RETROPHARYNGEAL AND LATERAL PHARYNGEAL ABSCESSES

AN ANATOMIC AND CLINICAL STUDY

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RETROPHARYNGEAL and lateral pharyngeal abscesses have been recognized and described under various terms (pharyngeal abscess, pharyngomaxillary abscess, postpharyngeal abscess, abscess of the neck, phlegmon of the neck, pterygomaxillary abscess, *etc.*) for a long time. According to Holmes (1907), Galen referred to a case of retropharyngeal abscess. Allin (1851) stated that the earliest mention of abscess behind the pharynx is to be found in the works of Platerus, in 1625. Horner (1818) described a case starting from ulcerations of the tonsil. Abercrombie described three cases, in 1819, and Fleming two cases, in 1850. Among other early reports and discussions were those of Taylor (1846), Henoch, in 1850 (Holmes, 1907), Pretty (1858), Bokai, Sr., in 1876 (Holmes, 1907), Chiene (1877), Elliot (1879), Smith (1879), Savoy (1880), Allen (1881), Cheyne (1881), Agnew (1882), McCoy (1882), Sands, (1882), Tyler (1882), Parker (1883), de Blois (1885), Clutton (1887), Burckhardt (1888), Hawkins-Ambler (1891), Berg (1894), Bokai, Jr., in 1896 (Holmes, 1907), and Koplik (1896).

Morse (1903) discussed the etiology and pathologic anatomy in detail. Similar descriptions were made by Meierhof (1905), Waugh (1906), Sheedy (1912), Badgerow (1912), Alexander and Montague (1913), McKenzie (1915), Fulkerson (1916), Richardson (1920), Waldapfel (1928), and Beck (1932). Travers (1902), Palmer (1933), and Salinger and Pearlman (1937) emphasized secondary hemorrhage from erosion of the large vessels of the neck.

Drainage of the superior and posterior mediastinum by cervical and thoracic approaches was described by Nasiloff (1888), Quenu and Hartmann (1891), Bryant (1895), Rehn (1898), Heidenhain (1899), Von Hacker (1901), Guadiani (1916), Lerche (1921–1924), and Lilienthal (1923). Dean (1919) described a method of external drainage for abscesses secondary to caries of the vertebrae. Mosher (1920 and 1929) discussed the fasciae and fascial compartments of the neck, emphasized the importance of thrombosis of the internal jugular vein and described incisions for drainage. Furstenberg (1929) described the fascial layers and compartments in the neck, and discussed the routes of spread from the nose and throat to the posterior mediastinum. He also discussed cervical (collar) and thoracic (dorsal) mediastinotomy. Kanavel (1922) described two cases treated by external incision. Numerous other articles, mostly case reports, have been found in the literature.

In a previous article (Grodinsky and Holyoke, 1938), a description of the fasciae of the head, neck and adjacent regions has been given based on the

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Figures 1 to 3, inclusive, are diagrammatic drawings based upon data of dissections, sections and injections of adult and fetal material.

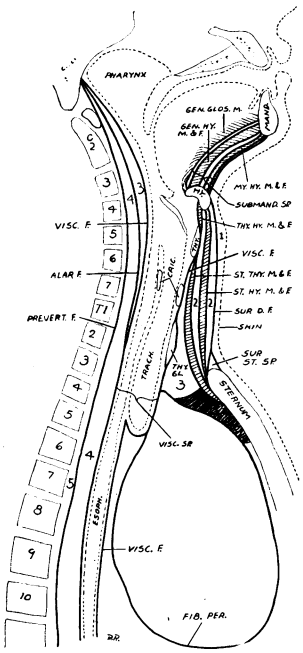

FIG. 1.—Diagrammatic drawing of fasciae of head and neck in midsagittal section.

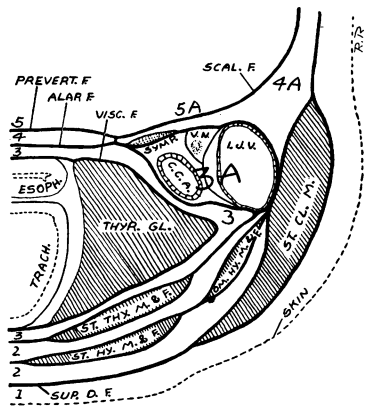

FIG. 2.—Diagrammatic drawing of fasciae of neck. Transverse section approximately at the level of the 6th cervical vertebra.

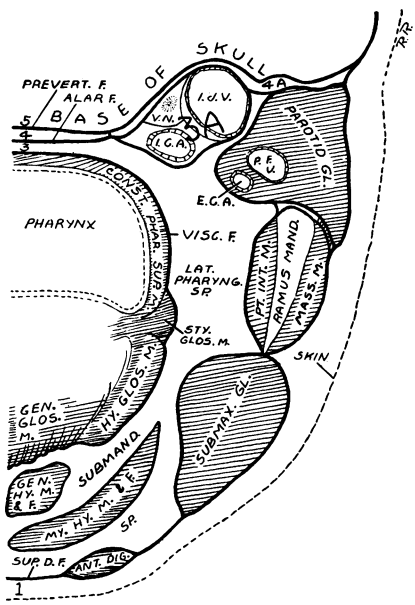

FIG. 3.—Diagrammatic drawing of fasciae of the head and neck. Oblique anteroposterior section showing the relation of the submandibular space to the lateral pharyngeal space and spaces 3 and 4.

KEY TO ABBREVIATIONS ON ILLUSTRATIONS

ALAR F.—Alar fascia. AX. SP.—Axillary space. ARYT.—Arytenoid cartilage. A. AOR.—Ascending aorta. AZ. V.—Azygos vein. BR. PL.—Brachial plexus. CLAV.—Clavicle. COROC.—Coracoid process. CRIC.—Cricoid cartilage. C. C. A.—Common carotid artery. CONST. PHAR. SUP. M.—Superior pharyngeal constrictor muscle. D. AOR.—Descending aorta. D. D. PECT. F.—Deep layer of deep pectoral fascia.

study of 75 adult cadavers and five full term fetuses by dissection, injection and section methods. In a second article (Grodinsky, 1938), this description was reviewed with special reference to its application to the clinical entity known as Ludwig's angina. It is my purpose in this article to review this anatomic description with special reference to retropharyngeal abscess and to discuss the clinical picture and treatment.

ANATOMY.—*Layers of Fasciae: The superficial fascia* is a continuous sheet of fatty tissue extending from the head and neck into the regions of the thorax, shoulders and axillae. In the neck it is a moderately loose layer containing the platysma muscle in its deep portion. In the face the superficial fascia is very adherent to the overlying skin and contains the muscles of expression in its deep portion.

The superficial layer of deep fascia crosses the anterior triangle of the neck, splits to form the sheath of the sternocleidomastoid muscle, crosses the posterior triangle, splits to form the sheath of the trapezius muscle, and finally attaches to the spines of the vertebrae in the midline posteriorly. In the midline anteriorly, it splits to form the suprasternal space of Burns, its anterior and posterior leaflets attaching to the corresponding margins of the sternum. Lateral to the sternum, it is attached inferiorly to the clavicle, acromium, and spine of the scapula. A corresponding layer, the superficial layer of deep pectoral fascia, then continues from the anterior inferior surface of the clavicle

DELT. M.—Deltoid muscle. DIG. ANT. M.—Digastric muscle, anterior belly. DIG. POST. M.—Digastric muscle, posterior belly. E. C. A.—External carotid artery. EPIGL.—Epiglottis. ESOPH.—Esophagus. EUST. TUBE.—Eustachian tube. GEN. GLOS. M.—Genioglossus muscle. GEN. HY. M.—Geniohyoid muscle. GLOT.—Glottis. HY.—Hyoid bone. HY. GLOS. M.—Hyoglossus muscle. I. C. A.—Internal carotid artery. I. J. V.—Internal jugular vein. L. LUNG.—Left lung. LEV. VEL. PAL. M.—Levator veli palatini muscle. LAT. PHARYNG. SP.—Lateral pharyngeal space. MAND.—Mandible. MASTIC. SP.—Masticator space. MAST. PROC.—Mastoid process. MAX. S.—Maxillary sinus. MY. HY. M.—Mylohyoid muscle. OCCIP. BONE.—Occipital bone. OM. HY. M.—Omohyoid muscle. P. A.—Pulmonary artery. PAROT. GL.—Parotid gland. PECT. MAJ. M.—Pectoralis major muscle. P. F. V.—Posterior fascial vein. PREVERT. F.—Prevertebral fascia. PT. INT. M.—Internal pterygoid muscle. PT. EXT. M.—External pterygoid muscle. PHR. N.—Phrenic nerve. PAR. PL.—Parietal pleura. R. LUNG.—Right lung. SCAL. F.—Scalenus fascia. SCAL. ANT. M.—Scalenus anterior muscle. SCAL. MED. M.—Scalenus medius muscle. SCAL. POST. M.—Scalenus posterior muscle. ST.—Sternum. SCAP.—Scapula. SUP. D. F.—Superficial layer of deep fascia. SUP. D. PECT. F.—Superficial layer of deep pectoral fascia. SUBMAND. SP.—Submandibular space. SUP. ST. SP.—Suprasternal space. SUBMAX. GL.—Submaxillary gland. S. V. C.—Superior vena cava. ST. CL. M.—Sternocleidomastoid muscle. ST. HY. M.—Sternohyoid muscle. ST. THY. M.—Sternothyroid muscle. STY. HY. M.—Stylohyoid muscle. STY. GLOS. M.—Styloglossus muscle. STY. PHAR M.—Stylopharyngeus muscle. SUBCLAV. M.—Subclavius muscle. SYM.—Sympathetic trunk. TEMP. M.—Temporalis muscle. THY.—Thyroid cartilage. THY. GL.—Thyroid gland. THYM. GL.—Thymus gland. TRACH.—Trachea. TRANS. F.—Transversalis fascia. TEN. VEL. PAL. M.—Tensor veli palatini muscle. TRAP. M.—Trapezius muscle. THY. HY. M.—Thyrohyoid muscle. VISC. F.—Visceral fascia. VISC. PL.—Visceral pleura. VISC. SP.—Visceral space. V. N.—Vagus nerve. ZYG.—Zygoma.

around the pectoralis major muscle, and at the lateral inferior border of this muscle becomes the deep axillary fascia, which crosses the axilla and splits to form the sheath of the latissimus dorsi muscle. (Figs. 1, 2, 6 and 7)

Superiorly the superficial layer of deep fascia attaches to the hyoid bone, and proceeds across the submental and submaxillary triangles (submandibular space). It fuses with the sheath of the anterior belly of the digastric muscle, although the two layers may be easily separated. It also becomes attached to the sheaths of the stylohyoid muscle and the posterior belly of the digastric muscle, and then splits to form the capsule of the submaxillary salivary gland. This is a completely closed capsule which attaches superiorly by two slips to the superficial and deep margins of the body of the mandible. The anterior belly of the digastric, the mylohyoid, the geniohyoid, the genioglossus, and the hyoglossus have independent sheaths with bony attachments at the attachments of these muscles. (Figs. 1, 3, 5 and 9)

Figures 4 to 9, inclusive, are line drawings made on bleached photographs of serial sections of human material.

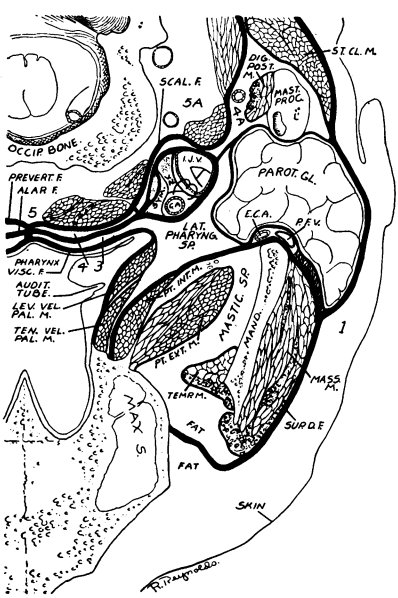

FIG. 4.—Transverse section of adult cadaver at level of hard palate. Superior view.

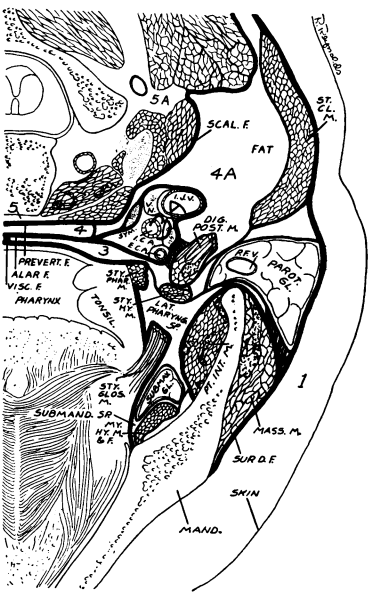

FIG. 5.—Transverse section of adult cadaver through the tongue and the palatine tonsil. Superior view.

Between the angle of the jaw and the anterior border of the sternocleidomastoid muscle, the superficial layer of deep fascia splits to form the capsule of the parotid gland, which in our experience is complete on all sides. From the body of the mandible, the superficial layer of deep fascia extends superiorly to form the sheath of the masseter muscle and attaches to the zygoma above. It then continues superiorly over the temporal muscle as the outer layer of deep temporal fascia. At the anterior and posterior borders of the masseter, it passes around the corresponding borders of the ramus of the mandible and

becomes continuous with the sheaths of the pterygoid muscles, thus completing the walls of the masticater space (see below). (Figs. 3, 4, 5 and 9)

The middle layer of deep fascia consists of three subdivisions: The *sternohyoid-omohyoid layer,* the *sternothyroid-thyrohyoid layer* and the *visceral layer.* The former is continuous across the midline anteriorly, forms the sheaths of the sternohyoid and omohyoid muscles, and attaches to the deep surface of the sternocleidomastoid sheath, where it forms a pulley between the anterior and posterior bellies of the omohyoid muscle. Superiorly it is attached to the hyoid bone and, more laterally, to the overlying superficial layer of deep fascia and underlying sternothyroid-thyrohyoid layer along the superolateral border of the anterior belly of the omohyoid muscle. Likewise, in the posterior triangle, it is attached along the superolateral border of the posterior belly of the omohyoid muscle to the superficial layer of deep fascia. Inferiorly this layer is attached to the sternum, clavicle, and scapula. A corresponding layer, the deep layer of deep pectoral fascia, starts at the clavicle, splits to form the sheath of the subclavius muscle, becomes the costocoracoid membrane, splits to form the sheath of the pectoralis minor muscle, and becomes the suspensory ligament of the axilla which runs into the axillary fascia. (Figs. 1, 2, 6 and 7)

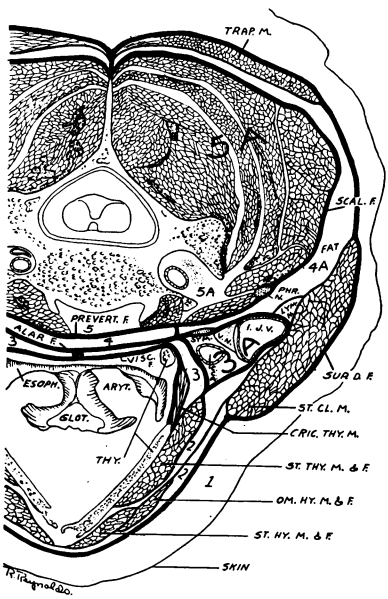

FIG. 6.—Transverse section of adult cadaver at the level of the thyroid cartilage. Superior view.

The sternothyroid-thyrohyoid layer crosses the midline anteriorly, splits to form the sheaths of the muscles indicated in the name, and runs laterally into the deep surface of the sternocleidomastoid sheath, fusing here with the carotid sheath. Inferiorly it attaches to the sternum and clavicle. Superiorly it attaches to the thyroid cartilage and hyoid bone; more laterally to the superficial layer of deep fascia and the sternohyoid-omothyoid layer superficially, and the carotid sheath deeply. (Figs. 1, 2, 6 and 7)

The visceral fascia completely surrounds the thyroid gland, trachea and esophagus. Superiorly it extends to the base of the skull on the posterior side, and to the thyroid cartilage and hyoid bone on the anterior and lateral sides. Inferiorly, at the root of the neck, it fuses with the alar fascia of the anterior wall of the carotid sheath, and becomes continuous with the fibrous pericardium covering the heart and great vessels of the thorax. It also continues inferiorly as the covering of the thoracic portion of the trachea and esophagus. (Figs. 1 to 8)

Deep Layer of Deep Fascia.—There are two main subdivisions: The *alar*

and *prevertebral* fasciae, including the continuations of the latter, *e.g.*, scalenus, transversalis, and Sibson's fasciae.

The alar fascia extends across the midline posterior to the pharynx, esophagus and visceral fascia, and fuses with the prevertebral fascia at the tips of the transverse processes, to which both these layers are attached. It then passes anterolaterally to form the medial wall of the carotid sheath, fusing with the sternothyroid layer and the deep surface of the sternocleidomastoid sheath. It also forms the posterior and lateral walls of the carotid sheath, again fusing with the deep surface of the sternocleidomastoid sheath and thus forming a complete sheath of alar fascia, the carotid sheath. Posteriorly, between the transverse processes, the alar fascia extends from the base of the skull to about the level of the seventh cervical vertebra, where it becomes intimately fused with the visceral fascia. (Figs. 1 to 8)

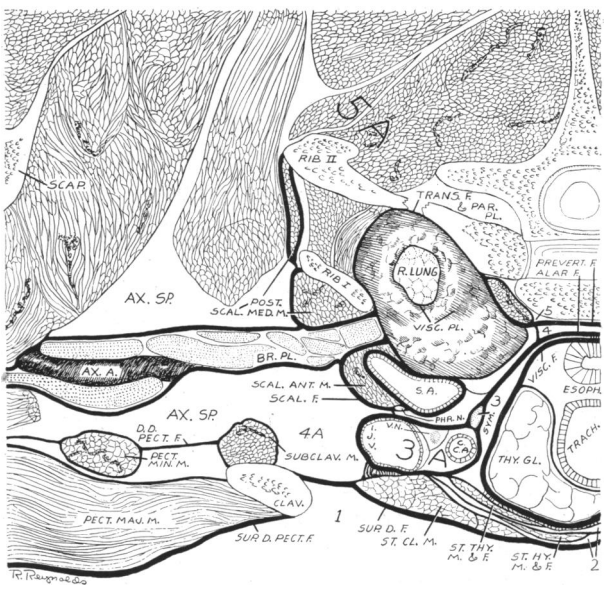

FIG. 7.—Transverse section of adult cadaver through the root of the neck. Superior view.

The prevertebral layer lies just anterior to the bodies of the vertebrae from the base of the skull to the coccyx. In the neck, it extends laterally to the tips of the transverse processes where it is fused both to these processes and to the alar fascia. Lateral to the transverse processes, it becomes the scalenus fascia which forms the sheaths of the scaleni, splenius capitus, levator scapulae and the other deep muscles of the back of the neck, and finally attaches to the spines of the vertebrae. Inferolaterally the scalenus fascia, after giving origin to the axillary sheath enclosing the axillary vessels and brachial plexus, attaches to the first and second ribs. In the thoracic and abdominal regions, the lateral extension of the prevertebral fascia becomes the extrapleuroperitoneal or transversalis fascia. Over the dome of the pleura, it is identical with the layer often described as Sibson's fascia. (Figs. 1 to 8)

Fascial Spaces: Superficial Space 1.—This is the potential space between the skin and deep fascia, that is, within the superficial fascia. It is the seat of superficial cellulitis and is continuous from region to region; in this case from head to neck and trunk. In the neck it may be subdivided into superficial and deep portions by the platysma muscle, both divisions being fairly loose and allowing rather large accumulations of fluids. (Figs. 1 to 7, and 9)

The deep fascial spaces may be considered under two headings: Those of the *infrahyoid* region and those of the *suprahyoid* region. For convenience we have roughly divided the infrahyoid spaces into those of the anterior and posterior triangles, the former being designated by numerals and the latter by corresponding numerals followed by the letter "A."

Infrahyoid Spaces: Space 2.—This is the potential space between the superficial layer of deep fascia and the deep layer of the sternothyroid-thyrohyoid sheath. It contains, therefore, the sternohyoid-omohyoid muscles with their sheaths, and the sternothyroid-thyrohyoid muscles with the anterior layer of their sheaths. The extent of the space was demonstrated by injections of gelatin colored with India ink, as well as by study of dissections and sections. It is continuous across the midline and is blind laterally where the sternohyoid and sternothyroid layers fuse to the deep surface of the sternocleidomastoid sheath. It is also blind superiorly at the hyoid bone, superolaterally along the superolateral border of the anterior belly of the omohyoid, and inferiorly at the sternum and clavicle. The most frequent extensions of injected masses from this space were along the pulley of the omohyoid to Space 2A, superficially into Space 1, and deeply into Space 3. (Figs. 1, 2, 6, 7 and 9)

Space 2A.—This space, between the superficial layer of deep fascia and the sheath of the posterior belly of the omohyoid muscle, is blind anteriorly at the pulley, posteriorly at the insertion of the omohyoid (posterior belly), posterosuperiorly along the posterosuperior border of that muscle, and inferiorly at the clavicle. The most common extensions from this space were along the pulley into Space 2, and into Spaces 1 and 4A. (Fig. 7)

Space 3.—This is the potential space between the visceral fascia on the one hand, and the sternothyroid layer, carotid sheath and alar fascia on the other. It thus has anterior, lateral, and posterior portions, all continuous. On the posterior side, it extends from the base of the skull to the level of the seventh cervical vertebra, where it is shut off by the close fusion of the visceral and alar layers. On the anterior side, it extends from the thyroid cartilage to the upper border of the arch of the aorta (fourth thoracic vertebra), where it is shut off by dense adhesions between the fibrous pericardium and the sternum. Laterally this space is blind at the root of the neck, where there are dense adhesions between the alar and visceral fasciae around the inferior thyroid arteries. Injected masses tended to remain localized within this space (3) but, when spread did occur, it was usually into Spaces 2 and 4, and inferiorly into the superior mediastinum slightly lower than the normal limits of the space. This is of special importance in retropharyngeal abscess. Retropharyngeal abscess may thus be confined within the visceral space (between the pharyngeal wall and the visceral fascia) or within Space 3 (between the

visceral and alar fasciae), the extension from the nose and throat occurring by lymphatics or direct continuity. Space 3, as we shall see, is directly continuous with the lateral pharyngeal or pharyngomaxillary space. However, retropharyngeal abscess may also involve Space 4 (see below) either by direct lymphatic extension from the nose and throat or by extension through the alar fascia from Space 3. (Figs. 1 to 7)

Space 3A.—This is the potential space within the carotid sheath. Primary injections into this space were usually limited closely to the region of injection, but in some cases extended as high as the hyoid bone and as low as the root of the neck, beyond which levels the close adherence of the sheath to the

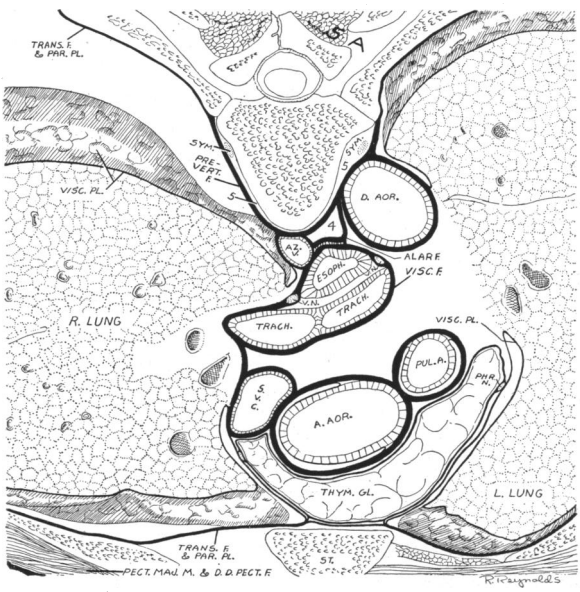

FIG. 8.—Transverse section of adult cadaver through the superior mediastinum. Superior view.

contained structures made further spread impossible. The space therefore bears little relation to infections of the head and neck except those associated with thrombosis within the internal jugular vein and with the lymph nodes lying within the sheath. According to Mosher (1920 and 1929), thrombosis of the internal jugular vein occurs either by primary extension of infected emboli from the veins of the nose and throat where retropharyngeal abscess begins; or secondary to adenitis and paradenitis of the retropharyngeal, lateral pharyngeal (deep parotid) or pendent groups of lymph nodes which drain the nose and throat. Waldapfel (1928) demonstrated the presence of thrombi in the tonsillar veins, but stated that nevertheless thrombosis plays but a minor rôle and that the primary aim should be drainage of the infected focus, *e.g.*, the lateral pharyngeal space which the pus reaches by lymphatics or direct extension from the nose and throat. According to him, ligation of the internal jugular vein is of secondary importance. It may be done if easily accessible, but is not absolutely necessary. (Figs. 2 to 7)

Space 4.—This space, often referred to as the "danger space," is the loose areolar space between the alar and prevertebral fasciae. It is limited laterally where these layers fuse at the tips of the transverse processes. It extends superiorly to the base of the skull and inferiorly into the posterior mediastinum. It is because of the latter relationship that it is often called the "danger space." There was very little tendency for injected masses to spread beyond this space, the most common being into Space 4A. However, extension did occur from other spaces into this space, especially from Space 3. It is in this way that Ludwig's infection and retropharyngeal abscesses find their way into the posterior mediastinum. As stated above, retropharyngeal abscess may start in Space 4 (by lymphatic extension from the nose and throat) or may secondarily extend into Space 4 from Space 3. (Figs. 1 to 8)

Space 4A.—This is the potential space between the superficial layer of deep fascia and the scalenus fascia. In the subclavian triangle, it lies between the sheath of the posterior belly of the omohyoid muscle and the scalenus fascia. This space is continuous with the axilla, but a rather dense fatty pad between the clavicle and first rib makes this communication less free. (Figs. 2 to 7)

Space 5.—This is the potential space between the prevertebral fascia and the bodies of the vertebrae. It extends from the base of the skull to the coccyx and is limited laterally by the attachment of the prevertebral fascia to the transverse processes. There was very little tendency for injected masses to rupture through the walls of Space 5 into Spaces 4, 4A, and 5A. However, this did occur at times. Space 5 is the space involved in tuberculosis of the bodies of the vertebrae, resulting in cold abscesses. These usually extend inferiorly posterior to the prevertebral fascia along muscles taking origin from the vertebral bodies (psoas abscess). Sometimes they remain localized in the cervical region. They either stay posterior to the prevertebral fascia (in Space 5) or rupture through that layer and enter Space 4. However, the typical retropharyngeal abscess originates in the nose and throat and the typical cold abscess gravitates to a lower plane within Space 5. (Figs. 1 to 8)

Space 5A.—This space, posterior to the scalenus fascia, lies between the deep muscles of the back of the neck. Infections within it extend superiorly and inferiorly along these muscles, thus sometimes traveling great distances. (Figs. 2 and 4 to 8)

Suprahyoid Spaces: The Masticator, Temporal and Parotid Spaces.—The *masticator* space is bounded by the superficial layer of deep fascia which, after forming the sheath of the masseter muscle, passes around the anterior and posterior borders of the ramus of the mandible and becomes continuous with the sheaths of the pterygoid muscles. The space thus contains the masseter muscle, the external and internal pterygoid muscles, and the ramus of the mandible. It is closed on all sides except superiorly, where it is in relation with the *temporal* space, deep to the deep temporal fascia. Injections into either space spread to the other, and under increased pressure, ruptured either superficially through the masseter sheath, or deeply into the parotid

space or lateral pharyngeal and submandibular spaces. The *parotid* space was found to be a completely closed space formed by a split of the superficial layer of deep fascia and occupied by the parotid gland, external carotid artery, and posterior facial vein. Injections made into this space showed infiltration into the substance of the gland and ruptures through the capsule: superficially with subcutaneous collections and deeply with extensions into the masticator, lateral pharyngeal, and submandibular spaces. (Figs. 3, 4, 5 and 9)

The Lateral Pharyngeal Space.—This important fascial space of the head is bounded by the pharynx, medially; the styloid muscles and carotid sheath, posteriorly; the parotid gland, posterolaterally; the mandible, pterygoids and masseter, anterolaterally; and the pterygomandibular raphe, anteriorly. Superiorly it extends to the base of the skull and inferiorly it is shut off from the neck by the attachment of the submaxillary capsule to the sheaths of the stylohyoid and the posterior belly of the digastric muscles. Inferomedially it communicates freely with the submandibular space deep to the submaxillary capsule. Posteromedially it communicates with Space 3. Injections made through the palatine tonsil and lateral pharyngeal wall went directly into the lateral pharyngeal space. From here, the injected masses spread easily into Space 3 and, in some cases, ruptured through the alar fascia into "danger space" 4. Extensions into the submandibular space took place freely. The lateral pharyngeal space is therefore infected from tonsillar abscesses, from retropharyngeal abscesses involving Space 3, and secondarily from the floor of the mouth through the submandibular space. Likewise, infections in this space may spread to the submandibular space and, in the later stages, resemble true Ludwig's angina. (Figs. 3, 4, 5 and 9)

The "Submandibular Space."—We have coined the term "submandibular space" to include the regions of the submental and submaxillary triangles lying between the mucous membrane of the floor of the mouth and the superficial layer of deep fascia over these regions. It thus encloses the sublingual and submaxillary salivary glands (the latter in a complete capsule), the genioglossus, geniohyoid, mylohyoid and digastric (anterior belly) muscles. The floor or deep wall of this space is made up of the hyoglossus muscle and superior pharyngeal constrictor, the latter covered by visceral fascia. Thus a group of potential spaces, all communicating, is established between the submental muscles, crossing the midline and extending deep to the capsule of the submaxillary salivary gland, superolaterally, to become continuous with the lateral pharyngeal space. This group of spaces, collectively making up the submandibular space, is limited inferiorly at the hyoid bone where the submental muscles and their sheaths attach; and inferolaterally at the inferior borders of the stylohyoid and posterior belly of the digastric muscles, the sheaths which are attached to the superficial layer of deep fascia superficially and the carotid sheath deeply. (Figs. 3, 5 and 9)

Injections, made through the mucous membrane of the floor of the mouth, anywhere from the midline anteriorly to the anterior tonsillar pillar posteriorly,

passed into the submandibular space. The more anterior injections first passed between the submental muscles and then spread laterally toward the lateral pharyngeal space deep to the submaxillary salivary gland. The more posterior injections passed into the lateral pharyngeal space more quickly. From the lateral pharyngeal space, the injections often passed into Space 3, from where they sometimes spread to the superior mediastinum, or broke through the alar fascia and extended down Space 4 to the posterior mediastinum. This is the pathway taken by infection from the floor of the mouth in Ludwig's angina and is practically a reversal in direction of that taken by retropharyngeal abscess. The latter, therefore, by extension to the submandibular space, may resemble Ludwig's angina in the later stages, although the origin and early spread of the two conditions are entirely different. (Figs. 3, 5 and 9)

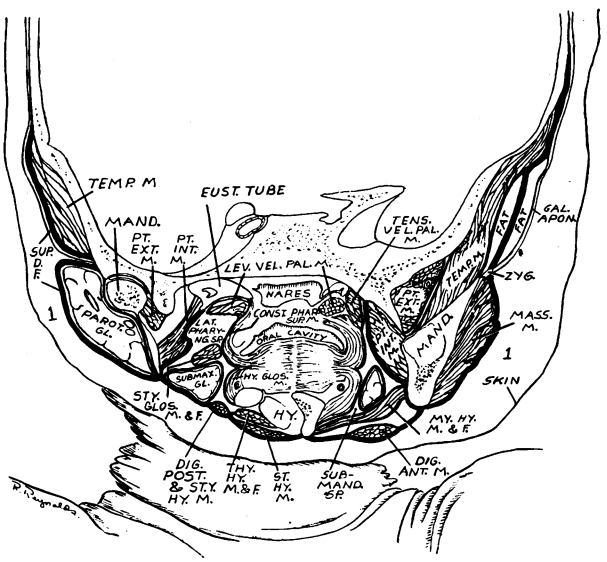

FIG. 9.—Frontal section of full term fetus through base of tongue and posterior nares. Anterior view.

ETIOLOGY AND PATHWAYS OF SPREAD.—Retropharyngeal abscess may be acute or chronic. The latter is usually due to tuberculous caries of the cervical vertebrae, is apt to be confined posterior to the prevertebral fascia in Space 5, and usually gravitates to lower levels along muscles taking origin from the vertebral bodies (psoas abscess). It is most common in adults. (Fig. 1)

The acute variety, on the other hand, is most common in children, especially under the age of three years. The portal of entry is practically always the nose, throat or middle ear. The infection passes through the pharyngeal wall by continuity or more commonly by lymphatics to the retropharyngeal and lateral pharyngeal nodes. Perhaps the greater number of retropharyngeal lymph nodes present under the age of three or four years accounts for the greater incidence in that age period (Morse, 1903; Meierhof, 1905; Alexander

and Montague, 1913). The possibility of spread through the veins from the pharynx to the internal jugular veins with thrombosis and secondary extension to the retro- and lateral pharyngeal spaces must also be kept in mind.

Infection, extending through the lateral pharyngeal wall opposite the palatine tonsil either by direct continuity or by lymphatics, leads to direct infection of the lateral pharyngeal space. On the other hand, infection from the posterior pharyngeal wall, nose (including the accessory sinuses) or middle ear may reach the retropharyngeal space by continuity or lymphatic extension. As shown above, this infection may be in the visceral space, Space 3 or Space 4. As Space 3 and the lateral pharyngeal space are continuous, there may be extension from one to the other. On the other hand, extension may occur from Space 3 to the superior mediastinum or through the alar fascia to Space 4 and thus to the posterior mediastinum. It is because of the possibility of such extension that retropharyngeal and lateral pharyngeal abscesses are so serious. (Figs. 1 to 9)

The causative organisms are usually the common pyogens. Koplik (1896) found the Streptococcus in all his cases. The Staphylococcus and pneumococcus have also been reported as causative agents. Bokay (Morse, 1903) reported a case due to the tubercle bacillus. These organisms get into the retro- and lateral pharyngeal spaces by continuity, lymphatics or veins —either through inflammation of or trauma to (foreign bodies, operative trauma) the mucous membrane of the throat, pharynx, nose, accessory sinuses or middle ear.

Clinical Picture: *Acute Retropharyngeal Abscess.*—The patient, as stated before, is usually a child (especially under three years), although adults are not immune (Allen, 1881; Goodale, 1901). The onset is usually sudden. Following a nasopharyngitis, the patient develops chills and fever (103° to 105° F.). There is usually stiffness of the neck muscles and the head may be in opisthotonos. The throat is sore, the pain being aggravated by swallowing, which is difficult. The voice assumes a nasal twang and thirst is marked. Dyspnea and cyanosis occur as the swelling increases. In young children, convulsions may ensue.

On examination of the throat, a definite bulging of the posterior pharyngeal wall is noted. This is usually a little to one side of the midline due to the fact that the retropharyngeal lymph nodes, which are usually involved, are distributed in two chains, one on either side of the midline (Morse, 1903; Meierhof, 1905; Waugh, 1906). Since such swellings are common without suppuration in ordinary lymphatic drainage from the nose, sinuses and nasopharynx, it is necessary to palpate the mass with the fingers to determine the presence of fluctuation and, in doubtful cases, even to needle the mass to prove the presence of pus. Extension of the process to the superior or posterior mediastinum is indicated by chest pain, dyspnea, persistence or recurrence of fever and roentgenographic evidence of mediastinitis.

Lateral Pharyngeal Abscess.—This may be secondary to a retropharyngeal abscess, or abscess in the parotid, masticator, or submandibular (Ludwig's

angina) spaces; or it may be primary due to extension by continuity, lymphatics or veins from the tonsil, lateral wall of the pharynx, nose or middle ear. It may, therefore, be preceded or accompanied by symptoms of retropharyngeal abscess, parotitis or Ludwig's angina. On the other hand, the first localization may be in the lateral pharyngeal space, in which case there is sudden onset of severe pain and tenderness just below the angle of the jaw and over the greater cornu of the hyoid bone. There is considerable pain on swallowing and salivation is apt to be excessive. An external swelling below the angle of the jaw is usually apparent by the second or third day and, internally, there is a bulging of the lateral pharyngeal wall, especially posterior and inferior to the palatine tonsil. Chills and fever are usually present. However, chills do not necessarily mean thrombosis of veins unless they persist after adequate drainage of the space involved. The voice and respirations are not affected unless the swelling becomes very large or is associated with retropharyngeal abscess. It is obvious that in the later stages, retropharyngeal abscess, lateral pharyngeal abscess and Ludwig's angina may closely resemble each other, although the origin of each is quite different. (Figs. 3, 4, 5 and 9)

Chronic Retropharyngeal Abscess.—As stated above, this is usually due to tuberculous caries of the cervical vertebrae and is, therefore, accompanied by other signs of that disease such as spinal deformity, spasm of the muscles of the back of the neck and associated cold abscesses gravitating to lower levels (psoas abscess). Roentgenographic evidence of caries of the cervical vertebrae confirms the diagnosis. Since the vertebral bodies are in the midline, this abscess is apt to cause forward bulging of the posterior wall of the pharynx in the midline, in contrast to the condition in acute retropharyngeal abscess. (Figs. 1 to 9)

TREATMENT.—Early and adequate drainage is essential. There is some difference of opinion as to whether drainage should be internally through the posterior pharyngeal wall or externally through the neck. There are many reports of successful drainages through the mouth (Allin, 1851; Smith, 1879; Allen, 1881; Agnew, 1882; McCoy, 1882; Sands, 1882; de Blois, 1885; Tiely, 1891 and 1892; Moore, 1893; Berg, 1894; Wharton, 1894; Koplik, 1896; Evans, 1897; Goodale, 1901; Travers, 1902; Morse, 1903; Meierhof, 1905; Holmes, 1907; Sheedy, 1912; Alexander and Montague, 1913; McKenzie, 1915). The objections to this method are the danger of aspiration of pus into the lungs causing suffocation or secondary abscess, the possibility of secondary infection from the throat, and the tendency of internal incisions to close, making reoperation sometimes necessary. On the other hand, the simplicity of the procedure in comparison with the external approach favors its use. Furthermore, by quickly inverting the child after the incision, the danger of aspiration can be largely avoided. (Figs. 1, 3 and 5)

External drainage was first performed by Chiene (1877), who made an incision along the posterior border of the sternocleidomastoid muscle and reached the abscess by dissecting behind the carotid sheath. Similar operations were performed by Cheyne (1881), and Hawkins and Ambler (1889). On

the other hand, Burckhardt (1888) described and employed an approach anterior to the sternocleidomastoid muscle similar to the incisions described later by Dean (1919), Kanavel (1922) and Furstenberg (1929). Mosher (1929) advised external drainage through a "T" incision below the angle of the jaw in front of the sternocleidomastoid muscle, the submaxillary salivary gland being displaced and the dissection being carried along the carotid artery until the focus is reached. This incision is especially applicable to primary and secondary involvement of the lateral pharyngeal or pharyngomaxillary space. Dean's incision is made between the hyoid bone and the cricoid cartilage along the anterior border of the sternocleidomastoid muscle, and the dissection passes between the carotid sheath and the thyroid gland. This opens Space 3 and drains any collections in this space. By plunging through the alar fascia with the finger, Space 4 is entered, and collections deeper in the retropharyngeal space and posterior mediastinum are drained. By going still deeper, through the prevertebral fasciae, Space 5 collections (due to caries of the vertebrae) may be also drained through this approach. Furstenberg's incision for cervical mediastinotomy is similarly placed but extends inferiorly to the suprasternal notch. (Figs. 2, 6 and 7)

It seems logical to drain small localized acute retropharyngeal abscesses without external swelling through the mouth, with proper precautions to prevent aspiration into the lungs. On the other hand, lateral pharyngeal collections, whether primary or secondary, with tumefaction externally at the angle of the jaw, are best drained by Mosher's or similar external approach. This will probably also take care of any associated retropharygeal abscess. Cold abscesses should certainly be drained externally by the method of Dean in order to prevent secondary infection from the throat. Such incisions may even be closed tight after evacuating the pus (Kanavel, 1929).

Mediastinotomy is indicated at the first sign of spread beyond the retro- or lateral pharyngeal spaces toward the superior or posterior mediastinum. There are in general two methods of approach: The collar (cervical) mediastinotomy of Lürmann (1876), Obalinski (1896), Cavazzani (1898), Ziembiecki (1898), Heidenhain (1899), Rasumowski (1900), von Hacker (1901), Guadiani (1916), Lerche (1921 and 1924), and Furstenberg (1929); and the dorsal (thoracic) mediastinotomy, first described by Nasiloff (1888). The collar drainage has already been described according to the technic of Dean and Furstenberg. This method is especially applicable to collections in the superior mediastinum (Space 3) and in the posterior mediastinum (Space 4) above the fourth thoracic vertebra (Figs. 2, 6 and 7). Dorsal mediastinotomy is especially indicated in collections in the posterior mediastinum below the fourth thoracic vertebra and as a secondary operation after collar mediastinotomy (Fig. 8). Various technics of dorsal mediastinotomy have been described by Quenu and Hartmann (1891), Bryant (1895), Heidenhain (1899), Enderlen (1901), and Lilienthal (1923). These vary chiefly in the location of the incision in relation to the vertebral spines. The reader is referred to these authors for details and procedure.

CASE REPORTS

Case 1.—University Hospital No. 42968: D. F., male, age 15 months, entered the University Hospital complaining of sore throat and difficulty in swallowing. Two weeks previously, he had contracted an acute respiratory infection and the cervical lymph nodes became enlarged. External cold packs were applied and seemed to localize the infection on the inside, behind the pharyngeal wall. Examination showed an infant of stated age with temperature of 101° F., pulse 150, respirations 32; apparently in considerable discomfort. The throat showed a bulging of the posterior pharyngeal wall a little to the right of the midline. Definite fluctuation could be appreciated upon digital examination. *Diagnosis:* Retropharyngeal abscess resulting from adenitis and paradenitis of the retropharyngeal lymph nodes, which in turn were infected from the nose and nasopharynx.

Treatment.—The abscess was incised through the posterior pharyngeal wall and the wound spread with a hemostat, according to the method of Hilton, on the day of entrance. Considerable thick, yellow pus was obtained which was permitted to drain out, with the child's head lowered to prevent aspiration. Uneventful convalescence. Patient was dismissed five days after entrance to the hospital.

COMMENT.—This is a case of typical retropharyngeal abscess secondary to adenitis and paradenitis of the retropharyngeal lymph nodes, following lymphatic extension from the nasopharynx. The retropharyngeal abscess probably occupied Space 3, and was also localized by an inflammatory wall. There was, therefore, very little tendency to extend laterally and inferiorly, and this probably explains the good results from simple internal drainage.

Case 2.—University Hospital No. 23976: N. F., female, age seven months, was brought to the University Hospital because of difficulty in breathing. She had been well until about seven weeks previous to entrance, when she contracted a sore throat and later a discharging ear. The posterior cervical nodes became enlarged, and were later incised. During the week previous to entrance, the parents noticed difficulty in her breathing, which had become worse during the last 24 hours. The patient had lost six pounds during this period. Examination showed a very pale, emaciated child with a temperature of 101° F. She was breathing with marked difficulty. The cervical nodes were enlarged, a soft, fluctuating group being present on the right. The posterior pharyngeal wall, a little to the right of the midline, was bulging, and fluctuated. *Diagnosis:* Retropharyngeal abscess. Suppurating cervical lymph nodes.

Treatment.—An internal incision through the posterior pharyngeal wall was made without anesthesia. Several ounces of thick pus were evacuated and the patient's head was lowered to prevent aspiration. The fluctuating cervical nodes were incised and drained. The child improved gradually and was dismissed from the hospital three weeks after operation.

COMMENT.—This presents another case of retropharyngeal abscess in an infant involving chiefly Space 3, and localizing in the posterior pharyngeal region. There was also primary and secondary lymphatic drainage from the nasopharynx to the pendent group of lymph nodes which suppurated and required separate incision.

Case 3.—University Hospital No. 51689: W. H., male, age two months, was brought to the University Hospital because of difficulty in breathing, of about six hours duration. The baby had been poorly nourished since birth, but had had no serious illness until one week before entrance, when a rounded swelling the size of a cherry was first noticed on the left side, a little below and posterior to the angle of the jaw. The swelling had increased considerably. About six hours before entrance, the baby had developed difficulty in

breathing, which had become progressively worse. Examination showed a poorly nourished child apparently in severe distress. Temperature, 100° F. There was a marked nasal and postnasal discharge. The cervical nodes were enlarged, with a large, hard swelling below the angle of the jaw on the left. The posterior pharyngeal wall was bulging, especially a little to the left of the midline. This swelling fluctuated. Both ear drums were dull, thick and red. *Diagnosis:* Postnasal discharge. Bilateral otitis media. Cervical adenitis. Retropharyngeal abscess.

Treatment.—The retropharyngeal abscess was incised through the mouth, with evacuation of thick pus. The head was lowered to prevent aspiration. A double paracentesis was performed; a bilateral mastoidectomy was, however, necessary a week later.

Postoperative Course.—The baby apparently recovered from the retropharyngeal abscess and mastoid operations, but died two weeks after entrance from malnutrition.

COMMENT.—The retropharyngeal abscess in this case may have been due to lymphatic drainage from either the nasopharynx or middle ear. Drainage of the retropharyngeal abscess and ears was apparently early and adequate, but the child succumbed because of malnutrition.

Case 4.—University Hospital No. 42267: D. B., male, age 33, entered the University Hospital complaining of sore throat and difficulty in swallowing. About two weeks previously he had developed the "flu" and sore throat. About five days before admission, his throat had become very sore and he was not able to swallow or talk. He was unable to sleep because of pain on involuntary swallowing, and was unable to take fluids or food. Examination showed a very emaciated young man, unable to swallow or talk above a whisper. Temperature was 100° F., pulse 60, respirations 18. Local examination revealed a large, red swelling of the posterior pharyngeal wall, pushing the tonsils forward and pressing against the uvula. *Diagnosis:* Retropharyngeal abscess.

Progress.—The abscess ruptured spontaneously and the patient made an uneventful recovery without surgery.

COMMENT.—This is a case of retropharyngeal abscess in the adult. Although it is possible that the infection passed directly through the posterior pharyngeal wall, it is more likely that the extension was by the lymphatics which, though less abundant than in early childhood, are still present in the adult. The abscess was no doubt localized in Space 3, thus making the spontaneous rupture possible.

Case 5.—University Hospital No. 57412: M. G., female, age 63, entered the University Hospital complaining of pain and fulness in the neck at the level of the cricoid cartilage. The night before, while eating supper, she had a sudden severe pain in her throat which later moved to the epigastrium and was referred to the back. Laryngoscopic examination was negative and esophagoscopy revealed only a red, edematous mucosa. Roentgenologic examination of the esophagus was negative and study of the chest revealed accentuation of the vascular markings with an area of calcification lateral to the right hilum. Soon after entrance, she experienced considerable difficulty in swallowing. Two days later she became suddenly cyanotic and expired. Autopsy revealed a retropharyngeal abscess and posterior mediastinitis.

COMMENT.—This case is a good example of retropharyngeal abscess involving Space 4, due to trauma of the pharyngeal wall rather than to lymphatic spread from the ear, nose or throat. There was very little tendency to localize in the head and cervical region (by inflammatory reaction) but, instead, the abscess gravitated to the posterior mediastinum which is directly

continuous with Space 4. The mediastinitis was not recognized antemortem. Possibly if it had been, and drainage had been instituted, the fatal outcome might have been averted.

Case 6.—University Hospital No. 41614: C. A., male, age seven, was admitted to the University Hospital with a history of having swallowed a tack one week previously. The tack was recovered in his stool six days later. His throat became very sore; he was unable to swallow, and his voice became nasal in type. Examination showed a thin, poorly nourished boy having some difficulty in breathing, swallowing and talking. The throat was red. The posterior cervical lymph nodes were palpable and the anterior neck was swollen from the mastoid to the submaxillary regions. Roentgenologic examination showed encysted fluid or pus behind the posterior pharyngeal wall at the level of the glottis. Examination of the throat showed a bulging of the posterior pharyngeal wall which compressed the epiglottis, and interfered with respiration and deglutition. *Diagnosis:* Retropharyngeal abscess following trauma.

Treatment.—On the eve of entrance, the child suddenly became cyanotic and more dyspneic, making a tracheotomy necessary. A little gas escaped from the sides of the larynx and trachea. Following this, the posterior pharyngeal wall was incised through the mouth and about two ounces of thick, yellow pus escaped. Patient made an uneventful convalescence and was discharged six days after entrance.

COMMENT.—This is another example of retropharyngeal abscess due to trauma of the posterior pharyngeal wall. In this case, however, the tack apparently penetrated only the pharyngeal wall and visceral fascia, thus infecting Space 3. There was some inferior and lateral extension in Space 3, but most of the infection remained localized in the oral region and was successfully drained through the mouth after a preliminary tracheotomy which included drainage of Space 3 on either side of the trachea and esophagus.

Case 7.—University Hospital No. 18600: C. S., male, age 28, entered the University Hospital complaining of pain in his throat, difficulty in swallowing, and pain in the neck. While eating dinner three days previously, he had experienced a sudden pain in his throat as though the bolus were lodged there. Since then there had been severe pain, especially on trying to swallow, and he had been unable to take anything except liquids. Twenty-four hours before entrance to the hospital, his neck had become swollen and tender. Examination showed the neck tense, red, and tender from the thyroid cartilage to the sternum. The throat was red. Roentgenologic examination showed a shadow of a foreign body anterior to the sixth cervical vertebra, possibly at the entrance of the esophagus. A directoscope was passed and a large bone was removed from the esophageal wall. The temperature on entrance was 102.4° F., pulse 104. *Diagnosis:* Foreign body. Retropharyngeal abscess extending through the neck to the superior mediastinum.

Subsequent Course and Treatment.—Patient carried a septic temperature (101 to 104.2° F.), rapid pulse (120 to 140), and rapid respirations (32 to 45). He had considerable difficulty in breathing. On the third day the neck was incised anterior to the left sternocleidomastoid muscle and considerable pus evacuated from around the thyroid gland and esophagus (Space 3). At this time the blood culture was positive for Staphylococcus and Streptococcus. The patient continued to run a septic temperature and in spite of supportive measures died rather suddenly.

Autopsy revealed a retropharyngeal abscess (traumatic), fascial space abscess of the neck (Space 3) and superior mediastinitis.

COMMENT.—Again we see a case of retropharyngeal abscess in Space 3, due to trauma of the pharyngeal wall. In this case, the foreign body entered

rather low (at the junction of the pharynx and esophagus, about the level of the sixth cervical vertebra) and the infection passed laterally and inferiorly, finally reaching the superior mediastinum. Cervical mediastinotomy was performed perhaps a little late, but the septicemia present would probably have led to fatal outcome even with earlier surgical intervention.

Case 8.—University Hospital No. 20411: A. H., female, age 34, entered the University Hospital complaining of sore throat, inability to swallow, and pain in the left ear. Two weeks previously, she had taken cold, her throat had become sore, and she had developed an earache. A few days before entrance, her neck had become swollen on the outside. Examination showed an obese woman, apparently in severe pain. There was a swelling on the left side of the neck extending from the ear almost to the clavicle. It was hard and indurated. The throat was red and there was a definite bulging of the lateral pharyngeal wall on the left side. There was a small amount of pus coming from an opening just above the tonsil. Temperature 103.5° F., pulse 130. *Diagnosis:* Lateral pharyngeal abscess.

Treatment.—The day after admission, an incision was made anterior to the left sternocleidomastoid muscle and a small amount of thick pus was obtained. The temperature remained high (106° F.), pulse rapid and respirations difficult. The patient gradually became weaker and expired two days after admission. No autopsy.

COMMENT.—This case is an example of lateral pharyngeal abscess resulting from direct extension through the lateral pharyngeal wall or lymphatic extension from the throat or middle ear. Extension through the venous system is also a possibility. Unfortunately no autopsy was obtained, but the clinical course suggests that the infection extended from the lateral pharyngeal space to Space 3 by continuity. From Space 3 the infection, no doubt, spread inferiorly through the neck to the superior mediastinum. It is also likely that the abscess ruptured through the alar fascia to enter Space 4, and extended inferiorly into the posterior mediastinum. The cervical incision was obviously inadequate to properly drain the spaces involved.

Case 9.—University Hospital No. 175: H. H., male, age 32, entered the University Hospital complaining of sore throat, swelling of the neck, pain in the chest, dyspnea, chills, and fever. About two weeks before entrance, patient had "La grippe" accompanied by sore throat. About one week later, his neck began to swell, and he experienced difficulty in swallowing and talking. A few days before entrance, he had had a severe chill lasting an hour. This was followed by pain in the center of the chest and difficulty in breathing, symptoms which were present on entrance. Examination showed a very ill man. Temperature 104.4° F., pulse 124, respirations 36. The throat was red but not bulging. The neck was swollen and indurated on both sides from the mandible to the sternum and clavicles. Dulness and moist râles were present over the lower right lobe of the lung. *Diagnosis:* Deep neck abscess and right empyema.

Subsequent Course and Treatment.—Three days after entrance, the neck was drained by bilateral incisions and much pus obtained. The next day, a right empyema was drained through an intercostal incision. Patient did poorly and died the following morning.

Autopsy.—Infection of the deep spaces of the neck secondary to retropharyngeal abscess and leading to posterior mediastinitis. Secondary right empyema by extension of infection from the posterior mediastinum.

COMMENT.—This patient no doubt had a severe nasopharyngitis during his attack of "La grippe" two weeks before entrance. The infection then spread by the lymphatics to the retropharyngeal nodes, causing an adenitis and paradenitis of these nodes, and resulting in a retropharyngeal abscess. The latter, however, did not remain localized in the retropharyngeal space (therefore, there was no bulging of the posterior pharyngeal wall), but extended inferiorly in Space 4, producing a posterior mediastinitis. The swelling in the neck was no doubt due to accumulation of pus in Space 4, but there may also have been some inferior extension in Space 3, and an adenitis of the pendent group of lymph nodes by drainage from the nose and throat. The incisions in the neck were late and inadequate, and no attempt was made to drain the mediastinum, although the secondary empyema on the right side was drained. It is conceivable that earlier and more adequate drainage might have resulted in a different outcome. This, in turn, would have required an earlier and more complete diagnosis based upon anatomic grounds.

CONCLUSIONS

(1) Acute retropharyngeal and lateral pharyngeal abscesses are secondary to infection of the nose, throat or middle ear. They are more common in young children under the age of three years. This may be due to the greater abundance of lymphatics in that age-period. The common pyogens are usually the responsible organisms.

(2) The infection reaches these spaces by direct continuity, venous or lymphatic drainage, the latter being most common except where trauma is a factor, in which case the spread is by direct implantation.

(3) Acute retropharyngeal abscess may involve the space between the pharyngeal wall and the visceral fascia (visceral space), the space between the visceral and alar fasciae (Space 3) or the space between the alar and prevertebral fasciae (Space 4).

(4) Infection in the visceral space is apt to remain localized at the site of origin. Infection in Space 3 may remain localized at the site of origin, but may also spread inferiorly and laterally through the neck to the superior mediastinum. It may also break through the alar fascia and reach Space 4. Infection in Space 4 ("danger space") is apt to gravitate through the neck into the posterior mediastinum.

(5) The lateral pharyngeal space is directly continuous with Space 3. It may be primarily infected from the lateral pharyngeal wall or may be secondarily infected from Space 3, the parotid space, masticator space or submandibular space. Vice versa, primary infection within the lateral pharyngeal space may spread secondarily into those spaces. Infection in the lateral pharyngeal space extending into the submandibular space may resemble Ludwig's angina in the later stages.

(6) Chronic retropharyngeal abscess is practically always due to tuberculous caries of the cervical vertebrae. It is usually confined to Space 5 behind

the prevertebral fascia, and usually gravitates to lower levels along muscles taking origin from the vertebral column (psoas abscess). It may, however, remain localized in the cervical region, in which case it may rupture through the alar fascia and enter "danger space" 4. It is more common in adults.

(7) The clinical picture of pain, difficulty in swallowing and speaking, chills and fever, internal bulging of the pharyngeal wall, and external swelling of the neck should make early diagnosis possible.

(8) The treatment is chiefly surgical—early and adequate drainage. This may be internal through the mouth for cases confined to the posterior pharyngeal region (visceral space and Space 3). External incision is necessary for collections in the lateral pharyngeal space or inferior extensions in Spaces 3 or 4. The "T" incision of Mosher with reflection of the submaxillary salivary gland is especially applicable for collections in the lateral pharyngeal space. Spaces 3 and 4, including collections in the superior mediastinum and posterior mediastinum above the fourth thoracic vertebra, may be effectively drained by cervical incision anterior to the sternocleidomastoid muscle (collar mediastinotomy). Collections in the posterior mediastinum below the level of the fourth thoracic vertebra demand posterior thoracic drainage (dorsal mediastinotomy).

NOTE:—The illustrations are reproduced through the courtesy of the *American Journal of Anatomy*.

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