

## NOTES ON CONDUCTIVE ANESTHESIA.

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**C**ONDUCTIVE anesthesia in contrast-distinction to other methods introduced of late years, has fulfilled all claims made in its favor.

When I returned from Europe in the fall of 1912, I was repeatedly ridiculed on account of statements which I made about this anesthesia. Many things were said, disapproving and disfavoring its value and efficiency by men, who in a very superficial way, had heard or read about this subject.

The tide has turned. Conductive anesthesia is in general use all over the country by the best practitioners and its merits appreciated highly. Of course accidents will happen, but if they do, only in the hands of those practitioners who do not care and do not take the time to study the subject before practicing it on their patients.

In my own hands this method has given excellent results. Tho occasionally an injection had to be repeated, there has never been an accident not even as much as syncope. In many thousand injections there was never a needle broken.

Only because I believe in the extreme usefulness of this method, I again write on the same subject.

My remarks will be few, but important.

The anesthetic still in general use is novocain. For the last five years the E tablet of the Farbwerke Hoechst Co.

containing each 0.02 gram novocain and 0.00005 gram suprarenin was employed both in the hospital and in my private practice exclusively.

I shall try to describe in a few words the preparation of the 2% solution. The novocain tablet dissolver which you all know, is filled with about 5cc. of Sterile normal saline solution and brought to the boiling point. The syringe which was kept in a glycerine-alcohol solution (70% alcohol 700 parts, glycerine 300 parts), is cleaned by drawing the hot saline into its barrel, emptying it and repeating this until all the solution is used up.

Now the cup is filled again up to a little above the 3cc. mark and again allowed to boil. Three E tablets are thrown into this solution and dissolved by heating. The novocain solution drawn into the syringe is now ready to be injected when reaching body temperature. The steel needle and hub are removed from the sterilizer and attached to the syringe.

There is no objection on my part to using Rinber's tablets instead of normal saline, but my experience with the latter has been so satisfactory that I continue employing it. The hypodermic syringe of Freienstein has given practically perfect results as have the two kinds of steel needles: No. 1 (0.90 mm. in diameter), 40 mm. long for mandibular injections, and No. 17 (0.47 mm. in

diameter), 42 mm. long for all other anesthetics.

During the last few weeks we have on trial at the hospital, a syringe designed by Dr. Riethmueller who was kind enough to give me the following description:

"It holds  $2\frac{1}{2}$  c. c. In its design, delicacy and lightness have been prime considerations. It is an all glass and metal syringe without washers of any kind, which for purposes of sterilization is taken apart in two sections. The glass and metal are annealed in such a way as to permit of vigorous prolonged boiling. All gnarled corrugated surfaces are avoided, and all corners are rounded off and the piston is made to end in a graceful indented end in which the ball of the thumb fits snugly. The cross-bar moves readily and the barrel is long enough so that the operator's second and third fingers find ample working space between cross bar and cheek so as not to obscure the field of vision. Altho very light pressure only is required in conductive anesthesia, the syringe is tested to 60 lbs. pressure so as to allow of infiltration without regurgitation. To prevent the migration of a broken needle into deeper strata of tissue, the needles have been provided with a safety disc, wider than the lumen of the needle perforation, so that the needle fragment is automatically arrested. Since, according to the laws of mechanics, the needle, no matter whether of steel or iridio-platinum, must break at the orifice of the hub to which the needle is attached, the risk of "losing" a needle is eliminated, which fact may be especially appreciated by the beginner. To facilitate finding the inclination of the bevel of the needle, a mark is placed on the hexagonal hub in such a way that visibility of the mark indicates pointing of the bevel of the needle toward the bone. To avoid confusion the hubs of steel needles are nickel-plated, those of iridio-platinum are gold-plated."

So far both syringe and needles have stood the test. It seems that the needle bends at the distal part of the disc and repeated straightening may weaken it considerably. The syringe is smaller and lighter than the so-called Fischer syringe. It is very easily handled and satisfactory in every way. We hope that unimportant defects which may be found at any time, will be simple to remedy.

In regard to mandibular injection, I unfortunately cannot report any improvement. The technic is as follows: In injecting for the right side, the left index finger is placed upon the lower fold and pushed backward until the finger tip comes in contact with the external oblique line. Then it is moved up on that line until the finger is about level with the occlusal surfaces of the lower teeth. The finger tip is so turned, that the finger nail will come in contact with the internal oblique line, while the finger ball rests in the retromolar triangle. The finger nail is then retracted from the internal oblique line to make room for the needle to go 1 cm. above the occlusal surfaces of the lower teeth thru the soft tissues right against the internal oblique line. Retracting the needle slightly, so as to release it from the periosteum, move mesially and backward to pass the internal oblique line where three or four drops are deposited to anesthetize the lingual nerve. The needle point at this time is not in contact with the bone (inner aspect of the ascending ramus); to reach the bone the syringe, which up to now was in nearly sagittal direction, is moved towards the opposite side until the point of the needle comes in contact with the bone again. The needle should now proceed backward alongside the bone until 2 cm. of its length have disappeared in the soft tissue. We have now reached the region of the inferior dental nerve where we deposit the remainder of the solution (about  $1\frac{1}{2}$  c. c.) To inject the left man-

dibular region, the syringe is held in the left hand.

The mental injection is not as useful as the mandibular, being employed mostly to complete mandibular anesthesia of the opposite side over the median line or, desensitize that part of the lower jaw which lies anterior to both mental foramina.

An infraorbital injection includes the anesthesia of the first bicuspid in practically all cases, of the second, in a small percentage. A discussion of the superior dental branches in another part of the paper will explain this. The method of injecting is quite simple.

With the left index finger we palpate for the infraorbital foramen which lies a little less than 1 cm. below the middle of the inferior orbital margin. With the thumb of the same hand, the upper lip is held upward and outward. The needle point is inserted slightly posterior to the apex of the cuspid tooth, not into the fold, but slightly away towards the lip, so as not to come in contact with the bone too soon. Then the needle is directed up thru the soft tissue to the foramen, where 2 c. c. of the anesthetizing solution are deposited. The palatal side must be injected separately if more than operative dental work is contemplated.

The injection at the maxillary tuberosity has brought forward more discussion and created more misunderstanding than any other subject pertaining to conductive anesthesia. It is hoped that Dr. Riethmueller's technic, while not nearly perfect at the present time, will, in the near future, give us that longed for method which, if successful, will include the anesthesia of not only the second but also the first bicuspid.

Having the opportunity of seeing the doctor work at my clinic in the New York Throat, Nose and Lung Hospital, I am in a position to watch with greatest interest and hopes, the outcome of this study.

Below I am giving Dr. Riethmueller's summary on this question.

"Reports concerning the extent of anesthesia produced by tuberosity injection seem to vary as widely as the opinions of anatomists regarding the course of the superior middle alveolo-dental branch. This branch, if it exists—and some anatomists claim it does not—may present the following variations in course. It is either given off from the large infraorbital branch within the infraorbital canal and runs from there in the mucosa of the maxillary antrum to the upper bicuspid without appearing upon the facial surface of the maxillary bone; or it is inserted together with the posterior branch at the cribriform plate; or it is inserted in foramina situated anteriorly thereto. The examination of numerous skulls and clinical observations tend to point out that the latter two conditions are present in at least seventy-five per cent. of cases. If the long needle is inserted in the reflection of the mucous membrane back of the distal root of the first molar, in other words, between first and second molars, and advanced on the bony surface, without discharging solution in an upward, backward and inward direction at an angle of about 45° with the masticating surfaces of the upper molars, and 1½ c. c. of solution are injected when the needle has been introduced to full length; if then in slowly withdrawing 1 c. c. of solution is discharged as the needle is withdrawn, thus leaving a deposit of solution from the cribriform plate to the reflection of the mucous membrane; then, the three molars and two bicuspid together with the soft tissues connected therewith are satisfactorily anesthetized. It is of little practical value to argue how this anesthesia is obtained. Suffice it to say that either the posterior and middle branches are blocked simultaneously at the cribriform plate or, if the middle branch is inserted in its own foramina anteriorly

to the cribriform plate, it is blocked there as the needle is withdrawn, or if the middle branch descends within the antrum, enough solution penetrates the canaliculi in the cortical facial bone to produce bicuspid anesthesia. If the first bicuspid is only partly anesthetized, as happens in some cases, this is due to the anastomosing fibres of the anterior branch. Most operators seem to insert the needle too far posteriorly and at too obtuse an angle, thus getting way beyond the cribriform plate, and yet not deeply enough into the spheno-maxillary fissure to block the maxillary branch in toto. Stern's suggestion of using the long needle in the bayonet-shaped hub has not given any better satisfaction. In all cases where the operator attempts an injection at a very obtuse angle a great deal of his solution seems to be deposited in the very heavy layer of areolar tissue overlying the cribriform plate and filling the spheno-maxillary fissure, so that very little solution is left for the nerve branches to conduct. This will also explain the observation of some operators who obtain only partial anesthesia of the first molar."

To simplify matters, I consider it very important to review the nerve supply of the maxilla. Therefore, I cite the following paragraphs from one of my previous papers:

"For conductive anesthesia in the upper jaw, two nerve loops must be taken into consideration, the outer of which is formed by a part of the maxillary division of the fifth cranial nerve and its termination, the infraorbital, and their branches: the posterior, middle and anterior superior dental nerves. The posterior superior dental branches enter the bone thru the posterior dental foramina (foramina alveolaria) at the tuberosity (tuber maxillae); the middle superior springs from the infraorbital nerve in the posterior part of the infraorbital canal, and the anterior superior branches just posteriorly to the infraorbital foramen.

The above-mentioned nerve loop supplies the bone and all the teeth of the corresponding half jaw, the mucous membrane of the maxillary sinus and the buccal periosteum and gum tissue. The infraorbital nerve—after leaving the foramen—distributes branches to the lower eyelid, the side of the nose and the moveable part of the septal cartilage (alae nasi and septum mobile nasi), and skin and mucous membrane of one-half of the upper lip. At the tuberosity are two to three posterior dental foramina at a distance of one to two cm. about the alveolar border. The infraorbital foramen is situated about seven mm. below the center of the lower orbital margin.

The inner nerve loop also originates from the maxillary division of the fifth cranial nerve, but thru the medium of the spheno-palatine ganglion, which receives it motor (great superficial petrosal nerve of the seventh cranial n.) and sympathetic (great deep petrosal nerve of the carotid plexus) roots from the Vidian nerve; the great superficial petrosal and great deep petrosal nerves join to form the Vidian. The anterior palatine nerve (of the descending branches of this ganglion) making its appearance upon the palate thru the anterior palatine foramen and the nasopalatine (of the internal branches) coming thru the incisive foramen are the two components of the inner nerve loop. It supplies the hard palate of one side and the soft tissues covering it. The anterior palatine foramen will be found one-half cm. to the palatal side of the alveolar border of the first, second or third molar depending upon the age of the patient. The incisive foramen occupies a position eight mm. behind the alveolar process between the two central incisors in the median line. This opening is very easily reached, because it lies behind and above the incisive papilla.

To anesthetize the nerves at the tu-

berosity, we hold the lip and cheek away with the index finger of the left hand and tell the patient to partly close his mouth; then we take the syringe with the right hand, pierce the mucous membrane at a point corresponding to the middle of the distobuccal root of the second molar and continuously injecting while the needle is in the tissues—proceed in the direction above the apex of the third molar until about two cm. of the needle disappear; stay in contact with the bone and deposit two c. c. of the solution. In children, and in cases where the third molar has not erupted, always use the last molar and the one next to the last as guides.

While the nerve supply of the maxilla, as given above, may be considered normal, it must nevertheless be of great interest to the practitioner to review the different descriptions by the most prominent anatomists and also the more common variations in the distribution of these nerves; thus we should find an explanation of the variation in the extent of the area anesthetized by the same method in different patients or the failure to produce anesthesia.

Piersol, in his anatomy, states "that in absence of the buccal branch of the fifth, the posterior superior dental has been observed to be of large size and to assume the distribution of the buccal.

The middle superior dental nerve occasionally arises from the anterior superior dental.

The anterior superior dental nerve is the largest of the three superior dental nerves." They all help to form the superior dental plexus.

"Two thickenings are sometimes found in the superior dental plexus. One of these, known as the ganglion of Valentin, lies above the tip of the root of the second premolar tooth, at the junction of the middle and posterior superior dental nerves; and the other, sometimes called the ganglion of Bochdalek, is situated more anteriorly, at

the junction of the middle and anterior dental nerves. Neither of these enlargements is a true ganglion, being without nerve-cells and consisting of interlacing bundles of nerve-fibers."

Gray gives the following description: "The posterior superior dental branches enter the posterior dental canals on the zygomatic surface of the maxilla, and passing from behind forward in the substance of the bone, communicate with the middle dental nerve by a plexus formation, and give off branches to the lining membrane of the antrum and three twigs to each molar tooth. These twigs enter the foramina at the apices of the fangs and supply the pulp."

"The middle superior dental branch is given off from the superior maxillary nerve in the back part of the infraorbital canal and runs downward and forward in a special canal in the outer wall of the antrum to supply the two bicuspid teeth. It communicates with the posterior and anterior dental branches by a plexus formation (plexus dentalis superior)."

In Cunningham's text-book of anatomy the superior dental nerves are somewhat differently distributed: "*Rami alveolares superiores posteriores* (posterior superior alveolar nerves, which may be double) descend thru the pterygo-maxillary fissure to the lateral side of the maxilla, and proceed forward along the alveolar artery. They supply the gum and the upper molar teeth by branches which perforate the bone to reach the alveoli. The nerves form a fine plexus joined by the middle alveolar nerve before finally reaching the teeth."

"In the infraorbital canal the infraorbital nerve supplies one and sometimes two branches to the teeth—the middle and anterior superior alveolar nerves (*ramus alveolaris superior medius et rami alveolares superiores anteriores*). The former may be only a secondary branch of the latter nerves,

or they may arise independently from the infraorbital nerve. However formed, the nerves descend in bony canals in the wall of the maxillary sinus (to the lining of which branches are given), and reach the alveolar arch, when they form minute plexuses and supply the teeth (joining posteriorly with the branches of the posterior superior alveolar nerve). The anterior superior alveolar supplies the incisor and canine teeth; the middle superior alveolar nerve the pre-molar teeth.

Spalteholz describes the ramus alveolaris superior medium as being given off in the posterior part of the infraorbital canal, while the corresponding illustration shows it to branch off before the maxillary nerve enters the canal.

According to Zuckerwandl, only the posterior and anterior superior dental nerves are constantly present, the former supplying the molar teeth. The middle branch—if present—innervates the bicuspid teeth.

In studying carefully the different descriptions of the nerve supply of the maxilla, we must necessarily come to the conclusion that the teeth are not innervated by the posterior, middle and anterior superior dental branches directly, but thru the medium of the superior dental plexus. The middle branch—according to Zuckergandl and Cunningham—is mostly present in a certain percentage of cases; it often is a part of the anterior, which is always the largest nerve of the three.

The ganglion of Valentin, situated above the tip of the root of the second premolar tooth, gives evidence of an anastomosis between posterior and middle nerves and accounts for the number of failures to anesthetize the first molar region by a tuberosity injection. With an infraorbital anesthesia we very often reach the first bicuspid, but I never could include the second (ganglion of Bochdalek). In some instances a tuberosity and infraorbital injection will

still leave the region of the bicuspid sensitive, which can only be explained—assuming the injection has been properly given—by a large middle branch given off in the infraorbital canal. Both bicuspid teeth will, under normal conditions, never be anesthetized with a tuberosity injection, unless large quantities of the solution are deposited and driven up and around the maxillary nerve before it enters the infraorbital canal, which would be equal to a blocking of the second division. Even if the posterior and middle branches enter the bone at the tuberosity and we there anesthetize both, the first bicuspid will remain sensitive on account of the anastomosis of the anterior and middle nerves. Local injection (infiltration) must be recommended for operative work on the bicuspid teeth with the exception of infected cases."

Dr. Riethmueller's statement that "it is of little practical value to argue how this anesthesia is obtained," must be contradicted. If an anesthesia is successful, our first thought must be how the same is accomplished, anatomically and physiologically.

The most important fact then, in regard to the superior dental branches is, that the greatest authority, Zuckerwandl, describes only two branches, the larger anterior which includes normally the middle branch, and the smaller posterior nerve. Piersol and Cunningham admit the frequency of the above distribution.

It is comparatively simple to understand from the above, the impossibility of anesthetizing the bicuspid teeth in the average case by means of conductive anesthesia at the tuberosity of the maxilla.

If occasionally we do get an anesthesia of the bicuspid teeth, it must be due to the blocking of the main second branch or to an abnormal distribution of the superior dental branches.

For Dr. Riethmueller's method, I would give the following explanation:

The depositing of  $1\frac{1}{2}$  c. c. at the highest point which the needle reaches at the tuberosity, may and does at times anesthetize the main second division of the fifth cranial nerve in that region. Furthermore, the infiltration of this whole area from the highest point to the lowest, which lies above the first molar, possibly effects the inclusion of the second bicuspid.

The anesthesia of even the first bicuspid, which is claimed to occur at times, proves the above statement, because we all know that even tho the first bicuspid were not supplied by the anterior superior dental branches alone, it could not be anesthetized entirely if the so-called middle and anterior branch give it its nerve supply.

The fact that the infraorbital injection practically always reaches the first bicuspid and in a small number of cases even the second, shows the correctness of Zuckerkandl's anatomical description of this region. Why should it be a rare exception that the bicuspid region remains sensitive after an infraorbital and tuberosity injection as outlined by myself above? Only because it is a rare exception for a middle superior dental branch to be given off in the infraorbital canal. If two distinct branches enter the bone at the tuberosity, they are both posterior branches and not posterior and middle. The partial anesthesia of the first molar after the tuberosity injection, which occasionally occurs, is in my experience not due to faulty method but to an anastomosis of anterior and posterior branches in that region. It may also be mentioned at this time that the results of Dr. Rieth-

mueller's injection are not nearly as successful as the infraorbital or mandibular.

We have also noted that even tho the bicuspid were anesthetized, the palatal side was still sensitive, showing that the spheno-palatine ganglion lying posterior to where the solution is deposited, is not infiltrated; but at the same time not excluding the blocking of the main second division, anterior to the ganglion.

Apart from the above points under discussion, conductive anesthesia is still indispensable and THE method of anesthesia in dental and oral surgery. With the improvement of the dentist as to asepsis, knowledge of anatomy, pathology, etc., with the simplifying of preparation of the solution and the methods of injection, conductive anesthesia is accessible to everybody.

Experience shows that only an extremely small number of patients are exempt from its application. Only the other day, a patient came under my care with the advice from an extraction specialist in our city, not to take anything but gas for surgical treatment. I gave her an infraorbital injection, extracted a cuspid tooth and curetted the apical region thru a buccal incision without any trouble. There is practically no condition under which conductive anesthesia, if carefully employed, will not be successful, but we have to remember that the needle must not pass thru infected tissues. Let us not forget that this method is not the only one and a general anesthetic must be employed whenever indicated, even tho only in a comparatively small number of cases.