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THE SPHENOID SINUS*

BY

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In scanning the literature of sinusitis one has the impression that with the sphenoid, and even more with the posterior ethmoid, it is a case of "out of sight out of mind." The maxillary and the frontal cavities are so accessible for direct observation, transillumination, x rays, and treatment that they receive more than their share of attention. What we know of them is apt to be applied by inference to the others. To some extent this is practical, but the sphenoid has special attributes. Being of an anatomical and physiological nature they are of more than passing interest, since they constitute the basis of treatment.

I shall review briefly only those anatomical characteristics which among the sinuses are peculiar to the sphenoid. It develops that most of them are.

Situated in the depth of the nasal cavity out of the direct line of the air-stream, the sphenoid sinus is sheltered from cold and dust and dryness. In the normal nose only a small part of the face of the sphenoid is visible or even accessible. As to the cavity itself almost every part is in intimate contact with some structure capable of making serious trouble when disturbed.

Structure

On examining skulls one is often impressed with the thinness of the bony walls and the intimate relations which the pneumatized cavity assumes with neighbouring structures. It is almost as though some corroding or dissolving fluid had been at work in the bone, extending the cavity here and there, adapting it to the contours of the surrounding nerves and vessels, leaving only a mere shell of bone between. Sometimes even this disappears, and the normally adjoining structure finds itself, but for the lining mucosa, within the sphenoid cavity.

There are no fewer than 13 such structures: the dura mater, the pituitary body, the optic nerve and chiasm, the cavernous sinus, the internal carotid artery, the abducens nerve, the oculo-motor nerve, the trochlear nerve, the ophthalmic nerve, the maxillary nerve, the sphenopalatine ganglion, the sphenopalatine artery, and the pterygoid canal and its nerve.

Herniations of the mucosa through dehiscences in the bone have been known to occur. They may carry the cavity of the sphenoid sinus even beyond the normal limits of the sphenoid bone. Contrast this with the maxillary sinus, whose walls are relatively sturdy and accessible and whose environs are much less vulnerable.

There are histological and physiological differences as well. The inspired air passing the face of the sphenoid on its way to the pharynx misses the ostium, which lies lateral to the main current. The sphenoidal mucosa is quite thin, and being thoroughly protected from the evaporating effects

of air currents is very sparsely supplied with glands—a thing of primary importance to the surgeon.

The ostium, in any case, is likely to be a slit rather than a well-defined opening. When a high nasal obstruction occurs and there is swelling of the mucosa of the sphenoidal angle the ostium is closed. Ciliary streams within the sinus converging at the ostium are blocked and the mucus is retained. Since there are few glands and therefore scant mucus, the inundation is not comparable to that which occurs in the maxillary sinus.

Unless the invading organism is especially virulent the reaction is apt to be a low-grade affair, tending to chronicity if overlooked and producing a dense but relatively thin hyperplasia. Thick, redundant, polypoid hyperplasias do occur, but the type often encountered in the maxillary antrum is the exception. In evaluating roentgenographic shadows one should remember that it is possible even for this thin membrane to be so distended by a transient oedema as to obliterate the cavity completely.

Sinus Infections

The nature and proportion of severe sinus infections seem to depend somewhat upon climate, living conditions, and public health education. Not only do the majority of severe cases originate in communities where these are unfavourable, but on the whole their incidence has fallen off materially in one's own recollection as a result of early attention to minor infections and obstructions.

There is the occasional case of fulminating suppurative sphenoiditis, acute, invasive, destructive, threatening life. On this I shall not dwell, for there is little in its diagnosis or management that is debatable. Only the prognosis has been modified in recent years by the advent of the sulphonamides and the antibiotics. The management of anything less than such an emergency seems to me to call first for consideration of the ultimate recovery of physiological function. Under such conditions eradication of "pyogenic" membranes is apt to impede drainage permanently and should be the last instead of the first resort.

It is necessary to distinguish between an abscess and a pus-filled sinus, a distinction not usually made in years past. The abscess is a collection of infectious material lying in an adventitious cavity, requiring evacuation and obliteration to return the tissues to normal. The sinus, on the other hand, is an infected hollow anatomical structure having functioning parts temporarily deranged but capable of restoration. Obliteration of such a structure approximates normality no more than does the amputation of an arm or a leg, although it may become necessary in either case for special reasons.

In the older literature treatment does not take into account the physiological processes by means of which a sinus protects itself, and this is still true of many contemporary textbooks. Most of these are only rewritten from older textbooks, and though the author may have the courage to introduce new ideas he is somehow reluctant to discard old ones, however faulty. On the whole, treatment of sphenoiditis is suggested tentatively in the textbooks, with the reservation that, if this fails, measures more and more drastic must be applied. In the light of present knowledge it is clear that if the treatment suggested did not actually prevent recovery it could only retard it at best. At worst it produced a situation requiring the most drastic measures.

To clarify, Skillern (1923) relates that "a long cotton-carrier saturated with strong adrenaline-cocaine solution is introduced into the ostium and allowed to remain several minutes until the mucosa around the opening is shrunken, thereby enlarging the ostium." This is carried out daily with subsequent irrigation. It is known now that the

*Read in opening a discussion in the Section of Oto-rhino-laryngology at the Annual Meeting of the British Medical Association, Cambridge, 1948.

two mortal enemies of ciliary activity are cocaine and epinephrine and that their daily application in strong solution through the ostium, whence they could run to the floor, must have effectively prevented the very drainage for which they were applied, a function at which the cilia are much better than we are.

Drainage

While on the subject of drainage reference may be made to the older and some of the newer literature in regard to surgical openings. We are cautioned to make these independent portions for drainage, smoothing the edges and leaving no ridges to retain secretions. This reckons without the cilia, which keep right on emptying mucus through the ostium as long as possible, and further overlooks the fact that for one-third of our lives we are lying down. We know now that nature does not depend upon gravity for drainage.

Newer methods are based on the better understanding of the cilia and their importance and upon the assurance, given long ago by Wright and Smith (1914*a*) and scarcely heeded by anyone at the time, that in chronic rhinitis "there is an increase in the volume of the connective tissue, but this is often more apparent than real. There can usually be plainly seen in the neighbourhood of blood vessels new connective-tissue cells, and the periosteum is much thicker in some places than in others; but the bulk of the stroma increase is due not to proliferation of the connective tissue alone, but to the dilatation of the lymph spaces and the filling of the meshes of the stroma with serum and corpuscular elements, lymphocytes, and polynuclears. . . . The coagulation of the fibrin incidental to the fixation of the specimen for examination in sections makes a mass of fibrinous threads indistinguishable from the real fibrils of the connective-tissue cells except by special staining, but when this is resorted to the scantiness of new connective-tissue cells and their fibrils will be noted when compared to the general increase in bulk."

Searching for this passage, I was dumbfounded to find also a reference to something which I thought was original with me 20 years later: "There is one observation to be noted in regard to the oedematous and granulomatous fragments of mucosa removed from long-standing chronic inflammation of the sinuses, and that is the persistence of the cilia on the surface. Widespread and extreme lesions may exist in the subepithelial stroma, but the delicate cilia of the one- or two-layered columnar epithelium remain in tissue removed from the sinuses." (Wright and Smith, 1914*b*). Once more in the deep shadow of a library shelf we find what we had thought was something new under the sun.

New Procedures

These newer conceptions require changing of the rules of sinus treatment and sinus surgery. Since the sphenoid is rather badly situated for the old procedures and almost ideally for the new, let us outline some of the latter here.

Vasoconstrictors should be chosen for their freedom from any restraining action on the cilia, for their freedom from secondary vasodilatation effects, and, if introduced into the sinuses, for their freedom from systemic effects.

Cocaine is taboo for anything but analgesia; epinephrine for anything but haemostasis.

Antiseptics are of small value, partly because they impede ciliary activity, more particularly because they do not reach the infection, which is in the glands and tissues of the submucosa.

Any solution employed in the nose should be relatively isotonic and neutral in reaction.

Any surgical opening short of the radical obliterative operation should be: (a) as much as possible out of the direct airstream; (b) as small as practicable, to prevent drying out the

interior of the cavity; and (c) as cleanly cut as possible to avoid exuberant granulations and closing.

All these measures are far away from the old idea of obliteration and are directed towards physiological recovery. Let us apply them to the sphenoid. Sphenoiditis is not necessarily characterized by pus. Pus may be absent or so scant as to be practically undetectable. Sometimes, though present in quantity, it may discharge only intermittently and thus be overlooked by the examiner. Symptoms attributable to low-grade, acute, and chronic sphenoiditis have been well and frequently described. They range from simple demonstrable reactions of inflammation to pain, headache, and mental confusion. Collateral symptoms are those arising from the irritation of any of the structures mentioned above which lie in relation to the cavity. Commonly, though not always, they subside with the disappearance of the sphenoiditis.

Since minor and indefinite derangements of the sphenoidal mucosa can give rise to annoying and disabling symptoms it is important that the measures adopted should restore the tissues to function and not leave new abnormalities in their wake. This can be accomplished in the majority of cases by the application of solutions by the "displacement" principle. The sphenoid is fortunately situated in this respect, since, with the head in the inverted position, it lies at the bottom of the cavity with its ostium uppermost.

The arrangement of the tissues about the ostium is such that most of the distensible elements are components of the mucosa on the nasal side, the sphenoidal membrane being much thinner and relatively free of blood spaces. For this reason application of vasoconstrictors to the face of the sphenoid about the ostium is usually sufficient to open it without having to penetrate it. If this is not the case, the interior is still accessible through the displacement manoeuvre, since it is possible with the permitted negative pressure to withdraw a small part of the contained air and thus ensure the introduction of some of the fluid.

If a mild vasoconstrictor—for example, 0.25% ephedrine sulphate or 2-aminoheptane sulphate—is introduced every second day drainage is maintained over a period of time which is comparable to surgical drainage—in fact better, since it promotes emptying in the normal way.

Bearing in mind Wright's description of the cytological conditions it is not surprising that the membrane tends to heal, to throw off its infection, and to return to normal, which it commonly does. Whether or not some excess of fibrotic tissue remains is unimportant so long as the patient is symptom-free. It is seldom necessary to remove contained secretions by positive irrigation or other means. With the ostium open and the cilia working the sinus can take care of itself. Since aqueous solutions remain in the sinus after displacement for 10 or 12 hours continuous drainage is ensured.

If the reaction in the tissues has reached a point where it is irreversible and the method fails, then surgical drainage must be established.

Surgical Intervention

Adhering still to physiological principles, a narrow longitudinal opening is made as close to the septum (or the intersinus wall) as possible. Its width is only that of a sharp-biting punch forceps (for it is important to keep the margins smooth and clean) and it is as long as can conveniently be made in that portion of the bone which cuts easily. Prolonging the operation downward into the thicker, more resistant bone does not add to its effectiveness but increases the likelihood of early closure by stimulating proliferation. There is much less tendency to close than exists after the

general destruction of the face with its ostium. Nature makes every attempt to close any opening, while we persist in trying to thwart her.

This narrow opening as described will accomplish anything that the larger one will do: it permits access for observation, ventilation, drainage, and irrigation, and prevents the desiccation of the interior which results in the destruction of cilia and the metaplasia of the epithelium—an irreversible change which may start up disagreeable symptoms of its own.

The operation is comparable to a so-called "antrum window," which is effective because it lies away from the air-stream and leaves the ostium intact. It is of course not applicable to sinuses obliterated by large cysts and abscesses, nor is it designed for exploratory purposes such as the diagnosis of tumours, aneurysms, and the like. It would not apply to most of the type of cases described a few years ago by Pickworth and Graves, in which the bone had been deeply involved and the infection had reached the meninges, or to those discussed in Turner and Reynolds's classical monograph on intracranial invasions. For such the emergency suggests its own rules; fortunately they are the exception.

Collateral problems surrounding the sphenoid occur to one, such as its part in the causation of headaches, neuralgias, intracranial lesions, and retrobulbar neuritis. Each of them has been the subject of much debate, and I am not sure that I could add anything to what has been said many times on both sides of the Atlantic.

In the time available it seemed preferable to emphasize those physiological factors which may alter our conception of what is desirable in sinus treatment and open the way to better end-results in sinus surgery. My own approaches are of secondary importance. If this review has helped to awaken fresh interest in the subject or suggested a fresh point of view it will have served its purpose.

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To mark the beginning of the National Health Service the Minister of Health attended various ceremonies in Lancashire on July 5. Speaking at Preston Mr. Bevan said that he wanted to thank all those men and women—in local government, in voluntary hospitals, in insurance committees, in nursing associations, and in all those other bodies and organizations—which had had the job to do in the past and had done it so well. They were handing over much that was a good going concern, with good ready-made assets with which to start, and so making the task easier. "We are not changing the old services because they were bad; we are changing rather to make good services better and more available to all." He would also like to thank all those who had worked unremittingly during the last two years in framing the new scheme. Among them were the representatives of the professions who had helped with regulations and administrative arrangements, especially the chemists and ophthalmic surgeons and opticians, whose willing and constructive co-operation had been most valuable in working out a better scheme than would otherwise have been possible. He would particularly mention the staffs of insurance committees, who now passed to executive councils and who had had to carry a very heavy burden; the various local professional committees; those who had served on preparatory committees, such as the three presided over by Sir Will Spens; the Pharmaceutical Working Party under Mr. W. Penman, and the Dental Estimates Board and its officers. There were some doctors reported to be telling some of their patients that they would accept them as paying patients but not under the National Health Service. Such conduct was of course a complete abuse of the doctor's right of free choice of patient, and doctors guilty of it would be condemned by their colleagues as a disgrace to their profession. All could help the new scheme by co-operation, by approaching the Service with the determination to make it work well, and by not rushing for treatment which was not urgent in the early days of the scheme.

THE SURGICAL ANATOMY OF THE PAROTID GLAND*

BY

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Gray, Buchanan, Piersol, Cunningham, Quain, and Morris are among an elect company whose names strike a most familiar note in the mind of every member of the profession: one or other of their classic books recalls the early years of our professional studies. Rightly we regard our anatomical bibles with profound respect; the more so, perhaps, because anatomy, the basic subject of the curriculum, can be likened unto the law of the Medes and Persians.

Because of stereotyped descriptions in the anatomical textbooks we envisage the normal parotid gland as being possessed of a plateau-like superficial surface and a deep surface with prolongations into vulnerable and inaccessible recesses. For the same reason (strengthened by personal experience in the dissecting-room) the profession believes that in the midst of the gland lies the seventh cranial nerve, so intimately incorporated in salivary tissue that to display the nerve trunk, its two divisions, and, above all, its fine branches requires days of dissection by someone upon whom the mantle of John Hunter has fallen.

Little wonder, then, that general practitioners, physicians, and surgeons alike are steeped in the doctrine promulgated by that prince of surgical anatomists Sir Frederick Treves—"It follows from the complex relations of the parotid that its entire removal as a surgical procedure is an anatomical impossibility."

In 1937, after coming across its superficial lobe accidentally during the course of an operation upon the parotid gland and subsequently being inspired by the anatomical studies of McWhorter (1917), I came to the conclusion that the parotid was a bilobed structure, and that the facial nerve lay not in the gland but between its two lobes; in short, that the facial nerve might be regarded as the meat within a parotid sandwich (Fig. 1). No other secretory gland, I argued, has an important motor nerve† running through it, and no other secretory gland has lymphatic nodes within its parenchyma. Surely both the nerve and the lymphatic nodes are extracapsular, just in the same way as lymphatic nodes lie tucked between the opposing capsule-covered surfaces of the buccal and cervical lobes of the submaxillary salivary gland.

Although there are considerable variations in the disposition of the nerve within the parotid gland, for practical purposes it may be stated that much more often than not the facial nerve lies between a comparatively large superficial lobe and a variably sized deep lobe, the two being connected by an isthmus. It is on this anatomical concept that the operations of superficial lobectomy and complete parotidectomy are rendered practicable; consequently the



FIG. 1.—Diagrammatic conception of a coronal section through the parotid gland, showing the branches of the facial nerve sandwiched between the superficial and deep lobes.

*Part of an address delivered before the Assembly of the International College of Surgeons in Rome on May 19, 1948.

†A possible exception is the recurrent laryngeal nerve, which, according to Berlin, traverses the thyroid gland in 7% of cases.