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The intrinsic functions of the paranasal sinuses in health and inflammation

Rudolf Aust, Bengt Falck and Henrik Svanholm, Uppsala, Sweden

Many theories have been discussed regarding the functions of the paranasal sinuses. However, none of the theories has been widely accepted. The question as to why man has paranasal sinuses is still unresolved. One thing within ENT-practice which is troublesome, however, is that the paranasal sinuses can become infected. Sinusitis is, according to Aust and Drettner (1974), more likely to occur in sinuses with small ostia and lower oxygen content.

Gas changes in the maxillary sinuses may occur in two ways:
I Through the ostial ventilation.
II Through diffusion to the cells and blood vessels in the sinus mucosa.

The ostial ventilation can be divided into three subgroups:
1. Diffusion through the ostium.
2. Gas transport through the ostium caused by breathing.
3. Gas transport through the ostium caused by the pulse wave.

The diffusion is almost directly proportional to the ostial diameter (Svanholm et al., 1981). Aust and Drettner (1974) have shown that the ostial diameter varies

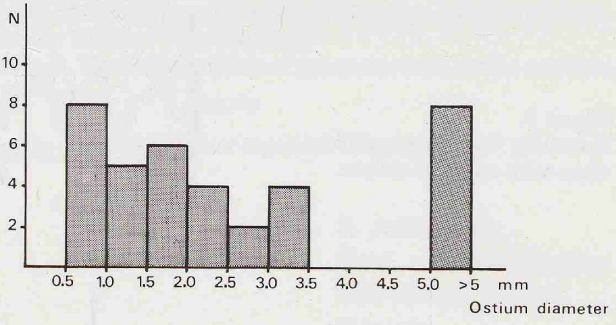

Figure 1.
The distribution of ostial sizes as shown by Aust and Drettner (1974).

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from 0.5 to about 5 mm (Figure 1). These calculations showed a mean ostial diameter of 2.4 mm. The ventilatory capacity of diffusion has its greatest importance when the ostia are large (Figure 2).
Respiration (Figure 3) causes a breathing wave of about 20 µl. This breathing wave has its ventilatory capacity spread over all ranges of ostial diameters (Figure 2).
The pulse causes a wave in the maxillary sinus of about 5 µl (Figure 4). When the ostial diameter is less than 1 mm this wave exceeds the dead space of the ostium and causes a ventilation that increases with diminishing ostial size (Figure 2).

When one or more of the ostial ventilatory factors are diminished or absent the sinus oxygen content will decrease and the carbon dioxide content will increase. In the mucosa the gas changes occur either through diffusion to the blood vessels or through the metabolism of the mucosal cells. The mucosal blood flow is very high and can be compared with that of the liver, brain and intestines. This was measured by Aust and Drettner in a pletysmographic method where the pulse wave and antral pressure increase, when compressing the jugular veins, were

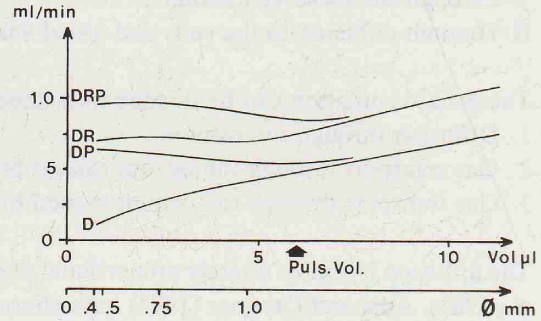

Figure 2.
The gas flow noted for the different ventilation methods and related to ostial volumes or diameters.
D = Diffusion
DP = Diffusion + pulsation
DR = Diffusion + respiration
DRP = Diffusion + respiration + pulsation

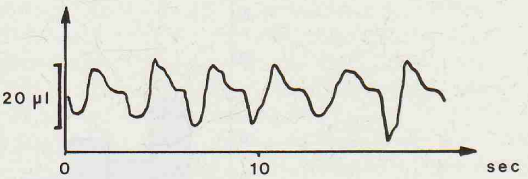

Figure 3.
Breathing wave in a maxillary sinus with an open ostium.

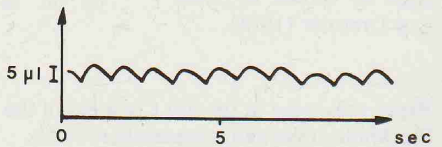

Figure 4.
Mucosal pulse produces a pressure wave in a maxillary sinus with a closed ostium.

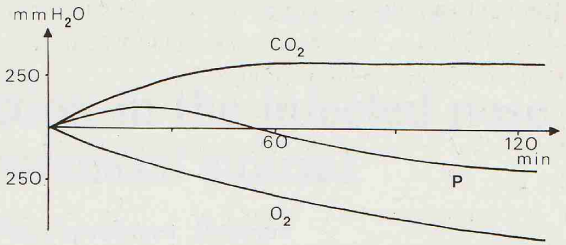

Figure 5.
A fast increase of the carbon dioxide partial pressure (CO_2) and the somewhat slower decrease of the oxygen partial pressure (O_2) results first in an increased antral pressure later in a decrease of the pressure (P).

registered. They estimated that the gas transportation capacity of blood is more than sufficient to supply the mucosa with oxygen and to transport away the carbon dioxide. This oxygen is of importance to the ciliary activity.

In studies made on sinuses with experimentally occluded ostia the gas content approaches the values of venous blood (Svanholm, Aust, Falck, 1980). This gas exchange gives pressure changes in the sinus (Figure 5).
In sinusitis the pO_2 of the pus will approach 0 (Carenfelt, Lundberg, 1977) due to consumption in the granulocytes. The role of the mucosal swelling in sinusitis is still unresolved.
As shown above it is of great importance that all ventilatory factors are intact and in balance with each other in order to decrease the possibility of a sinusitis.

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R. Aust, M.D.
Dept. of Otolaryngology
University Hospital
Uppsala
Sweden