

Efficiency of Alcohol Salivary Strip Test in 'Comparison to Breath Alcohol Analyser as Forensic Screening Tools for Blood Alcohol Analysis - A Comparative Study

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Abstract

Background: Alcohol induced intoxication is responsible for altered behavior in individuals. Blood alcohol concentration (BAC) has been the key toxicology test, which is considered as the gold standard in medico-legal evidence. BAC can be assessed by determining blood ethanol or methanol concentration. It is expensive and time-consuming procedure and so, it cannot be considered as primary choice for screening of alcohol consumption. At present breath analysis is the most common and accepted screening procedure but there are certain limitations to this procedure and hence assessment of other procedures for screening is also important.

Aim and Objective: The primary aim of the study is to assess efficiency of salivary strip test vs breath alcohol analyzer in screening for alcohol consumption among the individuals who are suspected for drunken driving by the city traffic police of Kannur district.

Setting and Design: It's a Prospective case control study where samples are collected from Traffic aid post in Kannur district of Kerala for screening of suspected drunken driving.

Materials and Method: Individuals suspected of drunken driving by the city traffic police of Kannur district were included in the study. Subjects were screened by using alcohol breath alcohol analyzer and Alcohol salivary strip.

Statistical Analysis: It was performed using SPSS 20.0. Chi square test was used for association between variables.

Results: The result shows that both salivary alcohol strip test is as effective as breath alcohol analysis.

Conclusion: Salivary alcohol test strip is rapid, economically feasible and can easily be performed. The result given by strip is easy to interpret and can easily indicate different BAC level as it is very much sensitive even at a BAC value of 0.02%.

Keywords: Alcohol, Saliva, Breath, Blood alcohol concentration (BAC), Alcohol Salivary strips, Breathalyzer.

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Introduction

Alcohol is the key intoxicating constituent of wine, beer, spirits, and other alcoholic drinks.¹ It has got psychoactive and in toxification effect when consumed. The term alcohol refers to a whole class of organic compounds that include a hydroxyl group – consisting of an oxygen atom and a hydrogen atom – bonded to a carbon atom and is called as ethanol.²

Alcohol induced intoxication is responsible for altered behavior in individuals. Violence and Injuries – both unintentional and intentional – account for more than a third of the burden of disease attributable to alcohol consumption. Each year it is responsible for about 2.3 million premature deaths world-wide. These include injuries from road traffic crashes, burns, poisoning, falls and drowning as well as violence against oneself or others.⁵

Blood/Breath Alcohol Concentration (BAC) is the amount of alcohol in the bloodstream or on one's breath. BAC is expressed as the weight of ethanol, in grams, in 100 milliliters of blood, or 210 liters of breath. BAC can be measured by breath, blood, or urine test.⁶ BAC is considered as the best indicator of the level of impairment and is the gold standard test.

DUI, or driving under the influence in India is a criminal offence under the Motor Vehicle Act 1988. Section 185 of the Act states that any person who is found to have alcohol exceeding 30 mg per 100 ml of blood i.e., 0.03 % BAC in their system is breaking the law.³ Even with 0.03% intoxication level, a person is seven times more likely to be involved in a vehicle crash than a person who has not consumed any alcohol and the accepted legal age of consumption in Kerala is above 18 years. The impairment start at very low concentration even at BAC level of 0.02% - 0.03% and alcohol poisoning at level above 0.25%.⁶

Alcohol from the blood passes to other biological fluids like urine and saliva. It is also present in exhaled breath. Alcohol concentration in the other biological fluids in essence reflect the blood alcohol concentration. So, these have been used as sample for assessing alcohol concentration. Breath analysis using breathalyzers is the commonly used method in different scenario but it cannot be used in patients who are in trauma, unconscious or un cooperative

as it requires forceful expiration. Also, there is high chance of cross contamination as single device is used for multiple patient. Taking this into consideration, alternative methods have been tested. Saliva is a body fluid which can correctly reflect the blood alcohol concentration. It is easily available, can be easily accessed even in unconscious patients and hence can be a better sample for analyzing BAC.

Salivary strip test is a test in which we can easily assess the presence of alcohol in saliva. The strip test is based on the high specificity of alcohol oxidase for ethyl alcohol. Alcohol oxidase in the strip reacts with ethyl alcohol present in saliva in the presence of peroxidase and enzyme substrate such as tetra methyl benzidine to produce a chromatic change in the reaction pad of the strip. It is a very sensitive test and has good validity. The advantages of this method are; noninvasive, the results are not influenced by the presence of blood in the oral cavity, Rapid determination can be done, it could also be used in determining postmortem saliva ethanol levels, contact less test can a be done. Last but not least, because of the relatively low cost of the salivary strips it can be a cost-effective alternative in public health settings where mild to moderately intoxicated persons are encountered.^{5,7,8}

Aim and Objective

Aim of the study was to assess efficiency of salivary strip test vs breath alcohol analyzer in screening of blood alcohol consumption and assess the efficiency of salivary strip test in screening for alcohol consumption in individuals who are suspected for drunken driving by the City Traffic Police Department of Kannur.

Methodology

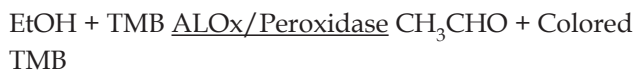
A prospective case control study was carried out in the Kannur district of Kerala after obtaining permission from The District Police Chief, Kannur of Kerala Police Department. The study was carried out in association with the traffic police department, Kannur district.

Sixty individuals who were above 18 years of age and suspected of drunken driving by the city traffic police of Kannur district were included in the study.

Each subject was explained about the procedure and informed consent was obtained. Brief history regarding the alcohol consumption which include the time of consumption and quantity of alcohol. Subjects are screened by using breath alcohol analyzer and Alcohol salivary strip (Wondfo salivary alcohol test trip).

Subjects were asked to take a deep breath and blow steadily into the breath analyzer unit for at least 5 seconds until a deep sound to signal the completion of the testing. Once the sensor has analyzed the breath sample, it produces a green light along with the beep sound which indicate a positive result. And if no sound or no green light formation means a negative result.

Subjects are then screened using salivary alcohol test. The alcohol salivary strip with a reactive pad is checked for any chromatic change prior to test and then the pad is saturated with the saliva of the subjects either by applying directly or from a sputum cup. The results on the pad are observed after 2 min. Results after more than 2 min may not be accurate and hence not considered.⁸ The alcohol salivary strip test is based on the high specificity of alcohol oxidase (ALOX) for ethyl alcohol in the presence of peroxidase and enzyme substrate such as tetramethylbenzidine (TMB) as shown in the following:



The distinct color on reactive pad can be observed at any concentration above 0.02%.

Interpretation of results

Positive

- A distinct color developed all over the pad. The positive result indicated that the BAC was 0.02% or higher.

Negative

- Almost no color changes by comparing with the background. The negative result indicated that the BAC was less than 0.02%.

Invalid

- The test was considered as invalid if only the edge of the reactive pad turned color that might be ascribed due to insufficient sampling. The subject is re-tested.

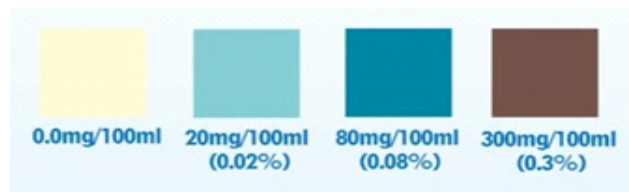


Figure 1: showing chromatic change and BAC level



Figure 2: Demonstration of alcohol saliva strip test.

Statistical Analysis

All statistical procedures were performed using Statistical Package for Social Sciences (SPSS) 20.0. All quantitative variables expressed in mean and standard Deviation. Qualitative variables will be expressed in percentages. Chi square was used for association between variables. Probability value ($p < 0.05$) was considered statistically significant.

Result

The result indicate that the salivary strip test is equally efficacious as breathalyzer in identifying presence of alcohol in saliva, which indicate alcohol consumption. No significant statistical difference between the breathalyzer and alcohol salivary strip in identifying the presence of alcohol in saliva [Table 2]. On correlating the history of alcohol consumption, it was observed that the salivary strip was able to detect the presence of alcohol even after 6-7 hours after the consumption of last drink Table 1.

Table 1: Showing time duration between last drink and the test positivity

Time	N
1-2 hrs	1
1 hrs	8
2 hrs	16
2-3 hrs	4
3 hrs	13
3-4 hrs	2
4-5 hrs	5
45 min	1
4 hrs	4
5-6 hrs	3
5 hrs	2
7 hrs	1

Table 2: Comparison between Breathalyzer and saliva alcohol strip

	Negative n(%)	Positive n(%)	P value
Breathalyzer	3(5)	57(95)	0.12
Saliva Alcohol strip	0	60(100)	

Discusion

The adverse effect of alcohol on cognitive and psychomotor skills is well known, particularly with respect to vehicle driving performance. Increases in reaction time and performance error can be found at all doses of intoxication.

The effects of alcohol (i.e., ethanol) on various tissues depend on its concentration in the blood (blood alcohol concentration [BAC]) over time. From the blood it is distributed to other tissues and fluids and is present in other body fluids like saliva, urine as well as expelled breath. It is proven that there is a correlated change in the alcohol concentration in the saliva and in the breath with respect to the BAC⁽⁹⁾. This fact laid the foundation for the premise that

these samples can also be used to screen the presence of alcohol and that this data can be correlated to the BAC.

At present breath alcohol analysis is the most accepted screening test for alcohol consumption in many situations like law- enforcement and medico-legal cases. It has the advantages like easily obtainable, easy to perform and immediate availability of results. But this type of screening has its own limitations as it cannot be used in patients with trauma, coma patients or on any other individual who is unconscious and un cooperative. Another disadvantage is that the same equipment is used across different individuals and carries the risk of cross contamination.

It is proven that other samples can also be used for screening and among them saliva is a good sample. Salivary test strip is sensitive, reliable and easy to use tool which use saliva as a sample for screening of alcohol consumption. T M Rao et. al. determined BACs by ALCO-SCREEN 02 plastic strip in a group of people who attended an organized party. The result was statistically significant (P value 0).⁵ Phair et. al. determined BACs by ALCO-SCREEN salivary reagent strip in a series of patients who presented with suspected alcohol intoxication and the results were found to be significant (P < 0.0001). They recommended reagent strips for rapid measurement of BAC.¹¹ Bates et. al. correlated BACs by alcohol sensitive saliva strips with breath estimates of BAC and found close estimates of BAC with that of saliva strips and breathalyzer; recommending alcohol saliva strips for BAC.⁷

The Alcohol Salivary Test Strip is designed for use with human saliva only; a positive result indicates only the presence of alcohol and does not indicate or measure intoxication, and there is a possibility that technical or procedural errors, as well other substances in certain foods and medicines.

Our study was a prospective case control trial. Our results indicate that the saliva alcohol strip is as efficacious as the breath analyzer in the detection of alcohol. In our sample the time elapsed between the time of consumption of alcohol and testing ranged from 45 min to 7hrs but most of the participants were in the 2-3hrs bracket. BAC level reaches the peak about 1-2hrs after consumption and is most

easily detectable in this time range. In our study also, the test positivity was maximum between the time interval of 2-3 hrs. Both the breathalyzer and salivary strip test were equally efficacious during this time interval. Similar results were reported in previous studies done.^{7,13,14}

A very significant finding in our study was that the saliva alcohol strip could detect the presence of alcohol even when the time lapsed was more than 5 hrs. Positive results were seen as late as 5-7 hrs in 3 subjects while screening with salivary strip and showed negative result with breathalyzer test. This has not been reported in any previous studies. The reason could be that the breath alcohol content is expelled faster where as in saliva it stays for a longer time. This is a clear advantage of using salivary strip test in comparison to breathalyzer.

A big advantage of the salivary strip test is that it is capable of showing different colors denoting different BACs. In our study we saw light blue color in who have consumed less alcohol and dark blue color in who have consumed more alcohol. In contrast, only breathalyzers which have advanced digital readers can show the different alcoholic concentrations. These are comparatively expensive and are not commonly used as screening tools. The breathalyzer commonly used as screening tools by the police department for drunken driving do not contain digital reader and hence cannot determine the different alcohol concentration. The can only indicate the presence or absence of alcohol in breath. So salivary strip test is also advantageous in this point of view.

Conclusion

Our study proves that screening for alcohol consumption using salivary alcohol test strip is rapid, economically feasible and can easily be performed and it is as effective as breathalyzer. The result given by strip is easy to interpret and can easily indicate different BAC level as it is very much sensitive even at a BAC value of 0.02%.

Thus, from the results we can conclude by saying that salivary alcohol test strip is very efficacious and valid tool, and can be used as effective as breathalyzer for screening drunken driving. Moreover, it can be a

useful screening tool in many medico-legal situations like trauma patients, coma patients, postmortem cases and other law and enforcement situation, where breathalyzer cannot be used.

In the present scenario of covid-19 pandemic, screening for alcohol consumption using breathalyzer has been suspended all over India and many other countries because of the fact that the same instrument is used and disinfection of the instrument is very difficult. Expelled breath can contain Corona virus and several other infective agents and disinfecting in between tests is difficult to carry out. Saliva test strips being single use strips and the fact that it can be performed without contact is a great advantage.

Based on these points it is valid to recommend that salivary strip test can be used as a screening tool instead of breathalyzer. More studies can further validate these findings. Indigenous production of saliva test strip can reduce the price of the test strips and can facilitate its extensive use.

Conflicts of interest: There is no conflict of interest.

Source of funding: Self

Ethical clearance: The present study has been reviewed by the institutional ethical committee and has therefore been performed in accordance with the ethical standards laid down in the 1965 Declaration of Helsinki. Permission was also obtained from The District Police Chief Kannur of Kerala Police Department.

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