Rhinology, 34, 83-85, 1996

A probe holder for precise intranasal microcirculation measurements*

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SUMMARY *A probe holder for long-term measurements of intranasal microcirculation by laser Doppler flowmetry is described. It is adjustable to any physiognomy and allows precise intranasal probe insertion. It is based on a commercially-available shooting-spectacles frame and might also be useful for other measurements such as intranasal temperature, humidity and pO_2.*

Key words: probe holder, laser Doppler flowmetry, microcirculation, nasal mucosa

INTRODUCTION

Needle stimulation at either acupuncture or placebo points causes an acute transient decrease in finger microcirculation (Kistler et al., unpublished data), as measured with laser Doppler flowmetry (Schabauer and Rooke, 1994). To determine the extent to which needle stimulation affects microcirculation, we have examined the nasal mucosa. The present report describes an intranasal probe holder which we developed for this purpose. The device provides artifact-free (movement-independent) measurements over long periods of time.

MATERIAL AND METHODS

Healthy subjects were measured under well-controlled environmental conditions including temperature, humidity, and airflow. The acclimatization period was 20-30 min. In order to reduce fear and other emotions that affect autonomic parameters, the experimental procedure was explained to the subjects in detail before starting the study. After 10 min of equilibration the first needle was inserted followed by three other needles at 5-min intervals. During the entire study which lasted 30 min, the only talking occurred when the acupuncturist announced needle insertion. Needle stimulation was effected by rotation, lasted 30 s and constituted the exogenous stimulus for laser Doppler flux reactions. Similar effects on microcirculation were induced when needle insertions were on the forearm, hand or the lower leg (data not shown).

A commercially-available shooting-spectacles frame (Baumann, Champion-Schiessbrillen; Baar, Switzerland) was modified to serve as the probe holder (Figure 1). For measurements in the sitting or standing position, the silicon comfort bridge of the spectacles frame can be adjusted. For our measurements in the supine position, the bridge was adapted so that it was rectangular lying on and supported by the *radix nasi*. Thus, face and head movements were not transferred to the probe holder or probe. A support rod (fixing bar) was bent and one end fixed to the existing holder on the spectacles frame. A clip device for the probe was mounted on the other end of the bar.

Figure 1. Shooting spectacles frame modified to function as a probe holder for measuring nasal mucosa microcirculation with laser Doppler flowmetry.

* Received for publication February 23, 1995; accepted April 24, 1995

This clip device permits the probe to be adjusted in all directions, thus adapting to individual physiognomy. The clip device also allows the probe to be carefully introduced to the intranasal location where measurements are made. After positioning, the probe can be micro-adjusted sidewards by the adjustment thread of the shooting spectacles; the precise position is then controlled under direct vision with a nasal specula and a cold light source. Details of the probe holder are shown in Figure 2.

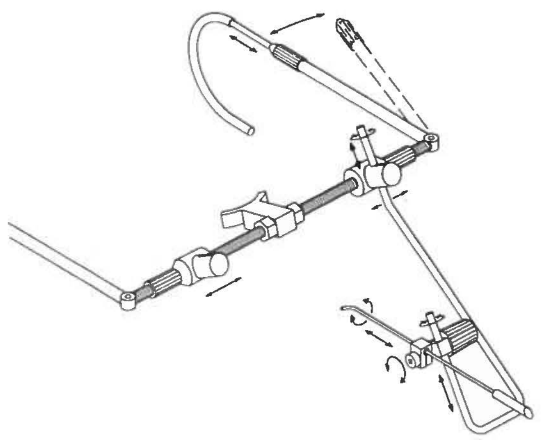

Figure 2. Details of the probe holder. The adjustment possibilities are indicated by arrows. The support rod can be bent to adapt to any physiognomy.

The microcirculation of nasal mucosa and finger skin was measured by means of a laser Doppler flowmeter (Periflux PF3, Perimed, Sweden). The laser Doppler signal is stable at a distance between probe and nasal mucosa of up to 3.5 mm (Olson et al., 1985). For nasal mucosa measurements, a special probe with a bending radius of 3.5 mm (Perimed, Sweden) was used, in order to reach the head of the lower turbinate. Cutaneous microcirculation was measured on the palmar fingertip of the third finger. The laser Doppler signals were transferred to Acknowledge software (Biopac Systems, Inc.) for recording and analysis. We used the term "flux" to describe perfusion or blood cell flux, the latter being defined as the number of blood cells moving in the measured volume multiplied by the mean velocity of these cells expressed as perfusion units (1 unit equals 0.01 V). Heart rate was recorded by ECG (ECG100A, Biopac Systems, Inc.).

RESULTS

Figure 3 shows the pulse waves of the laser Doppler flux in nasal mucosa and finger skin and their slight shift in time compared with the R-peak of the ECG. A representative, long-term (30 min) recording (Figure 4) shows the endogenous laser Doppler flux motion and the flux reaction to needle stimulation. The pattern of rhythmic oscillations in blood flow varies from subject to subject.

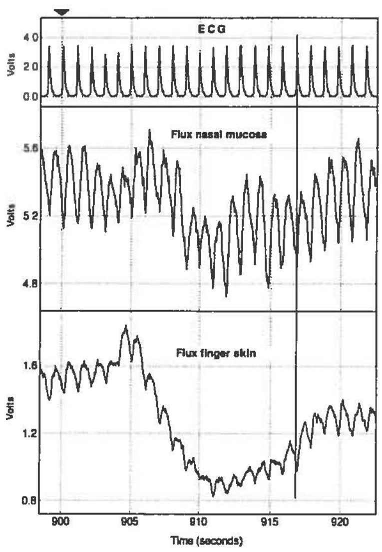

Figure 3. Heart rate and laser Doppler flux in nasal mucosa and finger tip skin. The vertical bar demonstrates the slight shift in pulsatile flux compared with the R-peak of ECG.

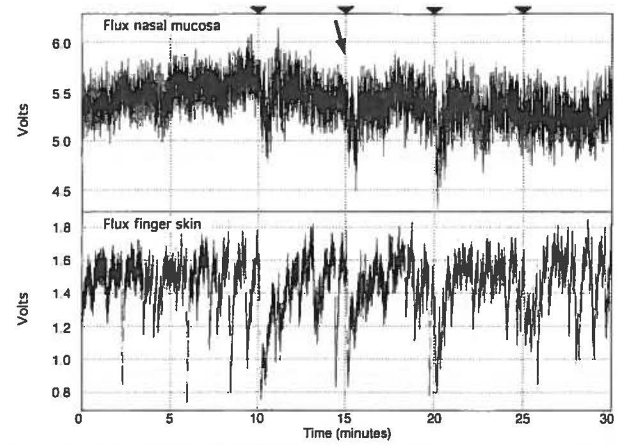

Figure 4. Long-term recording of laser Doppler flux in nasal mucosa and finger tip skin. Needle stimulations are indicated by arrowheads. Note the acute transient decrease in laser Doppler flux after needle stimulation. Arrow indicates the timepoint selected to demonstrate pulse waves in Figure 3.

DISCUSSION

The probe holder as described here using laser Doppler flowmetry (Druce, 1993) permits the non-invasive and continuous measurement in real-time of microvascular perfusion in nasal mucosa for a long period of time. For comparative purposes the cutaneous microcirculation in finger skin was also measured.

Several other probe holders have been described; in some of these the support rod is held into position by a pair of earphones (Druce et al., 1984) whereas others use a Leyla retractor which is attached to a hard plastic crown on the subject's head (Olson et al., 1985).

Our probe holder has several advantages for intranasal measurements. Firstly, because the probe holder is fixed on the spectacles frame – which itself is supported by the *radix nasi* – any movements of the face and head do not affect the probe and the measurement. This movement-free measurement is important for laser Doppler flowmetry. Secondly, with the probe adjustable in all directions, it can be correctly positioned for any physiognomy. Thirdly, the free movement of the probe allows precise intranasal probe insertion during which utmost care can be directed to the place of measurement. Positioning of the probe is done under direct vision with a nasal specula and a cold-light source or, if necessary, under endoscopically guided control further back in the nose. Fourthly, sidewards adjustment to the precise location of measurement - a prerequisite for laser Doppler flowmetry - can be achieved by the adjustment thread of the shooting glasses. Fifthly, after intranasal placement of the probe, neither the probe holder nor the probe discomfort the subject.

For our intranasal measurements we used a special probe with a small bending radius (3.5 mm) which permitted the precise positioning of the probe tip over the head of the inferior turbinate in a rectangular position without touching the mucosa. The continuous presence of the pulse wave in the laser Doppler flux confirmed the artifact-free recording.

In conclusion, the probe holder described is useful for intranasal measurements using laser Doppler flowmetry and should also serve for determining other intranasal parameters such as temperature, humidity and pO_2. Movement-independent recordings can be obtained over a long period of time.

ACKNOWLEDGEMENTS

The authors thank Dr. K. von Berlepsch for his support and helpful comments throughout the course of this work, H.R. Bramaz for photographic work, Prof. T.C. Medici for helpful suggestions, and Dr. H. Etlinger for critical reading of the manuscript.

This study was supported in part by project No. 4034-35872 of the Swiss National Science Foundation (Complementary Medicine)

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ANNOUNCEMENT