 mg per 100 ml or lower. Overt signs may or may not accompany blood alcohol levels between 50 to 100 mg per 100 ml. Above 100 mg per 100 ml—close exam almost always reveal garrulousness, euphoria etc.'

API Text Book of Medicine[2] (1979) states

'In different countries, different blood alcohol levels, ranging from 0.05 to 0.15% have been fixed for pronouncing a driving offence as legally punishable.'

WG CDR GN KUNZRU[5] in his paper 'Alcohol and Flying' has stated

'The following are alcohol levels laid down by law below which driving of cars after ingestion of alcohol is legally permitted. Some of these are:

Norway	50 mgm%
UK & Sweden	80 mgm%
Denmark	100 mgm%
U.S.A.	150 mgm%

However, deterioration in human functions in relation to task resembling car driving has been reported by some workers at even as low levels of blood alcohol as 10-80 mgm% (Drew), 30 mgm% (Loomis and West) and 40-50 mgm% (Bjerner and Goldberg). Aksnes (1954) noted that complicated skill tests such as a U-track or a link trainer deteriorated at about 50 mgm% blood alcohol levels and also pointed out that one must be prepared for lowered ability to perform a skilled test with alcohol levels around 20 mgm%. Harper & Albers (1964) have stated that flying skills are measurably decreased by only one-fourth the amount of alcohol necssary to produce measurable decrease in driving skills that is at present 35-40 mgm%. These figures are further supported by a very recent study by Billing et al (1973) who found serious decrement in flying performance at 40 mgm% blood alcohol level. Workers from West Germany (Knefft 1969) consider 20 mgm% as the upper blood alcohol limit over which flying performance gets deteriorated'.

Aircraft Rules 1937 (India)[1] prohibit crew from taking alcohol or other stimulant drug within 12 hours of the commencement of the flight or during the flight.

Julius Merry[4] has stated

'As the average excretion rate is 9.5 ml alcohol per hour or 100 ml/kg/hour', amount of alcohol consumed before 12 hours would determine whether the crew would be free from the influence of alcohol at the the time of the flight.

Table I

Sub. No.	Age	Type of drink	Quantity	Average time taken for drink		Time lapsed after last drink		Instrument No.			Blood alcohol mgm %	Remarks
				Hour	Min	Hour	Min	1	2	3		
5A	32	Whisky	30 ml	—	15	—	20	+	—	—	23.00	(35 min later)
5B						1	45	—	—	—		
2A	46	Rum	60 ml	—	35	1	—	+	—	—	25.87	
3A	43	Whisky	60 ml	—	55	—	5	+	—	—	28.75	
8A	34	Whisky	60 ml	—	20	—	30	+	+	+	17.25	
9	40	Whisky	60 ml	—	15	—	30	+	—	—	40.25	
3B	43	Whisky	180 ml	2	20	2	—	+	+	+	80.50	
6	40	Whisky	210 ml	2	20	1	50	+	+	+	40.25	
1	44	Whisky	240 ml	2	20	1	40	+	+	+	40.25	
8B	34	Whisky	240 ml	2	20	2	10	+	+	+	57.50	
8C						13	—	—	—	—		
7	28	Whisky	300 ml	2	—	1	35	+	+	+	115.00	
10	29	Whisky	300 ml	2	—	1	30	+	+	+	74.75	

But in flying no limit has been laid down. However our aim should be to detect ethanol quantities in as low level as possible. Ideally in the interests of flight safety the test should be able to detect the ethanol even in sub-clinical levels.

At present in the pre-flight examination, clinical examination is done which is followed by a breath analysis using alco-measure tubes. When the person blows through the tube, inflating the polythene bag and if the breath contains ethanol, potassium dichromate crystals change colour from Yellow to Green (Cr_2O_3). The test is qualitative.

In an earlier study, where air was analysed qualitatively, Electronic apparatus gave consistently +ve results till corresponding blood alcohol concentration became 25 gm % under laboratory condition.

In the present study, the electronic instrument detected alcohol levels as low as 17.5 mgm %. The apparatus would give false +ve results in the presence of Carbon Monoxide, Ether and Acetone. We can eliminate the first factor by requesting the crew to refrain from smoking at the time of pre-flight. Presence of Acetone is improbable as the crew undergo periodic medical examination by Air Force Board. The presence of Ether in the pre-flight room can be avoided. Arbitrary callibration of the apparatus has not been satisfactory for quantitative purposes.

As the study was conducted in mileu of Social gathering where the subjects chose their refreshment, snacks and finally dinner, co-relation between quantity of alcohol taken and blood ethanol level is not possible. In fact this was not the aim of this study.

During the experiment false —ve results were obtained when the instrument was kept in the same room where the alcohol was being consumed. This situation is unlikely to arise in a pre-flight room. Apparatus did not give +ve response in case of persons who had not taken alcohol.

Conclusion

Electronic Breath Alcohol Apparatus is suitable as a qualitative screening test. Further study would be necessary in case callibration methods can be improved and the instrument needs to be used as a quantitative screening test.

References

1. Aircraft Rules 1937 (India).
2. API Text Book of Medicine, Vol I, Page 158 of the 3rd Edition 1979.
3. Cecil Loeb (Page 1500) Text Book of Medicine 1967.
4. Julius Merry Practitioner in the July 1971 Edition (Page No. 87).
5. WG CDR GN KUNZRU in his paper 'Alcohol and Flying' presented at 16th Annual Conference of the Aero Medical Society of India on 23rd Nov.2 1973.