

The value of computerised rhinomanometry and a simple manometry with saline in predicting the outcome of patients with acute trephined frontal sinusitis*

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SUMMARY

Infection of the anterior ethmoids and recessus frontalis causes swelling of the mucosa and obstruction of the nasofrontal duct, impairing the drainage of the frontal sinus. During the healing process the obstruction diminishes gradually. Prolongation of this process can lead to chronic infection of the nasofrontal region causing recurrent or chronic frontal sinusitis. In our everyday work we need a simple and reliable method to evaluate the patency of the nasofrontal duct, in order to be able to assess the recovery and to find those patients whose disease tends to become chronic. For this purpose we have measured the patency of the nasofrontal duct in 58 patients with frontal sinusitis after trephination with computerized rhinomanometry (RM) and with a simple salinemanometry (SM). The validity of the two methods to predict the further outcome of the patients has been compared in order to find out if SM would prove to be at least almost as reliable as rhinomanometry. Our statistics prove that SM is a useful aid in assessing the short-term recovery process of the patients. The long-term predictive value still remains to be seen.

Key words: frontal sinusitis, nasofrontal duct, patency, salinemanometry, rhinomanometry

INTRODUCTION

Acute frontal sinusitis can be considered to be the most dangerous of the paranasal sinus infections, because of the possible fatal complications of the disease (Maran and Lund, 1990). Frontal sinusitis has become an increasing problem in the region served by our hospital. About 250 cases are diagnosed annually and the number of surgical interventions has increased (Suonpää and Antila, 1990).

Only mild cases of acute frontal sinusitis can be treated as outpatients (Ruoppi et al., 1993). Middleton et al. (1985) state that only 50% of the patients respond to medical treatment alone and a great number of the patients require some sort of operative treatment. In the ENT Clinic of Turku University Central Hospital the standard treatment protocol is to perform trephination of the frontal sinus if symptoms and radiological findings do not subside in 3-5 days with conservative treatment with antibiotics and nasal decongestants.

According to our earlier results the recurrence rate after trephination has been 22% (Sipilä and Suonpää, 1991). The main

cause of acute and chronic frontal sinusitis is considered to be an obstructive process in the ethmoid region. This can be due to septal deviation, nasal trauma, polyps, mucosal swelling or acute infection which in turn causes obstruction and dysfunction of the mucociliary system at the nasofrontal duct. Drainage of the sinuses is suppressed and the mucosa becomes favourable to pathogenic bacteria (Suonpää and Antila, 1990).

In cases of failure after trephination other forms of operations include removal of intersinus septum through an external trephination, which Pope (1985) considered a simple and safe method for improving the drainage. Medial dislocation of the middle turbinate and intranasal blind cannulation has also been done, but today these are considered to be contra-indicated because of the risk of permanent obstruction of the drainage system (Ruoppi et al., 1993). Because of the difficulty caused by the many anatomical variations (Kasper, 1936), the use of the endoscopic surgery (FESS) has become more common. The aim is to achieve adequate sinus drainage under direct visual control. Perkins et al. (1993) state that FESS performed in order

to improve the frontal sinus drainage is technically difficult and, therefore, there is a need to evaluate which of the patients actually require operative treatment. This is best evaluated by measuring the patency of the nasofrontal duct with for example ventilation measurements.

In the normal situation the pressure changes caused by respiration can be monitored inside the frontal sinus (Andreasson et al., 1985). Infection causes swelling of the mucosa and obstruction of the nasofrontal duct and, thus, no pressure changes can be monitored, or at least the changes are minimal. Andreasson et al. (1985) have concluded that there is a relation between recurrent attacks of frontal sinusitis and impaired function of the nasofrontal duct. Current practice is to evaluate the status of the nasofrontal duct with CT, however this does not give information about the function. There is a need for a valid system to evaluate the patency of the nasofrontal duct and, thus, the grade of inflammation and the healing process after trephination; in order to find the patients whose illness is about to become chronic in good time, so that further examinations and adequate treatment could be planned. We have earlier published studies where rhinomanometry has been applied to evaluate nasofrontal duct patency (Sipilä, 1991). The purpose of this study was to use simple manometry by physiological saline (salinemanometry, SM) to evaluate the patency of the nasofrontal duct after trephination and compare the results with those found with rhinomanometry (RM).

MATERIAL AND METHODS

This study includes 58 patients with acute trephined frontal sinusitis treated in Turku University Central Hospital. There were 41 men with a mean age of 37 years (range: 16-78 years) and 17 women with a mean age of 38 years (range: 24-69 years). The examinations were made in two different series: from October 1991 to February 1992, and from January 1993 to August 1993. These time intervals were included, because at these times we had the opportunity to do all the necessary ventilation measurements in all consecutive patients. The patients were hospitalized for trephination 3-5 days after beginning of the conservative treatment, if no improvement was observed in symptoms or in plain sinus radiography. Antibiotics and local decongestants were continued, and maxillary lavations were performed daily if there was secretion in maxillary sinuses also. Trephination was performed under local anaesthesia and irrigations via the trephination drain (diameter 4.2 mm) were done twice daily. On the second or third post-operative day, rhinomanometric and salinemanometric measurements were begun and were carried out subsequently every other day.

For salinemanometry, a 50-cm long translucent plastic drain was connected to the trephination drain and the length of the saline (0.9%) pillar needed for the saline to yield to the nose was measured in cm (Figure 1). The level of the eyebrow was used as a zero-point. According to our pilot study, the nasofrontal duct was considered to be patent when the height of the saline pillar did not reach 10 cm before the saline yielded into the nose.

For rhinomanometry, a modern computerised rhinomanometer has been used. The rhinomanometer consists of a main unit

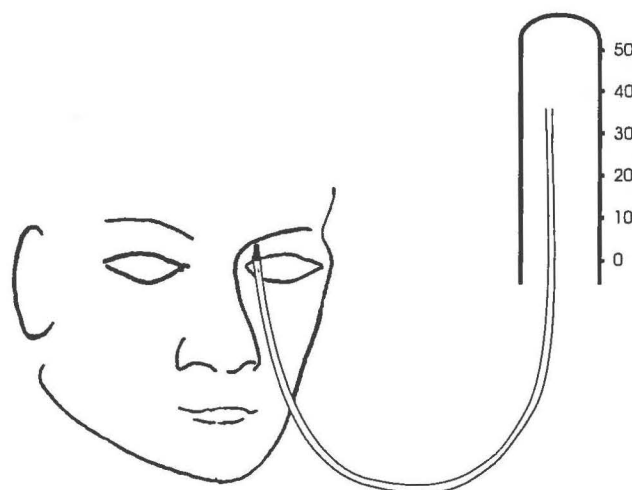


Figure 1. The salinemanometric measurement. A 50-cm plastic drain is connected to the trephination drain and the height of the saline pillar, needed for the saline to yield into the nose, is measured. The zero-point is the level of the eyebrow.

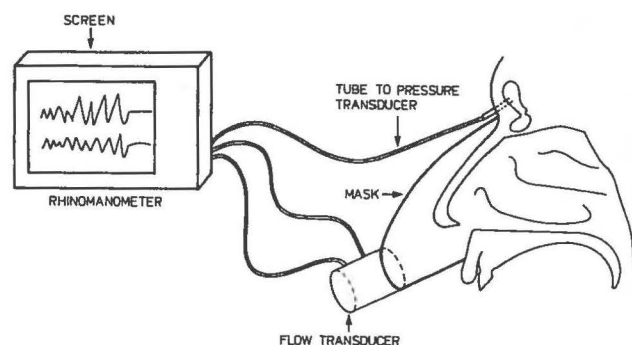


Figure 2. The rhinomanometric system used for measuring the patency of the nasofrontal duct. On the screen, the pressure gradients and the flow curves can be seen. The patient is breathing into a mask, which is connected to the flow transducer, and the pressure channel is connected to the irrigation drain.

containing the microprocessor, pressure transducer and AD converter. The computer has a screen for observation of the pressure gradient and flow curves. During the test the patient breathes through a mask which is connected to the rhinomanometer's flow-transducer. The pressure channel is connected to the irrigation drain. The flow caused by nasal breathing and the simultaneous pressure changes can be monitored on the screen (Figure 2; cf., Sipilä, 1991). According to the pressure gradient curve, the status of the ostium is described in one of the following ways: (1) *obstructed ostium*: no regular respiratory flow occurred inside the sinus, not even during the Valsalva manoeuvre; (2) *partially open ostium*: a regular respiratory flow occurred inside the sinus, but its mean was less than 50% of the corresponding nasal flow; and (3) *open ostium*: the mean of the respiratory flow in the sinus was at least 50% of the corresponding nasal flow (Figure 3).

During the test the patients were told first to breathe normally through their nose, then with forced breathing, and finally a Valsalva manoeuvre was performed. The nasofrontal duct was considered totally obstructed if no pressure changes were

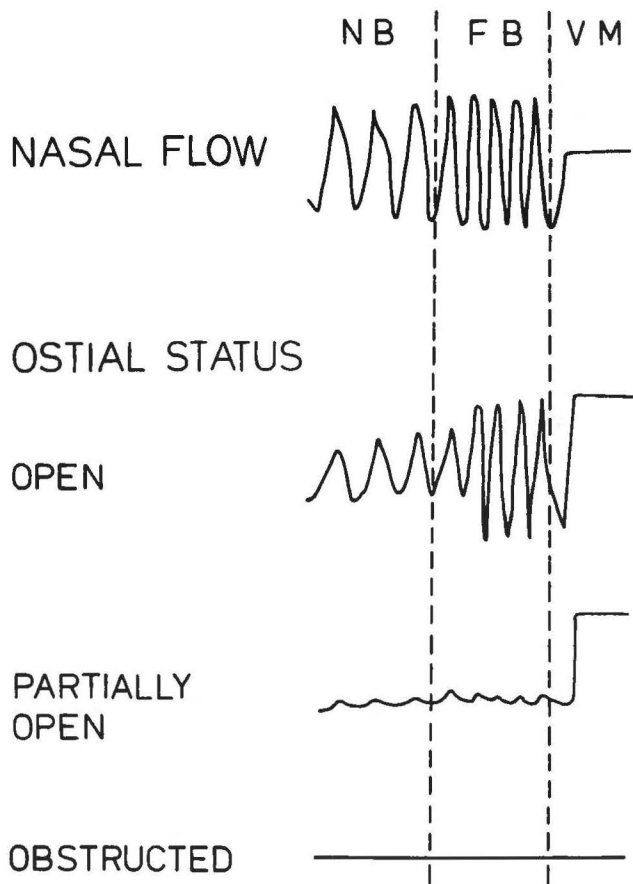


Figure 3. The criteria for assessing the patency of the nasofrontal duct during various types of breathing (NB: normal breathing; FB: forced breathing; VM: Valsalva manoeuvre).

recorded, not even during the Valsalva manoeuvre. The results of the worst side were taken into account in cases of bilateral frontal sinusitis. RM was performed first and subsequently SM. The patients were discharged from the hospital when the measurements showed minimal or no obstruction and no pus was encountered, at which point also the drain was removed. The patients who did not show any (or insufficient) signs of improvement were also released from the hospital after about one week, but the drain was left for further ambulatory irrigations. In these cases coronary CT-scans were taken and further surgery (FESS) was performed when needed.

For the purpose of this study, evaluation of the healing of the initial frontal sinus infection was made after a 2-month period, at which point the clinical and radiological status were evaluated. According to these results, the patients were divided into three groups: (A) patients with recurrence of the disease, needing further surgery; (B) patients with prolongation of the disease leading to recovery without operative interventions; and (C) patients with complete recovery.

RESULTS

Table 1 shows the results of the last measurements before discharge of the patients from the hospital. In group A (with recur-

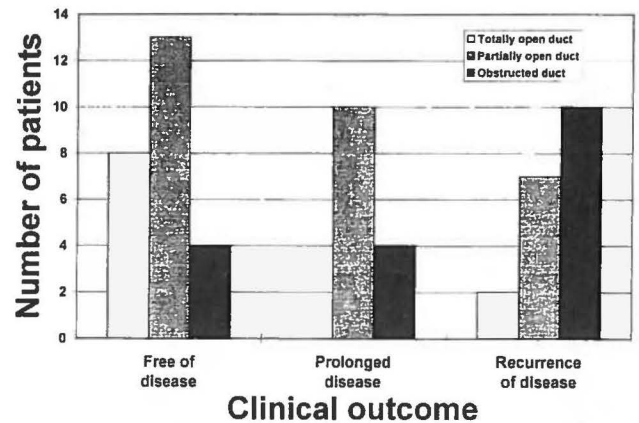


Figure 4. The rhinomanometric measurements compared to clinical outcome.

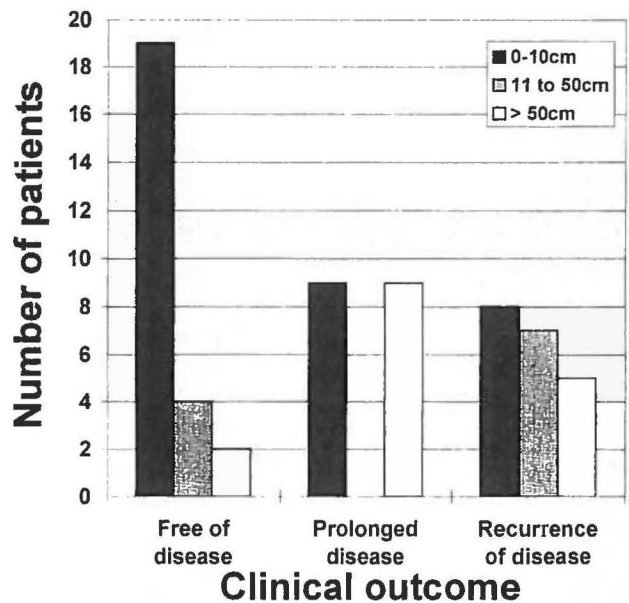


Figure 5. The salinemanometric measurements compared to clinical outcome.

rence of the disease), the number of patients with a totally open duct and good salinemanometric results is clearly the smallest (only 22%). In group C (with no evidence of the disease at the follow-up control), the number of patients with partially or totally open duct and good manometric values is the largest (80%). Only one patient in this group had totally obstructed duct and manometric result over 50 cm. In the intermediate group (group B: with prolonged healing), three patients (21%) showed totally impaired patency by SM, but in all others the nasofrontal duct yielded the saline into the nose with normal pressure. Figure 4 shows the rhinomanometric results and Figure 5 the salinemanometric results compared to the clinical outcome.

The sensitivity of RM was 94% and here the test was considered positive if the nasofrontal duct was partially open or totally obstructed and manometric result over 50 cm. In the intermediate group (group B: with prolonged healing), three patients (21%) showed totally impaired patency by SM, but in all others the nasofrontal duct yielded the saline into the nose with normal pressure. The sensitivity of SM was 48% and the test was considered positive if the cm-value was over 10, and negative if under 10. The specified values were 32% for RM and 76% for SM. The positive predic-

Table 1. Ventilation measurements of nasofrontal duct on last day at the hospital with rhinomanometry and salinemanometry. Measurements on the last day at the hospital grouped according to the final outcome of the patients after two-month follow-up.

group A: patients with recurrent disease				
	salinemanometry			total
	0-10 cm	over 10 cm	over 50 cm	
<i>rhinomanometry</i>				
obstructed duct	1	5	3	9
partially open duct	4	2	2	8
totally open duct	2	0	0	2
total	7	7	5	19
group B: patients with prolonged disease				
	salinemanometry			total
	0-10 cm	over 10 cm	over 50 cm	
<i>rhinomanometry</i>				
obstructed duct	2	0	2	4
partially open duct	9	0	1	10
totally open duct	0	0	0	0
total	11	0	3	14
group C: patients with no evidence of recurrent disease				
	salinemanometry			total
	0-10 cm	over 10 cm	over 50 cm	
<i>rhinomanometry</i>				
obstructed duct	2	1	1	4
partially open duct	12	0	1	13
totally open duct	8	0	0	8
total	22	1	2	25

tive value of RM was 65% (i.e., the percentage of patients who had the disease when the test was positive) and that of SM 73%. The negative predictive values were 80% and 53% in the same order (i.e., the percentage of patients who did not have the disease when the test was negative).

DISCUSSION

The acute phase of the frontal sinusitis is treated in our country with trephination, if no evidence of improvement is observed with conservative treatment in 3-5 days. The failure rate of the trephination is relatively high (recurrences in 22%), which underscores the need to find a method to evaluate the healing and find the patients whose illness becomes chronic and who need further examinations and more extensive operations, e.g. FESS.

In the normal frontal sinus the pressure changes caused by respiration can be monitored inside the sinus through the trephination drain (Andreasson et al., 1985). When infected, the mucosa swells and the nasofrontal duct becomes increasingly obstructed. The anatomy of the nasofrontal duct can be visualised with computerised tomography (Duvoisin and Schnyder, 1992). This does not, however, give us information about the function of the duct.

In this study, the patency of the nasofrontal duct of 58 patients with acute frontal sinusitis was measured with two separate methods. The measurements were made with computerised RM and with simple manometry using physiological saline. The results were compared in order to evaluate if SM was as reliable as RM, because it would be more easily available in everyday work. A similar system has been mentioned earlier by Drettner (1965), in measuring the resistance of the maxillary ostium. Drettner noted in his series that ostial resistance was considerably more increased in chronic sinusitis than in acute sinusitis. The comparison of the two methods clearly were in accordance when predicting healing, but individual variations were great. The sensitivity of RM was 94% and that of SM was 48%, the low figure probably being the result of the great variations in the group, with values ranging from 11 to 50 cm.

Our conclusion is that SM should be regarded as a useful aid to evaluate the function of the nasofrontal duct and considered together with the patient's clinical condition. This is further supported by the fact that SM is inexpensive and easy to use. When the height of the saline pillar does not reach 10 cm, the nasofrontal duct should be regarded as patent and the prognosis of the disease is very favourable. Further long-term follow-up of these patients will show the validity of the manometric method, and this is currently going on in our clinic.

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