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ORIGINAL ARTICLE

Nasal tactile sensitivity in elderly

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Abstract

Conclusion: Although older people varied widely in tactile sensitivity, our results show that tactile thresholds increased with age. *Objectives:* The aim of this study was to evaluate the effects of aging on nasal tactile sensitivity. *Methods:* A total of 160 healthy patients aged between 50 and 90 years were included. According to their age, patients were divided into groups (A, B, C, D, E, F, G, and H). From the age of 50, each group included subjects with an age range of 5 years (i.e. group A, 50–55 years; group B, 56–60 years, etc.). Each patient's outcome was assessed through the nasal monofilament test: a set of 20 Semmes-Weinstein monofilaments was used to detect nasal sensitivity for both nasal cavities. The sensitivity threshold was recorded as the minimum monofilament size from which patients could detect at least two of three stimuli. *Results:* In groups D (66–70 years), E (71–75 years), F (76–80 years), G (81–85 years), and H (86–90 years) a significantly ($p < 0.05$) higher stimulus (171.1 ± 0.34 mg vs 67.7 mg, 167.01 ± 0.31 mg 67.7 mg, 166.54 ± 0.28 mg 67.7 mg, 201.24 ± 0.43 mg 67.7 mg, 165,87 ± 0.27 mg 67.7 mg) was required to trigger a touch response in the monofilament test.

Keywords: *Monofilament test, aging process, sensory loss*

Introduction

A significant number of people over 65 years of age will experience age-related sensory losses that will impair overall health and well-being, self-sufficiency, and quality of life. Sensory losses are common in the elderly, and may occur as a part of the normal aging process or as a consequence of age-related disease states, surgery, trauma, malnutrition, or cumulative exposure to toxins. Nevertheless, these impairments can diminish quality of life as well as create safety issues in the elderly population [1].

For these reasons, geriatric medicine has experienced a dramatic growth in recent decades. However, little attention has been given to the nose, while lots of reports have been published on the aging process of other organs and tissues [2]. Although interest in measuring tactile sensitivity using objective methods is growing, due to a proposed association with functional mobility in older adults and also in connection with clinical studies testing the effectiveness of interventions aimed at improving peripheral nerve function (especially in diabetic patients), at the moment no specific study has been done to test the tactile sensitivity in the nose [3]. There are some reports on the aging process of the nose in the literature, but most of them are about nasal epithelial change, olfaction or taste – no data are present on change of nasal tactile sensitivity with aging.

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The aim of this study was to evaluate the effects of aging on nasal tactile sensitivity.

Material and methods

Study population

The regional ethics committee approved the study protocol. A total of 160 healthy patients aged between 50 and 90 years were included (74 years old on average). Objective evaluation of the intranasal findings was performed by anterior rhinoscopy and nasal endoscopy (rigid and flexible). Turbinate edema, nasal secretions, and crusts were graded using a five-point scale (0, absent; 1, mild; 2, moderate; 3, severe; and 4, very severe). Patients were included if they were more than 50 years old and without turbinate edema, nasal secretions, and crusts.

Exclusion criteria were: genetic and congenital conditions (cystic fibrosis, primary ciliary dyskinesia); nasal polyps; positive allergy testing; anatomic abnormalities (e.g. severe septal deviation); acquired mucociliary dysfunction; neoplasms; nasal radiotherapy; acute contemporary bacterial and/or viral rhinosinusitis; middle ear and upper respiratory tract infections; bronchopulmonary disease; nasal trauma; smoker; and previous nasal and sinus surgery. Additional exclusion criteria included oral steroid use, coagulation disorders, uncontrolled hypertension, diabetes, and anosmia.

Study design

After signing an informed consent, all subjects underwent medical history, ENT examination by an ENT specialist with nasal endoscopy, and the monofilament test. According to their age, patients were divided into numerically equal groups (A, B, C, D, E, F, G, and H). From the age of 50, each group included subjects with an age range of 5 years (i.e. group A, 50–55 years; group B, 56–60 years; C, 61–65 years; D, 66–70 years; E, 71–75 years; F, 76–80 years; G, 81–85 years; H, 86–90 years). Each group comprised 20 subjects.

Monofilament test

A set of 20 Semmes-Weinstein monofilaments (Sammons Preston, ABOcare srl, Grugliasco, Turin, Italy) was used to detect nasal sensitivity for both nasal cavities [4,5]. During the test, nostrils were held open, the vibrissae were held back with a nasal speculum, and patients were told to close their eyes [5]. The anterior aspect of the inferior turbinates was then probed with a series of 38 mm long monofilaments of increasing diameters, ranging from 1.65 mm (A) to 6.65 mm(T), and sized and numbered according to increasing force. The microfilaments were labeled with logarithmic Von Frey values (10× force in milligrams). The lowest force exerted by the series of microfilaments was 4.47 mg and the highest was 447 g. Since the instrument markings were Von Frey numbers, representing logarithmic values, they were first converted to force values for statistical testing [4,5] (Table I, Figure 1).

The examiner kept the filament perpendicular to the test site. The filament was bowed within about 1.5 s, the bow was maintained for approximately 1.5 s, and the filament was removed after an additional 1.5 s. The sensitivity threshold was recorded as the minimum monofilament size from which patients could detect at least two of three stimuli. The minimum filament size at which discomfort was caused was also noted. Discomfort was defined as discomfort, sneezing, eye tearing, or pain [3,4]. For each stimulus, the amount of force in milligrams exerted by the monofilament, as determined by its size was calculated. The 2.83 filament (67.6 mg) is considered

Table I. Monofilament size: Von Frey (VFN) number and the amount of force exerted by the monofilament.

Fiber label	VFN	Force (mg)
A	1.65	4.47
B	2.36	22.9
C	2.44	27.5
D	2.83	67.6
E	3.22	166.0
F	3.61	407.4
G	3.84	691.8
H	4.08	1202.3
I	4.17	1479.1
J	4.31	2052.0
K	4.56	3632
L	4.74	5500
M	4.93	8650
N	5.07	11 700
O	5.18	15 000
P	5.46	29 000
Q	5.88	75 000
R	6.10	127 000
S	6.45	281 500
T	6.65	447 000

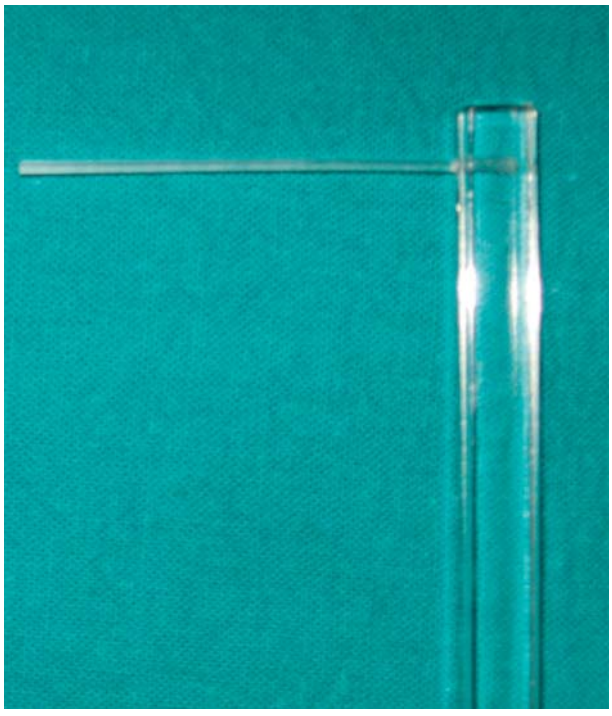

Figure 1. Monofilament assessment. Monofilament used in this study.

to represent normal sensitivity in most areas of the body and was therefore presented first [4,5] (Table I, Figure 1).

Statistical analysis

All the data were evaluated by the paired or unpaired *t* test, and χ^2 analysis where appropriate; *p* values of < 0.05 were regarded as significant. The results were reviewed and approved by the Institutional Review Board of the University of Genoa, Italy. Results for each group are expressed as means ± standard deviation (SD).

Results

As the 2.83 filament (67.6 mg) is considered to represent normal sensitivity, all the groups were compared with this mean value.

When compared with the other groups, group A showed the lower and normal stimulus to trigger a touch response in the monofilament test (67.7 mg). In groups D (66–70 years), E (71–75 years), F (76–80 years), G (81–85 years), and H (86–90 years) a significant ($p < 0.05$) higher stimulus (171.1 ± 0.34 mg vs 67.7 mg, 167.01 ± 0.31 mg 67.7 mg, 166.54 ± 0.28 mg 67.7 mg, 201.24 ± 0.43 mg 67.7 mg, 165.87 ± 0.27 mg 67.7 mg) was required to trigger a touch response in the monofilament test.

Subjects in group A (50–55 years), group B (56–60 years), and group C (61–65 years) showed a normal tactile sensitivity, without ($p > 0.05$) higher stimuli to trigger a touch response in the monofilament test (67.7 ± 0.23 mg vs 67.7 mg, 69.8 ± 0.24 mg vs 67.7 mg, 68.6 ± 0.24 mg vs 67.7 mg) (Table II).

Discussion

The geriatric section of the population is growing and the proportion of those aged 85 years and older is expected to rise from only 100 000 in 1900 to 18.9 million by 2050 [6]. Otolaryngologists have begun to take steps to address the role of aging in pathologic conditions of the head and neck; however, much additional research in otolaryngologic physiology and disorders of the elderly is needed [6].

The aging nose undergoes changes in all of its structural components, including the skin, mucosa, muscles, cartilages, and bones. The skin quality changes and the dermis becomes thinner with diminished skin elasticity [7].

It is often observed that the nasal cavity in old age is dry and atrophic [8]. It could be deduced that those changes might be attributed to the change (atrophy) of

Table II. Monofilament testing: mean values (±SD) for both nasal cavities in each group.

Group		Monofilament testing (mg)
A	F	67.7 ± 0.23
	p	>0.05
B	F	69.8 ± 0.24
	p	>0.05
C	F	68.6 ± 0.24
	p	>0.05
D	F	171.1 ± 0.34
	p	<0.05
E	F	167.01 ± 0.31
	p	<0.05
F	F	166.54 ± 0.28
	p	<0.05
G	F	201.24 ± 0.43
	p	<0.05
H	F	165.87 ± 0.27
	p	<0.05

p, *p* value between the mean sensitivity and normal sensitivity of each group; F, minimum amount of force required to cause irritation.

the non-erectile structural tissues including bone and soft tissues rather than the erectile tissues. A recent report showed that nasal cavity area increased. However, the mucosal shrinkage did not change with increasing age [8]; atrophy of bone or other structural parts of the nasal cavity with the increasing age could be one of the possibilities from these results.

Older subjects not only show reduced olfactory and gustatory sensitivities, but they also exhibit a reduced sensitivity of the intranasal trigeminal system, which responds to irritation of the nasal cavity [9].

Different fiber types are involved in trigeminally mediated sensations. C fibers mediate dull and burning painful sensations, while sharp and stinging sensations are known to appear in relation to excitation of A-δ fibers. These sensations follow different time courses and may have a different impact on olfactory sensations [10]. It has been shown that the responsiveness of A-δ fibers decreases with age while C fiber function seems to be largely unaffected [11].

Among other nasal problems, older subjects are reported to have a "drier" nose than younger subjects. Accordingly, it is unclear whether these different conditions could lead to altered perception of trigeminal stimulants simply due to differences in access of the stimulant to the trigeminal nerve endings [11]. Experiments in rats indicated that spraying liquid onto the mucosa had no significant effect on the mucosal recordings [12].

As regards somatosensation, different studies have demonstrated differences between young and older subjects for a range of modalities. Most of the somatosensory modalities tested more clearly showed an earlier significant reduction in acuity in midlife as well as reduced acuity in older decades: decreased somaesthetic sensitivity, raised thresholds for vibratory stimuli, and increased joint position error [13].

Cutaneous reflexes have been shown to have task, phase, and context dependency in their effects on motor control; recent studies showed a decrease as a function of age [14].

The sensory thresholds in older adults are hypothesized to be much higher due to changes in receptor morphology, reduction of receptor density, decreased elasticity of the skin, and decreased nerve conduction [15].

It is proposed that primary dysregulation of the immune system results in a chronic mild proinflammatory state in the elderly. It has been suggested that high levels of circulating proinflammatory cytokines may cause neural cell apoptosis, and probably play an important role in age-related decline in central nervous system function. Inflammatory cytokines exert their biological effects through their interactions with specific receptors. Further, some authors have reported a significant inverse association between peroneal nerve conduction velocity and circulating levels of serum interleukin-6 receptor (sIL-6R) [16]. Thus, it is reasonable to hypothesize that the mild proinflammatory state that is often encountered in older adults may account, at least in part, for the progressive decline of vibrotactile sensitivity.

Various factors may contribute to age-related decline in cutaneous vibrotactile sensitivity. Our data show a decrease of tactile sensitivity in patients aged more than 65 years; this decrease is not proportional to age, but appears to be constant. This constant modification of the nasal tactile sensitivity may highlight a chronic nasal inflammatory condition.

In accordance with others, our data show that blockage of the trigeminal sensorial receptors (afferent branch), and consequently the inhibition of the parasympathetic system (efferent branch), produces a reduction in tactile sensitivity [5]. For this reason an examination of the nasal tactile sensitivity function can be useful. Among the objective tests, monofilament testing has become the standard means for repeatable testing and measurement of the threshold of mucosal sensory perception.

Although further studies are necessary, these preliminary data show that a decrease of nasal tactile sensitivity points to a chronic nasal inflammatory condition in the elderly.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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