Regardless of the cause of root irritation the scalenus anticus is apt to be tender along with other muscles supplied by the root, and therefore pressure over the brachial plexus in the root of the neck gives rise to pain. Brain (1948a) states that pain in the neck is common in cases of herniated disk, and points out that loss of disk space without osteoarthritis is suggestive of this lesion.

3. *The "Drooping Shoulder Girdle Syndrome."*—This has had its province extended far beyond the bounds of reason. There is no question that minor abnormalities of the thoracic outlet can give rise to symptoms, but some authors claim that compression of the fifth, sixth, and seventh roots can occur at the thoracic outlet or between the slips of origin or insertion of the scalene muscles (Swank and Simeone, 1944; Kirgis and Reed, 1948). Walshe *et al.* (1944) speculate whether acroparaesthesia and acrocyanosis may not be a minor expression of this syndrome, but do not suggest that brachial neuralgia with symptoms referred to one of the higher roots can result from similar causes. Spurling and Scoville (1944) agree that it is only T1 and C8 which can reasonably be involved in this syndrome, and certainly if one of the higher roots should be involved it is difficult to see how the lower roots could at the same time escape. Nachlas (1942) believes that the scalene angle is widened by the contraction of this muscle, and points out that involvement of the posterior muscles, whose nerve supply arises high up, excludes the possibility that the cause of symptoms is in the costoclavicular region. The concept of a primary spasm of the scalenus anticus seems to be somewhat nebulous, and if spasm of this muscle occurs the most likely explanation is that it is in fact due to a lesion of the nerve root or roots.

The typical syndrome of the drooping shoulder girdle or costoclavicular syndrome is not as common as brachial neuralgia. It is precipitated by unaccustomed strain such as the carrying of heavy weights or by some general illness which lowers the tone of the muscles supporting the shoulder girdle.

Treatment

Spontaneous recovery usually occurs after some weeks or months, but is often only partial. Because there is so little to show for their symptoms patients are reluctant to take adequate rest, and indeed may be prejudiced against doing so because they often find that the pain is worse at night and when they are in bed. Nevertheless, rest is the most important factor in treatment, and if the patient can remain in bed this should be advised. In less severe cases a sling may be adequate, and sometimes immobilization of the neck in plaster or in a brace will help, but not all patients will tolerate this, particularly if there is a lot of muscular tenderness in the shoulder girdle.

Physiotherapy is useful, and the injection of procaine into persistently tender areas in the muscles may give lasting relief, but the patient should be warned that when the immediate effect of the injection wears off there will be a temporary increase in the pain. Elliott and Kremer (1945) have shown that electromyographic changes are found in these tender spots, and that the changes disappear after a procaine injection. Elliott (1944) states that such relief does not exclude a root lesion.

In a few cases admission to hospital becomes necessary. Extension of the neck is worth trying, and in cases of prolapsed disk may be strikingly beneficial. As a last resort, if all else fails, the patient can be offered an operation. This is neither so easy nor so successful as the operation for sciatica, and involves risk of damage to the cord. Localization can nearly always be obtained on clinical grounds and confirmed by oblique radiographs. Evidence of long-tract

compression, except in the very old, strengthens the case for laminectomy. If it is suspected that costoclavicular compression plays an important part, scalenotomy is a comparatively simple operation and is worth a trial where the doubt persists.

Besides the case reported in detail (Case 3), a laminectomy was performed in two cases in which symptoms remained in spite of all conservative measures. Both derived considerable benefit, though the improvement was slow in one of them. In neither case was it possible to remove the underlying cause—osteophytes in one and probably a disk protrusion in the other.

Summary

Forty-two cases of brachial neuralgia are reviewed. The importance of the neurocentral joint is underlined and the significance of the radiological changes in the cervical spine, especially narrowing of the disk space, is indicated. The differential diagnosis is discussed.

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COMPLETE EXCISION OF THE PAROTID GLAND WITH PRESERVATION OF THE FACIAL NERVE

BY

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This operation was first performed by Carwardine in 1907, but has not been widely adopted. Hamilton Bailey (1939) has described his technique and experience with the operation, and has also given a very interesting account of the anatomy of the parotid gland (Hamilton Bailey, 1948). D. State (1949), in America, is also an advocate of total parotidectomy as the method of choice for mixed parotid tumours.

The specialized technique, which the advent of intra-tracheal anaesthesia and electro-coagulation has simplified, is not described in modern textbooks, nor is it familiar to many surgeons. This operation should preserve all the branches of the seventh nerve and be followed by a complete recovery of the function of that nerve: it can therefore be performed, without fear of disfigurement, for the cure of a variety of pathological lesions. In frank malignant disease sacrifice of the facial nerve may be an unfortunate necessity, but in other lesions facial palsy is an avoidable tragedy.

Mixed tumours form the majority of parotid tumours and usually occur after the fourth decade. The diagnosis is not always easy, but the history is of considerable assistance. They grow very slowly and have been present

for a number of years before the patient seeks help. Sudden increase in size, a short history with a large tumour, or a hard fixed tumour suggests malignancy.

These tumours are not radiosensitive, and although they often feel spherical they are not truly so, but have a lobulated surface. Local excision without visualization of the branches of the seventh nerve will often result in a small portion of tumour being shaved off. Recurrences are thus frequent: Wood (1904) quoted 50%, Benedict and Meigs (1930) 42.5%, Stein and Geschickter (1934) 20%, Ahlbom (1935) 20-25%, and McFarland (1936) 25%. Hybbinette's (1940) method of incision into the tumour and then dissecting it out with a finger inside it is said to give better results, especially if followed by implantation of radium.

The distribution of the branches of the facial nerve varies very considerably, but, as shown by McCormack *et al.* (1945), conforms to seven main patterns. Hamilton Bailey (1948) has drawn attention to the collar-stud shape of the gland with the main branches surrounding the waist, but I do not believe it true to say that the gland is not traversed by many of the smaller branches. I think it advisable to preserve these branches.

Edwin Clausen and Bruce Henley (1948) report on the treatment of eight parotid tumours by parotidectomy and dissection of the facial nerve. They recommend exposure of the inferior mandibular branch first and use an electrical stimulator.

The operation I perform varies in several important details from that described by Hamilton Bailey (1939). In non-malignant cases I have never had to tie the external carotid artery, and the dissection is begun by finding the cervical facial branch in the submaxillary triangle and tracing it back until it joins the main stem. This has the advantage of enabling the surgeon to approach the main nerve at the correct depth and from below and behind. Mobilization of the lower and posterior border of the gland is facilitated.

Technique of Operation

Anaesthesia.—Intratracheal intubation with the administration of a non-inflammable anaesthetic is essential. Thiopentone, followed by gas, oxygen, and "trilene," is probably the best.

Incision.—A curved incision is made behind the angle of the jaw and extended upwards so as to split the apex of the tragus.

Haemostasis.—There is a free haemorrhage, but the use of diathermy coagulation in conjunction with a good suction apparatus enables the haemorrhage to be controlled and all dissection to be carried out under direct vision. It is not possible to apply ligatures to every individual bleeding-point.

Exposure of the Facial Nerve.—The cervical branch of the cervico-facial division can be identified, as it runs just below and parallel to the horizontal portion of the mandible, at the point where it pierces the deep fascia. It is then traced back, after division of the fascia, until the main cervico-facial division of the nerve is found. Dissection is made along the inferior border of the nerve, and only the communicating branches from the great auricular are divided. The temporal artery is ligated and the temporo-maxillary vein is now divided between ligatures and the main branch of the facial nerve traced back to the stylo-mastoid foramen. The posterior border of the parotid gland can now be defined after division of its fascial covering. The nerve is at first deeply placed, but lies superficial to the external carotid artery. As it traverses the gland the numerous divisions become quite superficial, but are no thicker than

pieces of thread. Each branch is exposed by inserting a pair of mosquito artery forceps parallel to the nerve and then dividing the superficial tissue. By this means the gland is split and all the branches of the nerve are preserved. Stensen's duct is divided and ligated, and the transverse facial artery also requires ligation. Once the nerve and its branches have been cleared the remnants of the deep portion of the gland can be dissected out.

Closure of the Wound.—Haemostasis is secured by use of the diathermy, and the upper part of the wound closed by horsehair sutures. A rubber tissue drain is inserted and the remainder of the wound closed with Michel clips. Acriflavine is used to clean the wound, but sulphonamide powder should not be instilled owing to the danger of fibrosis and compression of the nerve.

The operation averages two and a half hours in duration, and the anatomical arrangement of the branches of the nerves is found to vary considerably. The three main branches of the temporo-facial division—the temporal, malar, and infra-orbital—can be identified, as well as the buccal and supramandibular branch of the cervico-facial division.

The use of the diathermy for checking haemorrhage and of fine mosquito forceps for opening up the nerve tunnels simplifies a rather tedious dissection.

This operation was first performed by me in 1943, and has been employed for the following conditions: lipomatosis, caseous tuberculosis, chronic inflammation, mixed tumours, adenoma, and carcinoma.

Post-operative Complications

If the main auriculo-temporal or great auricular nerves are damaged, numbness of part of the ear may result. This happened in two cases, but it gradually became less troublesome. Two patients have complained of the Frey syndrome, which is a watery discharge from the skin over the side of the face after meals, and sometimes hot flushings. This may be less liable to occur if the auriculo-temporal nerve has been divided. The time of onset of the complication was five months and eight months, respectively, after operation.

Case Reports

Case 1.—A married woman aged 53 was seen in the outpatient department on November 5, 1943, and admitted the same day. In the upper part of the parotid there was a hard tumour which was not circumscribed, and the history was of a lump in the right side of the face for one year that had been gradually increasing in size, with swelling and pain. On November 9, under intratracheal gas, oxygen, and trilene, the gland was resected and a rubber tissue drain inserted for 48 hours. Convalescence was uneventful, but there was a considerable degree of facial palsy. A facial splint was applied and electrotherapy given. In six months recovery was complete. Dr. Roland John's report on the section was as follows: "Lipomatosis and atrophy of parotid and salivary gland."

Case 2.—A married woman aged 44 was admitted on December 31, 1943, with a history of swelling in the parotid for nine weeks. There was no pain on mastication. Tonsillectomy had been performed in 1930, and there had been some swelling of the upper cervical glands before the occurrence of the tumour. There was a very hard fixed swelling about the size of a cherry in the position of the pre-auricular gland. The blood pressure was 180/100, and x-ray examination of the chest was negative for tuberculosis. The cervical glands were not enlarged. At operation on January 4, 1944, a tumour the size of a hazel nut was found in the substance of the parotid, and the whole gland was completely excised. The wound was drained, and convalescence was uneventful. On section the tumour contained thick green pus, and Dr. Roland John reported: "Caseous tuberculosis of lymphatic glands lying in

relation to serous salivary gland; slight fatty atrophy of otherwise normal serous salivary gland." The caseating gland belonged to the intraparotid group, and was in relation to the external carotid artery. Facial paresis was present after the operation, but responded to the same treatment as in Case 1.

Case 3.—A married woman aged 44 was admitted on January 29, 1944. She complained of a lump which had been present since an attack of influenza about a month previously. The tumour had been increasing in size and was tender on pressure and fixed. The cervical glands were not enlarged, but there was an occasional rise of temperature to 99° F. (37.2° C.). X-ray examination of the chest was negative for tuberculosis, but the condition was thought to be tuberculous. At operation on February 1 under thiopentone, gas, oxygen, and chloroform, the gland was excised and the facial nerve dissected out. The wound was closed, with drainage, and during convalescence there was some pyrexia, which responded to sulphathiazole. The patient was discharged on February 12. Treatment was similar to that of Cases 1 and 2, and complete recovery ensued. Dr. Roland John reported: "Subacute inflammation of parotid salivary gland; subacute inflammation of lymphatic glands." This patient would very probably have recovered without operation, but, in view of the history, operation was thought to be advisable if the facial nerve could be preserved.

Case 4.—A married woman aged 42 was seen on August 3, 1945, because of a right parotid tumour which had been present for four years. She was then pregnant, and was seen again on September 19, 1946. At operation on September 28 total excision of the parotid with preservation of the facial nerve was carried out. She was treated by physiotherapy, with almost full recovery in three months. Pathological report: "Mixed salivary tumour with abundant soft ground substance. No evidence of malignancy."

Case 5.—A man aged 46 was admitted on January 14, 1947, with a history of tumour of the left parotid for three years. The swelling increased after eating. At operation on January 21

the parotid gland was totally excised, with preservation of the facial nerve. Figs. 1 and 2 show the distribution of the nerve in this case and in Case 6. Pathological report: "Organizing acute chronic inflammation—fibrosis of parotid—lymph gland actively functioning. No evidence of malignancy." He recovered facial movement, except of the left lower lip.

Case 6.—A married woman aged 44 was seen on January 28, 1947. She had had a tumour of the right parotid for ten years. Cystic nodules were adherent to skin below the lobe of the right ear. At operation on February 14 complete excision of the parotid with preservation of the facial nerve was carried out.

She was given physiotherapy, and recovery was slow. Pathological report: "Adenomatous nodule. Probably mixed tumour with a predominant epithelial element. No evidence of malignancy." A recent follow-up showed no evidence of recurrence.

Case 7.—A man aged 88 was admitted on November 19, 1947, with a history of swelling of the right ear for three months with pain at night. He believes it started as a mosquito bite. There was a watery discharge for one month. X-ray examination suggested the presence of a calculus. Total parotidectomy (under local analgesia), with preservation of the facial nerve, and removal of the upper group of lymphatic glands were performed on November 25. Pathological report: "Adenocarcinoma and squamous metaplasia." On January 13, 1948, a nodule occurred in the scar, and this was widely removed and the area skin-grafted. Pathological report: "Section shows invasion by well-differentiated, rather pleomorphic squamous epithelioma." By May 11 full movement of the face had been recovered, except for a branch of the lower lip. There has been no recurrence up to the time of writing.

Case 8.—A man aged 30 had had a left parotid tumour 1 in. (2.5 cm.) in diameter for four years. At operation on November 9, 1949, total parotidectomy was performed. Pathological report: "Mixed salivary tumour." He was discharged home on November 16. There was slight paresis of the left lower face. Complete recovery occurred in two months, and there has been no recurrence.

Case 9.—A man aged 64 was admitted on February 22, 1949, with a history of right parotid tumour for two years, gradually getting larger. There were no enlarged glands. Auricular fibrillation was present and the blood pressure was 210/140. At operation on February 23 total parotidectomy was performed. The cervico-facial division was sacrificed. Glands were dissected out. The tumour was 2 in. (5 cm.) in diameter. Pathological report: "Adenocarcinoma." The patient was discharged on March 6. Full recovery of paralysis, except for the lower lip, occurred in two months, and there has been no recurrence.

Comments

Nine cases have been treated by total parotidectomy. Full recovery of the facial nerve has been achieved in six. Two cases have some paresis of the lower lip only, and in one of these the cervico-facial branch was deliberately divided. One case is too recent to have obtained complete recovery, but there is no reason to think that it will not occur.

All cases have been recently assessed and most carefully tested for full recovery, which includes voluntary movement of the alae nasi.

The technique described enables the difficulties inherent in this dissection to be overcome, and, although the operating time is between two and three hours, it is hoped that other surgeons will be encouraged to adopt this method of treatment, which affords a better chance for cure and avoids the tragedy of permanent facial palsy.

Summary

Some anatomical and pathological aspects of the removal of the parotid gland are discussed.

The technique of the operation for total removal of the parotid gland with preservation of the facial nerve has been described.

Nine cases are reported.

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FIG. 1.—Facial nerve in Case 5.

FIG. 2.—Facial nerve in Case 6.