JACOBS PUBLISHERS

OPEN ACCESS

Jacobs Journal of Otolaryngology

Research Article

Correlation between The Visual Analogue Scale and The Olfactory Test in The Detection of Smell Disorders

Kouassi[1*] YM, Kouassi-Ndjeundo[2] JE, Koffi[1] YJ, Badou[1] KE, Tanon-Anoh[1] MJ, Kouassi[1] KB

[1]*Ent-Head and Neck surgery,teaching hospital of Yopougon, Abidjan (Cote d'Ivoire)*

[2]*Ent-Head and Neck surgery,teaching hospita of l Bouake (Cote d'Ivire)*

**Corresponding author: Dr. Yao Mathurin Kouassi, Ent-Head and Neck surgery,teaching hospital of Yopougon, Abidjan, Cote d'Ivoire, Tel: 00225 44835879; E-mail: mathurinkouassi@yahoo.fr*

Received: 03-03-2015

Accepted: 04-08-2015

Published: 04-15-2015

Abstract

Objective
To find a correlation between the Visual Analogue Scale (VAS) and olfactory test in screening of smell disorders.

Methods
Observational study, cross-sectional, prospective for a period of 6 months. Evaluation of smell was conducted in 2 phases: self-evaluation of smell using VAS and evaluation of smell by the investigator using the olfactory test. This test was performed with 5 odors contained in 8 capsules.

Results
The study sample included 1152 patients with 614 females (53.30%) and 538 males (46.70%), the sex ratio was 0.8. The study on 60 subjects, reported anosmic to VAS, 70% were actually anosmic after the olfactory test against 28.3% of hyposmic. Olfactory disorders determined by VAS were 32.5% while the actual prevalence determined by the olfactory test was 20.3%. There was a statistical significant connection between the olfactory perception and VAS ($p < 0.0001$); the concordance between VAS and olfactory test is 94.5%, that indicates a correlation between the VAS and the olfactory test. There was also a statistical significant association between the odor discrimination and VAS ($p < 0.0001$). VAS performance was determined by a sensitivity of 82.05% and a specificity of 80.17%.

Conclusion
There is a correlation between VAS and olfactory test; VAS can be used for screening the olfactory disorders.

Keywords: Correlation; Olfactory Disorders; Visual Analogue Scale; Olfactory Test

Introduction

Olfactory sense (smell) has a chemical sense, based on this, a progress of series events follows a contact with certain known odorant molecules with specific receptors localized in the olfactory neuroepithelium [1,2].

Smell is essential in both animals and humans life. In fact, animals have the power to recognize and discriminate a large number of chemical signals in their environment. This plays a major role in their behavior, their ability to survive in a hostile environment, but also in managing their emotions, reproduction, social life (recognition of the clan, the family) and some physiological regulations [3].

In humans, the inability to detect household odors significant-

ly limits their social activity [4].

Clinically, the study of smell disorders is fraught with difficulties due to the lack of physical parameter of the stimulus evolving continuously. In addition, screening and clinical exploration of smell in clinical practice requires the use of a rarely available olfactory test, particularly in Ivory Coast. Indeed, in our practice, only one box is available for clinical exploration of smell. Due to the unavailability of the olfactory test, we asked ourselves whether the visual analog scale (VAS) could not be an effective alternative and valid method in clinical evaluation of smell. The correlation research between self-assessment and measurement of olfactory function by different methods has been the subject of studies [5-9]. However, to our knowledge, it has never been the subject of study in smell disorders screening. Hence, we have undertaken this study whose objectives were to look for a correlation between VAS and olfactory test, and evaluate the VAS performance in smell disorders detecting.

Patients and Methods

Type of study

This was an observational study, cross-sectional, prospective held in schools and religious structures of Abidjan district.

Study population

Inclusion Criteria

We included in the study at least 15-years old subjects without any neuropsychiatric disorder. Patients were informed and gave their consent for participation in the study.

Exclusion criteria

Were excluded from the study, subjects that could not carry out the smell assessment (patients with a stoma or tracheotomy).

Methods

Conduct of inquiry

The survey was conducted in several sessions by appointment in structures or institutions with strong influence (church, school). It was carried out by a team of investigators trained for this purpose after host structure agreement.

The survey data (interview and evaluation of smell) were collected on an anonymous questionnaire by a team of 3 to 5 investigators per session.

Evaluation of smell was conducted in two successive stages: self-evaluation of smell and evaluation of smell through the olfactory test.

Self-evaluation of smell by the patient

Self-evaluation of olfactory status was performed by the subject, detected by visual analogue scale (VAS) and graded from 0 to 10 according to the criteria of EP3OS.

olfactory test procedure

The smell test was performed by the investigator to assess perception, discrimination, and recognition of different odors.

This test comprises of a box (Figure 1) containing 8 capsules (GlaxoSmithKline). Five (5) different odors were used: banana, vanilla, mint, lavender and lemon. The capsules numbered 1, 2, 3, and 4 each contained the banana smell in increasing concentrations (0.1% for the capsule 1, 1% for the capsule 2, 10% for the capsule 3 and 20% for the capsule 4. Capsules numbered 11, 12, 13, and 14 respectively contain the vanilla, mint, lavender and lemon odors with single concentration. The capsules were opened and presented to a patient one by one and a time of olfactory rest of about 1 minute was allowed after each presentation. The capsules numbered from 1 to 4 were first presented to the patient who indicated whether or not he felt an odor (perception) and if so, which description best met his perception from the list that was presented to him. The same procedure was followed for capsules 11 to 14. He indicated if or not felt a smell (perception) and if so, he had to clarify whether these odors were identical or different (discrimination). The last step of the test was to ask the patient to name or identify odors of capsules numbered from 11 to 14 (recognition).

Judgment criteria

The VAS was divided by three to get an average score. Thus, a VAS score of 0 corresponded to anosmia; a VAS score between 0 and 7 was hyposmia while a VAS score greater than 7 determined normosmia.

Olfaction was considered clinically normal when the patient perceived the smell of the capsule having the lowest concentration (capsule1). The patient was found hyposmic when he perceived the odor of capsules having the highest concentrations (capsules 2, 3 and 4). When he perceived no smells of any capsules, he was considered anosmic.

Odor's discrimination was made between 4 capsules numbered from 11 to 14. It was classified normal when the patient could differentiate at least 2 of the 4 different odors. The absence of discrimination was judged by inability to differentiate between any of the 4 odors presented.

The recognition of odors was appreciated from these same capsules numbered 11 to 14. It was classified good if the patient could name or identify a smell of one of these capsules. The lack of recognition was judged by inability to identify any

of the four odors presented.

VAS performance was evaluated by calculating the sensitivity and specificity, the olfactory test being the reference diagnostic test.

Statistical analysis

Statistical analyses were performed by means of SAS version 9.1 software (SAS Institute, Cary, NC). Quantitative variables were expressed as mean ± standard deviation. Variables were also expressed as frequencies and percentages. Relationships between self-assessment of smell disorders by VAS and olfactory perception by olfactory test were analyzed using logistic regression. An appropriateness test of the logistic model has been performed by the Hosmer and Lemeshow method to assess the logistic model validity. A $p < 0.05$ was considered statistically significant for all tests.

Results

Epidemiological characteristics of the population

During the study period, 1152 subjects were the subject of exploration of smell. This population consisted of 614 female patients (53.30%) and 538 male (46.70%), with a sex ratio of 0.8. The mean age of patients was 35.18 ± 14.67 years; extremes were 15 years and 77 years.

Self-assessment of smell by VAS

The average score of the VAS was 7 with a standard deviation of 2.8 and a median score of 8. In our study population, 60 patients (5.2%) reported being anosmic (VAS score of 0) and 314 subjects (27.3%) considered themselves hyposmic (score of VAS between 0 and 7). Those with olfactory disorders using the VAS represented 32.5% of subjects tested. A proportion of 67.5% of subjects found their olfaction normal (VAS score between 7 and 10) (Table I)

Table I. Distribution of subjects by visual analog scale (VAS) score.

	Number	Percentage
0	60	5,2
[0-7]	314	27,3
[7-10]	778	67,5
Total	**1152**	**100**

Evaluation of smell through the olfactory test

The prevalence of olfactory disorders was 20.3% of the test subjects. The proportion of anosmic patients was 7.5% against 12.8% for hyposmic subjects (Table II).

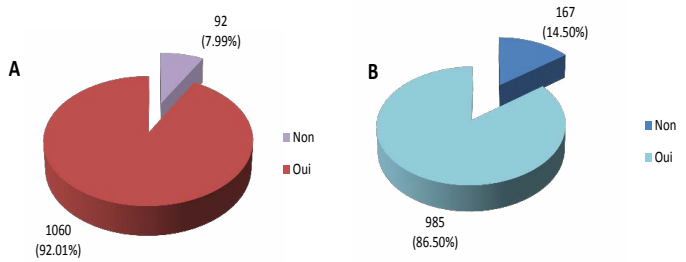
Table II. Distribution of subjects by odors perception.

	Number	Percentage
anosmia	86	7,5
hyposmia	148	12,8
normosmia	918	79,7
Total	**1152**	**100**

Approximately 92% of subjects were classified as normal for discrimination of odors (Figure 2A). The recognition of odors was good in 86.5% of subjects (Figure 2B).

Figure 1. Box of 8 capsules containing 5 odors and used for the olfactory test.

Figure 2. Discrimination and recognition of odors
A: Odor discrimination
B: Odor recognition



Relationship between VAS and olfactory test

Using the VAS, 70% (42 of 60 subjects) of subjects that considered they were anosmic were really anosmic after completing the olfactory test, while 28.3% were hyposmic. In addition, 94.6% of the subjects considered as normosmic according to the VAS assessment were really normosmic after the olfactory test (Table III).

Table III. Distribution of olfactory perception by VAS score.

		Self Assessment (VAS)			
		0	] 0-7[	[7-10]	Total
		N (%)	N (%)	N (%)	N (%)
Assessment by the olfactory test	anosmia	42 (70,0)	43 (13,7)	1 (0,1)	86 (7,5)
	hyposmia	17 (28,3)	90 (28,7)	41 (5,3)	148 (12,8)
	Normosmia	1 (1,7)	181 (57,6)	736 (94,6)	918 (79,7)
	Total	60	314	778	1152 (100)

The percentage of concordance was 94.5% and the discordance percentage was 4.9%. There was a statistically significant relation between the olfactory perception determined by the olfactory test and the VAS score (p <0.0001). Thus, a correlation existed between the VAS and the olfactory test.

There was also a statistically significant association between odor discrimination determined by the olfactory test and VAS (p <0.0001). Indeed, 70% of subjects said anosmic with VAS did not discriminate odors and 99.6% of normosmic subjects with VAS had normal olfaction according to olfactory test (Table IV).

Table IV. Distribution of the odors discrimination by VAS score

	0	] 0-7[	[7-10]	Total
	N (%)	N (%)	N (%)	N (%)
Without discrimination	42 (70,0)	47 (15,0)	3 (0,4)	92 (8,0)
Presence of discrimination	18 (30,0)	267 (85,0)	775 (99,6)	1060 (92,0)
Total	60	314	778	1152 (100)

VAS performance evaluation

True positives smell disorders (anosmic and hyposmic) subjects after the olfactory test were 192.

False negatives were 42; false positives were 182 and true negatives were 736.

Thus, the sensitivity of the VAS was 82.05%; the specificity was 80.17%.

Discussion

Correlation research

In our study, on the 60 subjects that reported being anosmic by VAS evaluation (score 0), 70% were really anosmic after the olfactory test against 28.3% of hyposmic subjects and 1.7% of normosmic subjects. Thus, overall margin of error was 30%. More, the likelihood to have normal olfaction after the olfactory test when the subject was declared anosmic by the VAS was 1.7%.

The olfactory disorders evaluated by VAS represented 374 cases out of a total of 1152 subjects, whether 32.5%, against an effective strength of 234 cases after the olfactory test evaluation, thus a prevalence of 20.3% in our study. Thus, olfactory disorders by VAS were overestimated. These data reflect an underestimation by patients of their olfactory performance. On the contrary, in the study of Hosemann et al [10], olfactory disorders are underestimated in the self-assessment. In fact, only 63% of patients had declared dysosmic with the self-assessment while the proportion was to 65% after the olfactory test. The high proportion of olfactory disorders in this study is due to the study population. Indeed, this population is related to patients with disabling nasal polyposis unlike our study relates to olfactory disorders detection in the general population.

In our study, there was a correlation between the VAS and the olfactory test. This correlation was determined by percentage of concordance (94.5%) and statistically significant relation between the olfactory perception and VAS (p <0.0001). The study of Hox et al. [8] confirms that good correlation. In their study related to a population of patients with nasal polyposis, there was a good correlation between the evaluation by the VAS and the measurement of olfactory function through the olfactory test. Furthermore, the relationship between smell self-evaluation and olfactory function measurement through the olfactory test in dysosmic patients aware of their olfactory deficit was well correlated.

On the contrary, the relationship between olfactory function assessment and nasal obstruction sensation was low in normal subjects [6] and very low in the patients' population of nasal polyposis [9]. In addition, there was no correlation between subjective methods represented by the smell self-assessment and objective evaluation methods [11]. The difference between our results and those of Philpott et al. [11] is at the methodological level.

For Nguyen et al. [12], visual analog scale and the olfactory test are two complementary methods of smell evaluation, especially in patients with smell fluctuations. Thus, both methods should be involved in screening or evaluation of dysosmia whenever the olfactory test is available.

Sensitivity and specificity of VAS

In our study, the sensitivity of the VAS was 82.05%. It is the ability of the VAS to detect smell disorders. As for the specificity of the VAS, which is the ability to identify normosmic subjects, it was 80.17%. In this study, where the diagnostic test (VAS) was evaluated in the olfactory disorders screening, sensitivity is from our point of view, the most relevant evaluation criterion of performance. Thus, the VAS performance is acceptable and even good enough in the olfactory disorders detection.

Conclusion

There is a correlation between the visual analogue scale and the olfactory test in the olfactory disorders detection. In addition, the visual analog scale performance is good, permitting olfactory disorders detection by this method, especially in case of olfactory test absence. Actually, olfactory test remains the reference clinical test in routine practice.

Acknowledgments

The authors wish to thank Professor Jean-Michel Klossek, in the Department of Otorhinolaryngology, University of Poitiers (France) for the gift of olfactory test box.

References

1. Lledo PM, Carleton A, Vincent JD. Odeur olfaction. J Soc Biol. 2002, 196: 59-65.

2. Lledo PM, Vincent JD. Odeur. M/S 1999, 15: 1211-1218.

3. Bonfils P, Jankowski R, Werner A. Les Troubles olfactifs dans les maladies des cavités nasales et des sinus para-nasaux: revue de la literature I. Ann Otolaryngol Chir Cervicofac 2001, 118: 131-142.

4. Bonfils P, Malinvaud D, Bozec H, Halimi P. Les troubles de l'olfaction, Ann Otolaryngol chir cervicofac, 2004, 121(2): 67-74.

5. Delank KW, Stoll W. Olfactory function after functional endoscopic sinus surgery for chronic sinusitis. Rhinology. 1998, 36:15-19.

6. Landis BN, Hummel T, Hugentobler M, Giger R, Lacroix JS. Ratings of overall olfactory function. Chem Senses. 2003, 28:691-694.

7. Welge-Luessen A, Hummel T, Stojan T, Wolfensberger M. What is the correlation between ratings and measures of olfactory function in patients with olfactory loss?. Am J Rhinol. 2005, 19(6): 567-571.

8. Knaapila A, Tuorila H, Kyvik KO, Wright MJ, Keskitalo K, et al. Self-ratings of olfactory function reflect odor annoyance rather than olfactory acuity. Laryngoscope. 2008, 118 (12): 2212–2217.

9. Hox V, Bobic S, Callebaux I, Jorissen M, Hellings PW. Nasal obstruction and smell impairment in nasal polyp disease: correlation between objective and subjective parameters. Rhinology. 2010, 48: 426-432.

10. Hosemann W, Goertzen W, Wohlleben R, Wolf S, Wigand ME. Olfaction after endoscopic endonasal ethmoidectomy. Am J Rhinol 1993, 7:11-15.

11. Philpott CM, Wolstenholme CR, Goodenough PC, Clark A, Murty GE. Comparison of subjective perception with objective measurement of olfaction. Otolaryngol Head Neck Surg. 2006, 134(3): 488-490.

12. Nguyen DT, Nguyen-Thi PL, Jankowski R. How does measured function correlate with self-ratings of the sense of smell in patients with nasal polyposis? Laryngoscope 2012, 122: 947-952.