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Original article

Influence of random answers on interpretation of the Sniffin' Stick identification test in nasal polyposis

H. Eluecque [a,*], D.T. Nguyen [a,b], R. Jankowski [a]

[a] Service d'ORL et de chirurgie cervico-faciale, hôpital central, CHU de Nancy, 29, avenue du Maréchal-de-Lattre-de-Tassigny, 54000 Nancy, France
[b] Inserm CIC-EC CIE6, 9, avenue de la Forêt-de-Haye, 54505 Vandœuvre-Lès-Nancy, France

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ABSTRACT

Objective: The Sniffin' Stick identification subtest, a validated tool to evaluate the sense of smell, is based on the recognition of 16 different odours. The patient is required to choose an answer from among four proposed odours, which introduces the possibility of obtaining random correct answers, especially in patients with an altered sense of smell.
This study was designed to evaluate the influence of these random correct answers on interpretation of the simplified version of the Sniffin' Stick test comprising threshold and identification tests in patients with nasal polyposis.
Materials and methods: Forty-two consecutive patients with nasal polyposis operated according to the nasalization procedure were enrolled in this prospective study. Odour threshold and identification tests of the Sniffin' Stick kit were performed before and 1 month after surgery. Random correct answers on the identification (I) test (I_H) were subtracted from the global number of correct answers (I_G) to calculate a real identification score (I_R), corresponding to the number of correct answers unrelated to chance.
Results: Two groups of patients were identified: one group with no random correct answers (I_{H0}) ($n = 17$) and another group giving 1 to 7 random correct answers (I_{H1-7}) ($n = 25$). In the I_{H1-7} group, significantly more patients had an immeasurable threshold ($T = 0$) than a measurable threshold (21 versus 4, $P = 0.0001$). In this subgroup of 21 patients [I_{H1-7}, $T = 0$], the mean I_R score was significantly lower than the mean I_G score ($P < 0.0001$) and 13 patients were classified as [$I_R = 0$; $T = 0$]. Among these 13 patients classified as severe anosmia [$I_R = 0$; $T = 0$] preoperatively, only 3 remained severe anosmic [$I_R = 0$; $T = 0$] postoperatively.
Conclusion: Random answers to the I identification test were more numerous among patients unable to detect n-Butanol on the T threshold test than among patients able to detect n-butanol. Calculation of the I_R identification score allows more precise interpretation of the results of the identification test in patients with severe anosmia.

1. Introduction

The Sniffin' Stick is a validated psychophysical tool used to measure the sense of smell. It comprises 3 subtests, the T threshold test, the D discrimination test and the I identification test [1,2]. The identification test consists of presenting the patient with 16 different odours. For each odour, the patient is required to choose between 4 proposals, only one of which is correct. This mandatory choice introduces the possibility of random correct answers. The role of chance was evaluated mathematically by Kobal et al., by calculating the probability of correct random answers provided by subjects not actually passing the test. According to this calculation, it is very unlikely to obtain more than 8 correct answers to the test exclusively by chance [3].

The definition and diagnosis of total anosmia are complex. Hummel et al. established an epidemiological, empirical diagnosis of anosmia combining the results of the 3 Sniffin' Stick subtests [2].

Impairment or loss of the sense of smell is a major clinical complaint reported by patients with nasal polyposis [4], but the intensity of olfactory loss is difficult to interpret by olfactory assessments with psychophysical tests at a given point in time, such as Sniffin' Stick or by tools that try to take into account olfactory fluctuations over time [5]. Nasal polyposis can be responsible for hypo-anosmia and the probability of obtaining correct random answers in these hypo-anosmic patients should logically be

* Corresponding author.
E-mail address: helene.eluecque@yahoo.fr (H. Eluecque).

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equivalent to that calculated by Kobal et al. for subjects responding without actually passing the test [3].

The objective of this study was to evaluate the influence of random correct answers on interpretation of the results of the simplified version of the Sniffin' Stick, comprising the T threshold test and the I identification test in patients with nasal polyposis.

2. Materials and methods

2.1. Study population

All patients hospitalised for nasal polyposis surgery were invited to participate in this prospective study conducted between July 2011 and May 2012. All patients were operated according to the nasalization procedure [6] with preservation of the middle turbinate [5].

Inclusion criteria were nasal polyposis failing to respond to medical treatment and age greater than 18 years.

Exclusion criteria were chronic rhinosinusitis without polyposis, other types of polyps (inverted papilloma, Killian's polyp, other benign polyps), post-traumatic anosmia and any neurological disease known to be associated with olfactory dysfunction (Parkinson's disease, Alzheimer's disease, schizophrenia, etc.), inability to complete the test (linguistic, mental reasons, etc.) and systemic corticosteroid therapy during the 4 weeks before and after surgery. Postoperative treatment comprised topical corticosteroids and daily nasal irrigation. Patients were systematically reviewed in the outpatient department 1 month postoperatively.

2.2. Assessment of smell

Smell was assessed with the tools of the Sniffin' Stick kit (Burghardt, Wedel, Germany) to evaluate the olfactory threshold T and identification I of odours.

The I identification test comprised 16 pens, each presented only once for 3 to 4 seconds at a distance of about 2 cm from the nostrils. The patient was asked, by a simple command ("Go") to sniff twice. For each pen, the patient was required to choose one odour from among 4 proposals [1].

In this study, the patients were asked to specify, for each answer, whether they were sure of the answer or whether they had answered at random, or whether they had hesitated between two odours. When the patient hesitated between two odours, one of which was the correct answer, the answer was considered not to be related to chance. A 30-second interval was observed between the presentations of each odour.

Three scores were used to characterize the answers to the identification test: global identification score I_G, real identification score I_R and random correct identification score I_H. The global score I_G represented the sum of the real score I_R (number of non-random correct answers) and the number of random correct answers I_H.

The T threshold test consisted of presenting the patient with 16 numbered pens impregnated with n-butanol, in which lower numbers corresponded to higher n-butanol concentrations. The test began with presentation, on several occasions, of the pen with the highest n-butanol concentration. If the patient was unable to perceive the odour of this pen, the test was stopped and the threshold test was considered to be immeasurable (T = 0). Patients able to perceive n-butanol were asked to memorize this odour and the other pens containing decreasing concentrations were then presented (from the pen with the highest n-butanol concentration to the pen with the lowest n-butanol concentration). Other pens not containing n-butanol were intercalated in the series, which the patient had to identify as being odourless. When the patient was unable to identify the pen as being odourless, the interval between 2 pens was prolonged (to 20 to 30 seconds). The threshold screening test was used to classify patients according to Hummel and Kobal's threshold criteria, which take the patient's age and gender [2] into account:

- T = 0: anosmia to n-butanol (immeasurable threshold screening test);
- T < 10th percentile: hyposmia to n-butanol (score on the threshold screening test greater than 0 but less than the 10th percentile);
- T > 10th percentile: normosmia to n-butanol (threshold screening test score greater than the 10th percentile).

These tests were performed in a bilateral mode on the day before surgery and one month after surgery in a quiet, well-ventilated room. To avoid any memory/recall bias, patients were only informed about the results of the identification test at the end of the study. The study was performed in compliance with the Declaration of Helsinki/Hong-Kong. Patients were informed and gave their consent to participate in the study in line with European regulations.

2.3. Statistical analysis

Statistical analysis was performed with SAS v9.1 software (SAS Institute, Cary, NC, USA). Continuous variables were expressed as the mean [minimum-maximum] and/or standard deviation. Qualitative variables were expressed as a frequency and percentage. The Wilcoxon-Mann-Whitney nonparametric test was used to compare mean identification test scores and Fisher's exact test was used to compare distributions of subjects between subgroups. A P value < 0.05 was considered to be significant.

3. Results

Forty-two patients were included in the study (16 females [38%] and 26 males [62%] with a mean age of 48.6 ± 10.5 years [29–72 years]). Patients did not experience any difficulty to confirm the validity or random nature of their answers to the identification test.

Fig. 1 shows the preoperative distribution of the number of random correct identifications in these 42 patients. No patient gave more than 7 random correct answers. Two groups of patients were identified: 17 patients gave no random correct answers (I_{H0}) and 25 patients gave 1 to 7 random answers (I_{H1-7}) (Fig. 1).

Table 1 presents the distribution of answers to the threshold test in the two groups of I_{H0} and I_{H1-7} patients. Five of the 17 patients in the I_{H0} group were classified as T = 0 (anosmia to n-butanol), 7 were classified as T < 10th (hyposmia to n-butanol) and 5 were classified as T > 10th (normosmia to n-butanol), while 21 of the 25 patients in the I_{H1-7} group were classified as T = 0, 3 were classified as T < 10th and 1 was classified as T > 10th. The number of patients anosmic to n-butanol (T = 0) was significantly higher in the I_{H1-7} group (P = 0.001).

Fig. 2 shows the preoperative distribution of correct random identifications (I_H) according to perception (T > 0) (n = 4) or absence of perception (T = 0) (n = 21) of n-butanol in I_{H1-7} patients. Four T > 0

Table 1
Comparison of preoperative responses to the threshold test in I_{H0} and I_{H1-7} patients (Fisher's correct test, P = 0.001).

T threshold to n-butanol	I_{H0} group n = 17	I_{H1-7} group n = 25
T = 0	5	21
T < 10th percentile	7	3
T > 10th percentile	5	1