

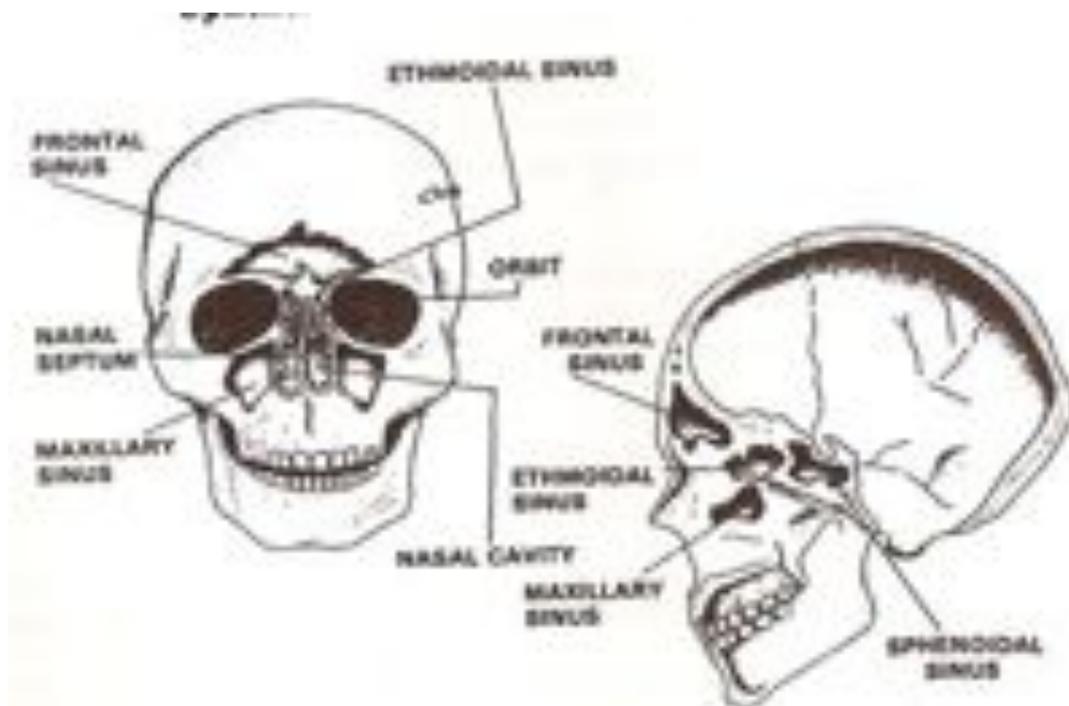
# Chapter 10

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# SINUS BAROTRAUMA

## ANATOMY OF THE SINUSES

The sinuses are air filled cavities contained within the bones of the base and front of the skull. Apart from causing inconvenience to divers, their exact function is unknown.



**Fig. 10.1**

Location of sinuses in the skull. They are connected by canals to the nose.

There are four main groups of sinuses, with openings into to the nose :

- Maxillary sinuses in the cheek bones
- Frontal sinuses in the skull above the eyes
- Ethmoid sinuses in the thin bone at the base of the nose
- Sphenoidal sinuses situated deep inside the central part of the skull.

All the sinuses are lined by a soft mucous-secreting tissue which is richly supplied with blood vessels. Each sinus communicates with the nose by its own narrow opening called the ostium, and through these, the sinuses are permanently open to the atmosphere.

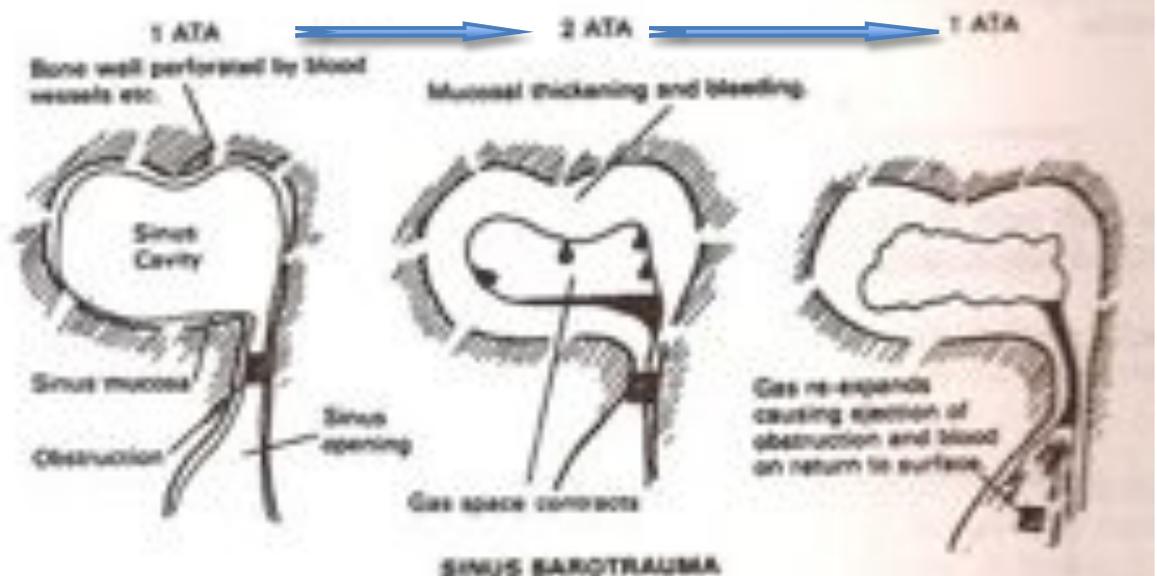
The mastoid sinus or antrum is a similar structure that opens into the middle ear cavity. It more often reflects the pathology of the middle ear and reference should be made to Chapter 9 for this.

## THE MECHANISM OF SINUS BAROTRAUMA

As the water pressure changes during a dive, the sinuses normally equalise automatically by free passage of gas into or out of their openings.

Problems are inevitable, however, if these openings become obstructed. Obstruction can be due to congestion associated with allergy, smoking, respiratory tract infection or the overuse of topical decongestants and other drugs. Other causes of ostia obstruction include chronic sinus inflammation (sinusitis), nasal inflammation (rhinitis), folds of tissue (polyps) and plugs of mucous.

When the sinus is blocked, during descent the gas in the sinus is compressed (according to Boyles' Law) causing sinus barotrauma of descent. The shrinking volume is replaced by swelling of the sinus lining, tissue fluid or bleeding – partly filling the sinus.



**Fig. 10.2** A blocked sinus cavity on the surface, after descent to 10 m. then re-surfacing.

This tissue fluid and blood, which may take days or weeks to absorb, represents a rich nutrient medium for bacterial growth, promoting sinus infection (see Chapter 28).

During ascent, blood and tissue fluid from the sinus barotrauma of descent may be discharged into the nose or back of the throat by the gas expanding in the sinus, causing an apparent nose bleed from the same side as the injured sinus. Alternately, it may be spat out or swallowed.

If the sinus opening becomes obstructed during ascent, the expansion of gas flattens the sinus lining against its bony wall, causing pain and injury to this delicate tissue. This is called sinus barotrauma of ascent.

Sinus barotrauma of descent is more common than ascent, but they often coexist.

## CLINICAL FEATURES

### **Sinus Barotrauma of Descent**

This condition usually presents during descent with a sensation of pressure, developing into a pain in the region of the affected sinus. It is usually felt over the eye (frontal or ethmoidal), the cheek bone (maxillary), or deep in the skull (sphenoidal) depending on which sinus is involved.

Maxillary sinus barotrauma can also present as pain in the upper teeth.

The pain may settle during the dive, as blood and other fluids equalise the pressure differential, or it may recur as the damaged sinus causes a dull pain or headache afterwards.

A small amount of blood issuing from the nose during or after ascent is a frequent accompaniment of sinus barotrauma.

Occasionally the maxillary nerve may be involved, causing numbness over the cheek.

### **Sinus Barotrauma of Ascent**

This presents with pain in the affected sinus during and after the diver's ascent. Bleeding from the sinus frequently drains through the nose or can be spat out.

Severe headache persisting or developing hours after the dive suggests either inflammation or developing infection ( i.e. sinusitis) or sinus tissue damage.

Rarely, the bony walls of the sinus may rupture, with the expanding gas passing into the eye socket (orbital emphysema), the brain cavity (pneumocephalus) or tracking elsewhere. Any such severe manifestation must be treated as a medical emergency

## TREATMENT

Any case of suspected sinus barotrauma accompanied by headache after a dive requires medical assessment, because decompression sickness and many other conditions can also present as headache. See Chapter 32.

Normally sinus barotrauma resolves without any treatment. Significant bleeding into the sinus may drain more rapidly if topical nasal and oral decongestants are used.

The diagnosis may be confirmed by X-Rays, CT scans or MRI (preferred) of the sinuses. The sooner this is done after the dive, the more likely it is to demonstrate the pathology.



**Fig. 10.3**

**Sinus x-ray showing fluid level (opaque area almost filling cavity below right orbit) in right maxillary sinus after barotrauma of descent. Left sinus cavity appears clear and filled only with air (black).**

Increasing pain in the sinus, with fever or malaise developing after the dive suggests infection which is treated with decongestants and antibiotics.

Diving and flying should be suspended until the condition has resolved, usually from 2–10 days.

## PREVENTION

Active and frequent middle ear equalisation, using positive pressure techniques such as the Valsalva, fortuitously assists by forcing air into the sinuses during descent and preventing barotrauma of descent. The “equalising ahead of the dive” technique is applicable (Chapter 8).

Diving should be avoided if the diver is suffering from any upper respiratory tract infection, to reduce both the risk of barotraumas and the infection complications. Smoking and allergic nasal congestion (hay fever) increases the risk of sinus barotrauma by obstructing the sinuses. A deviated nasal septum may also contribute to the development of sinus barotrauma, and if so, it can be surgically corrected.

Not all patients with chronic sinusitis need avoid diving. If the ostia is open and there are no polyps or other obstructions, the sinuses may get a good “washout” with air travelling into and out of the sinuses as the diver descends and ascends. This medical procedure is free to divers.

Nasal decongestants used at the time of diving tend to reduce the congestion of the sinus ostia (at least at the nasal end), but may not prevent sinus barotrauma of ascent. For this reason they should be avoided. It is better for the diver to be prevented from descending (sinus barotrauma of descent) than to be prevented from ascending (sinus barotrauma of ascent). See Chapter 37, last page, for a discussion on the effects of drugs used to prevent sinus barotrauma.

Repeated minor sinus barotraumas can result in progressive scarring of the ostia, causing obstruction and intractable sinus barotrauma. Then the diver has to choose between ceasing his diving career or problematic endoscopic surgery.



**Fig. 10.4**