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Interactions between Mouthwash and Breath Alcohol Testing

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Abstract

Introduction: Mouthwashes are widely used for daily oral hygiene and often contain ethanol as excipient. In the workplace, breath alcohol tests are performed regularly by the employer for workers with safety tasks. Their positivity might induce professional consequences for workers. The objective of this study was to evaluate the interaction of a mouthwash on breath alcohol.

Methods: Four volunteer subjects participated in the study. Breath alcohol tests were performed at various times by officially verified breathalyzers after a mouthwash.

Results: Breath alcohol levels were positive for the first 10 minutes after a mouthwash and rapidly became negative after 15 minutes.

Conclusion: The results support the hypothesis of a direct interaction of the alcohol-containing mouthwash solution on breath alcohol tests during the first 20 minutes, which justifies precautions when performing these tests.

Keywords: Mouthwashes; Ethanol; Breath tests; Workplace and Occupational medicine

Introduction

Mouthwashes are very widely used for daily oral hygiene [1] and can also be prescribed for the treatment of periodontal disease, mucosal lesions or for the prevention of postoperative infectious complications. A large number of commercially available mouthwash solutions contain denatured pharmaceutical ethanol as excipient. The main role of ethanol is to dissolve flavouring substances or active molecules in order to increase their bioavailability. In France, breath alcohol tests are performed regularly in the workplace by the employer for workers with safety-critical tasks. The positivity of breath alcohol test might have professional and socio-economic consequences,especially layoffs. Following positive breath alcohol tests in the workplace, ordered by the employer, the occupational health department was asked to assess the possible interference of an alcohol-containing mouthwash used during the minutes before breath alcohol testing.

The objective of this experimental study, conducted in a transport company in the Parisian region, was therefore to evaluate the possible interaction of a mouthwash under usual conditions of use on breath alcohol concentrations. Based on analysis of these data, several recommendations can be formulated for employer-initiated breath alcohol screening tests.

Materials and Methods

Four volunteer subjects of both sexes and of various ages participated in the study. Table 1 shows the initial characteristics of these subjects. The product used for this study was Chlorhexidine/ Chlorobutanol 0.5 ml/0.5 g per 100 ml, containing 96% ethanol. The mouthwash solution was diluted as recommended, i.e. 20 ml of product in 25 ml of water for a total volume of 45 ml and was used according to the instructions of the package leaflet.

Breath alcohol tests were performed repeatedly at various times, T1min, T3min, T5min, T8min, T10min and T15min by officially approved and verified breathalyzers (DRÄGER 6810, DRÄGER 7110 and DRÄGER 9510). T0 corresponded to the time of application of the mouthwash. Each subject had a breath alcohol level equivalent to zero prior to using the mouthwash. Breath alcohol levels were then determined at the end of the test, after rinsing the mouth with water at one minute.

Results

Breath alcohol levels determined by breath analyzers were positive for the first 10 minutes after using the above mouthwash solution. Breath alcohol levels rapidly became negative after 15 minutes (Table 2).

During the first few minutes after the mouthwash, the breathalyzer always indicated the result "Alcohol in mouth". These devices cannot indicate a breath alcohol concentration due to the high alcohol concentration in the mouth and the heterogeneous nature of this concentration during expiration resulting in unstable levels, as the breath alcohol concentration is very high at the beginning of expiration then suddenly drops. In contrast, after drinking alcohol, a homogeneous breath alcohol concentration is observed during expiration.

Very high breath alcohol levels, of up to 0.22 mg/l of expired air, can be observed, corresponding to 0.44 g/l in the context of ingestion of alcohol. These levels appear to vary from one subject to another and on repeated measurements in the same subject.

After rinsing the mouth with water after using the mouthwash, breath alcohol levels rapidly returned to zero within the first 10 minutes (Table 2).

Subject	Gender	Age (years)	Height(cm)	Weight(kg)	BMI(kg/m²)
1	F	32	163	65	24.1
2	F	53	172	66	22.3
3	M	53	175	80	26.1
4	M	49	180	95	29.3

Table 1: Subjects' characteristics

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Measured values (mg/l of expired air)	T0	1min	3min	5min	8min	10min	12min	15min
Breathanalyzer DRAGER 7110								
Subject 1	0	A	A	A	A	0,12	0	0
Subject 4	0	A	A	A	0,15	0	0	0
Breathanalyzer DRAGER 9510								
Subject 2	0	A	A	A	X	0	0	0
Subject 3	0	A	A	A	X	0	0	0

Table 2a: Duration of the mouthwash 30 seconds. A=Alcohol in mouth; X=data couldn't be obtained for technical reasons (error on the analyzer or insufficient breath during measurement)

Measured values (mg/l of expired air)	T0	1min	3min	5min	7min	8min	9min	10min	12min	15min
Breathanalyzer DRAGER 7110										
Subject 1	0	A	A	A	X	0,08	/	0	0	0
Subject 3	0	A	A	A	X	0	0	0	0	0
Subject 4	0	A	A	A	0,15	/	0,05	0	0	0
Breathanalyzer DRAGER 9510										
Subject 2	0	A	A	A	X	/	0	0	0	0
Breathanalyzer DRAGER 6810										
Subject 1	0	+	+	+	0,10	/	0,06	0	0	0
Subject 4	0	+	+	0,22	0,09	/	0,04	0	0	0

Table 2b: Duration of the mouthwash 60 seconds. A=Alcohol in mouth; / = not measured; X= data couldn't be obtained for technical reasons (error on the analyzer or insufficient breath during measurement);+= positivity for breathanalyzers = >0,25 mg/l of expired air (corresponding to 0.5 g/l in the context of ingestion of alcohol)

Measured values (mg/l of expired air)	T0	1min	Rinsing	3min	5min	6min	8min	10min
Breathanalyzer DRAGER 7110 on the subject 2	0	A		0,06	0	0	0	0
Breathanalyzer DRAGER 6810 on the subject 3	0	+		0,17	0,10	0,04	0	0

Table 2c: Duration of the mouthwash 60 seconds and rinsing at 1 minute. A=Alcohol in mouth; += positivity for breathanalyzers = > 0,25 mg/l of expired air (corresponding to 0.5 g/l in the context of ingestion of alcohol)

Discussion

Few studies have been published in the medical literature concerning the interactions between mouthwash solutions and positive breath alcohol tests [2-5]. These studies demonstrated positive breath alcohol tests during the first few minutes after using a mouthwash due to contamination of the oral cavity. The peak breath alcohol level was observed immediately after using the mouthwash. The results of the present study in terms of the rate of elimination of alcohol from the mouth seem to be comparable to those reported in the literature.

Various factors able to influence breath alcohol test results after using a mouthwash have been identified in the medical literature. Several factors influencing breath alcohol levels (peak levels and kinetics) were identified: the characteristics of the product (volume and alcohol concentration of the product), conditions of use of the product (duration, zone of oral mucosa in contact with the product, rinsing, etc.) and the subject's specific characteristics (formation of fresh saliva, breathing and speech, etc.).

Other drugs or therapeutic agents can also interact with breath alcohol testing, particularly drugs used for the treatment of asthma, nasal decongestants and breath fresheners [6-8].

In the present study, the duration of the mouthwash did not appear to have any impact on the kinetics of decline of breath alcohol levels, which generally became negative in less than 15 minutes. Rinsing the mouth with water eliminated this local contamination more rapidly, resulting in alcohol levels below the limit of detection within ten minutes.

The rate of elimination of alcohol from the blood, and consequently from expired air, is slower (0.10g/l-0.15 g/l per hour according to Widmark's formula) after drinking alcohol [9]. The rapid decline of breath alcohol levels, over 10 to 20 minutes, observed in the present study, can be explained by simple contamination of the mouth.

Several epidemiological studies have also concluded that repeated use of alcohol-based mouthwash solutions may be a potential risk factor for head and neck cancer related to increased salivary acetaldehyde levels [10], but these studies present a number of methodological biases [11,12].

Finally, differences in breath alcohol elimination rates between drinking alcohol and contamination of the oral mucosa by mouthwash should facilitate the differential diagnosis between alcohol ingestion and use of a mouthwash several minutes before breath alcohol testing.

Conclusion

The results obtained during this study and the data reported in the literature support the hypothesis of a direct interaction of the alcohol-containing mouthwash solution with breath alcohol test results during the first 20 minutes.

This interference therefore justifies certain precautions when performing breath alcohol tests, particularly the use of repeated tests over a period of 20 minutes to monitor the rate of decline and the use of laboratory markers, including ethanol assay.

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