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On the anatomy of the breast - Of the internal parts of the breast, or mammary gland

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OF THE INTERNAL PARTS OF THE BREAST, OR MAMMARY GLAND.

HAVING now described the appendage to the breast, which is so absolutely necessary to the due performance of its functions, I shall proceed to point out the secretory part of this organ.

The parts which enter into its composition are:—

First, the fascia mammæ.

Secondly, the lactiferous tubes, or milk ducts.

Thirdly, the glandules in which the milk is secreted.

Fourthly, the milk cells.

Fifthly, the common organization of arteries, veins, absorbents, and nerves.

Sixthly, the fat and cellular tissue.

First, of the *fascia mammæ*. This is divided into two layers; the superficial, and the deeper layer of the breast, between which the gland of the breast is included.

If I begin to trace this fascia from the sternum, I find both layers adhering to the ligamentous substance which covers that bone. From thence they proceed towards the breast, when one layer separates from the other, to include the breast between them.

The anterior or superficial layer passes upon the anterior or cutaneous surface of the breast: here it forms a fibrous covering, but not a true capsule, spread upon the surface of the gland, and passing between the gland and the skin; but it also enters the interior of the secretory structure.

Here it sends out two sets of processes of a fibrous nature from its two surfaces.

Anteriorly, large, strong, and numerous fibrous or fascial processes, to the posterior surface of the skin which covers the breast, into the substance of which it is received, and with which it is incorporated.

It is by these processes that the breast is suspended in its situation, and I shall therefore call them the *ligamenta suspensoria*.

By these processes, the breast is slung upon the forepart of the chest, for they form a moveable but very firm connexion with the skin, so that the breast has sufficient motion to elude violence; yet by this fibrous tissue it is, excepting under age, lactation, or relaxation, prevented from much change of place.

The ends of these ligaments are spread out and incorporated with the posterior surface of the skin, and give it its whiteness and firmness.

When raised and dried, the preparations of these liga-

mentous processes form a curious, irregular surface of folds, between the skin and the mammary gland. They are seen in a section of the breast, spread out and lost upon the inner surface of the skin at their anterior extremities. *See Plate.* When the breast is placed in its natural position, the posterior extremities of the ligamenta suspensoria are spread over the fore-part of the gland, support numerous folds of the glandular structure, penetrate the substance of the organ, and everywhere connect the portions of glands to each other.

A process of this fascia proceeds to the nipple, surrounding the ducts which are contained within it, and it becomes the principal and very powerful connecting medium between the gland and the nipple, so as to prevent this latter important part from being separated from the breast by violence.

Between the ligamenta suspensoria, the lobes of fat are placed, which serve further to defend this organ from injury.

The uses of the ligamenta suspensoria are to connect the nipple to the breast, the breast to the skin, and to fold up the gland to increase the secretory organ, without spreading it more widely over the surface of the chest. They also enclose the adipose matter of the breast.

Whilst the anterior or superficial layer of fascia is thus spread over the anterior surface of the breast, the posterior or deeper seated layer, when it has reached the margin of

the gland, passes behind it, and sends forth two layers of fibres. The anterior of these fibres pass on the back of the gland, sending processes of fascia into the organ to unite its parts, and other fibres which pass from one ridge of the gland to the other posteriorly, giving it a smoother surface than that of the anterior part of the breast, as it is not folded in the same manner.

The other fibres of this deeper seated fascia pass backwards, and are united to the aponeurosis of the pectoralis major.

Thus, then, the breast is supported by the two portions of fascia; the superficial layer connecting it to the skin anteriorly, and forming the ligamenta suspensoria, and the posterior layer of fascia joining it to the pectoral muscle, by its aponeurosis; and between these two processes it swings, and yields to pressure and to violence. Whilst the fascia thus affords support, it also firmly unites the different portions of the gland to each other, throughout the whole of the substance of the organ, by entering into its interior composition.

In tracing the constituent parts of the mammary gland, I shall be able to explain it most perspicuously, if I begin the description from the nipple, and proceed to the minute structure of the gland, in opposition to the course of the milk.

The breast, as regards its secretory structure, consists of the following parts:—

First, of the straight lactiferous tubes in the nipple, or *the mamillary tubes*.

Secondly, of these tubes suddenly enlarged at the base of the nipple, and under the areola, and which contain a large quantity of milk: these are the *reservoirs*, or areolar tubes.

Thirdly, of these tubes becoming arborescent in each part of the gland, and forming the mammary ducts.

Fourthly, of *glandules*, disposed in lobuli, which constitute the principal part of the mammary gland, and from which the milk tubes originate.

Fifthly, of the milk cells, into which the milk is first secreted by the mammary arteries.

Sixthly, of the common organization of arteries, veins, absorbents, and nerves.

Lastly, of the fat, and cellular tissue.

First, *Of the straight*, or *mamillary* tubes.

When the nipple is examined with attention, in a woman whose breast is not in a state of lactation, the papillæ which cover its sides to its apex form petals, like those of flowers, which reach to, and overlap, a part of the apex; and between them, on the apex or point of the nipple, may be observed a

cleft, in which the orifices of the lactiferous tubes are closely huddled together.

But during lactation, when the cone is reversed, and the papillæ are everted, the orifices of the lactiferous tubes are placed upon the truncated surface of the apex of the nipple.

The greatest number of lactiferous tubes I have been able to inject, has been twelve, and more frequently from seven to ten. But the greatest number of orifices I have been able to reckon has been twenty-two; however, some of these might have been follicles only, and not open ducts. I have had delineated two preparations of straight tubes, in one of which I found thirteen, and in the other twenty-two.

Their size also varies; for some of the orifices and straight tubes are much smaller than others, some only admitting a bristle, whilst others are as large as a common pin.

They commence in a cribriform surface formed by the skin, with some mixture of fibrous tissue; so that these orifices do not increase much, or yield to the pressure of the milk. A probe of large size will pass to their orifices, if introduced from the gland, but it cannot be made to escape through the orifice of the duct, without employing great force to overcome the resistance, and even to lacerate the orifice; in that respect resembling the urethra in the female, which will admit the little finger from the bladder, but only a probe at its orifice.

From this structure it is that the milk is prevented from escaping, excepting under a very strong vis a tergo; not from a transverse wrinkling of the lining of the duct, as has been supposed.

When the mamillary or straight tubes have passed these orifices, they begin to dilate, and to assume a conical form, gradually increasing in diameter to the basis of the nipple, and are therefore much larger than at the apex of the mamilla.

They are surrounded and enveloped by the fibrous tissue which lines the nipple, and which sends fibres between the tubes to keep them in their situation, and to strengthen them, and prevent their laceration.

The branches of arteries pass between the tubes, and, by their minute distribution, render them highly vascular, and the veins which return the blood are larger than the arteries, bnt less parallel.

The arteries of the nipple also send branches backwards into the interior of the gland, to meet those arteries which enter from behind the breast.

The nerves pass parallel to the arteries, and are sometimes supported by their coats, as they accompany those vessels.

The arteries, veins, absorbents, and nerves, are found in a cellular tissue, which enters into the composition of the

nipple, and passes between the ducts which it contains; and this part is chiefly reticular, and not adipose, or it would interfere with the functions of the nipple.

When the straight or mamillary milk tubes are cut open, they are found to be lined with a mucous membrane, which is wrinkled longitudinally, and which is highly vascular. The wrinkles in the mucous membrane arise from their elasticity, and that of the surrounding parts: they are not the cause of the non-escape of the milk, but they allow of a great increase of their diameters to receive the milk. The mucous membrane with which they are lined is highly vascular.

Secondly, The *areolar portions* of the tubes, or *reservoirs*, begin at the basis of the nipple, extend under the areola, and to some distance into the gland, when the breast is in a state of lactation.

Their greater size than that of the mamillary tubes is in part owing to the loss of the pressure of the nipple, but principally to the number of branches of milk tubes which enter them from the breast; five or six large branches are combined in a reservoir.

These receptacles are of a conical form, like the mamillary tubes; and they begin from the extremities of the larger branches of the milk tubes, and terminate in the straight ducts of the nipple.

The appellation of reservoir is less applicable to this portion of the ducts in the human subject than in other animals, as they retain less milk; but even in the human female, these large and numerous cavities will in their assemblage contain a large quantity of milk.

In the cow, the mare, the goat, the ewe, the deer, and the rabbit, the reservoirs are very large, and in the cow particularly they are of enormous size, so as to be able to retain at least a quart of milk or more, depending upon the size of the udder.

In the human subject they generally radiate from the nipple, although some of them pass directly backwards to the posterior or pectoral surface of the gland.

Their calibre is out of all proportion larger than that of the straight or mamillary tubes, and much larger than that of the milk tubes, which form their continuations.

When cut open, the reservoirs are found to be lined with a very vascular mucous membrane, like the mamillary or straight ducts, but they have a fibrous coat upon the outer side of this, which preserves their form, and which gives them their power of resistance to the great dilatation which the milk would otherwise produce.

The blood vessels, which supply them with vascularity, are derived from the retrograde branches of the arteries of

the nipple, and from the deep-seated arteries of the breast, which rise to meet them. The use of these reservoirs is to supply the immediate wants of the child when it is first applied to the breasts, so that it shall not be disappointed, but be induced to proceed with sucking until the *draught* be produced, when it receives a stream of milk from the lactiferous or milk tubes by a vis a tergo.

The next tubes in order, in tracing the structure of the gland in the opposite course to the milk, are the *mammary*, *lactiferous*, or *milk tubes*. They begin from the glandules, or secretory structure, in small and numerous branches, and increasing in size, terminate in forming the reservoirs.

They divide into branches, which increase in number as they proceed from the centre to the circumference; and their general appearance when injected, resembles that of the root of a tree.

The radiations of one of the mammary tubes sometimes occupies from one-sixth to one-fifth of the circumference of the breast. On the sternal and clavicular aspect of the breast, a single duct radiates to the margin; but upon the axillary and abdominal aspects, two or three ducts ramify to the circumference of the gland, so that two or three ducts are placed upon each other.

From this cause arises the greater thickness of the

lower and outer part of the breast, which enables it to form the cushion upon which the cheek of the child reposes. To this circumstance I have before alluded, and it shows by what simple means nature effects the most important purposes.

The branches of the ducts do not radiate equally to the circumference, for some are much longer than others, and are lost on the fascia which encircles the breast, rendering its margins unequal.

In other parts the ducts at the margin of the gland are turned upon the gland, so as to form a kind of hem at its circumference, and to produce also a thickening of the substance of the breast from this cause.

Many of the mammary tubes upon the anterior surface of the breast are turned forwards to the skin, and connected to it by the ligamenta suspensoria; so that in removing the skin from the fore part of the breast, many of them are necessarily divided.

The breast is not formed into regular lobes by the ramifications of the ducts, because they ramify between, and intermix with each other, so as to destroy the simplicity and uniformity of their divisions.

The most simple idea which can be formed of the mammary ducts, especially at the lower and outer part of the breast, is, that supposing them to resemble the roots of trees,

as they do, that one root is growing between others, destroying regularity, and distinctness of their growth. Or suppose one hand applied upon the back of another, and the fingers introduced between each other, and then the fingers of one hand inclined to the right, and those of the other to the left, it conveys the idea of the above-mentioned intermixture.

On the posterior surface of the gland, the ducts ramify more smoothly and equally, and pass in more regular ramifications to the gland, which is here much smoother than it is anteriorly.

The mammary ducts do not communicate with each other, as is easily shown by throwing injections of different colours into the ducts, or by injecting one duct only.

If various colours are thrown into each duct, they proceed to the gland without any admixture of colour. If one duct be most minutely injected with quicksilver, it does not escape into any other. And this remark is also applicable to the mammary glands of other animals, where there are many, as in the hare, the bitch, and the pig, the ducts are separate and distinct from those of the other gland.

I have only seen one instance to the contrary of this position, in injecting a milk tube from the interior of the gland towards the nipple, two large branches of ducts crossing each other, where they laid in contact, the injection found its

way by rupture, or by a deviation from the natural structure, from the one into the other duct, of which I have given a figure; and as this has only occurred once in more than two hundred times, it shows that it is not the result of a common structure. In the cow, the goat, and the ewe, in which there are different glands terminating at each teat, in a single duct, when the injection is thrown into one teat, it does not escape into any other gland.

After lactation, when the mammary gland is injected, the lactiferous or mammary tubes appear cellular, and more resemble large absorbent vessels than arteries or veins, for wherever two or three large branches enter, a sudden increase of size is produced, so as to form a little pouch, open at each end. These dilatations are also seen during lactation, when two or three branches are received at any part of the ducts.

The mammary ducts are formed by a fibrous coat upon the outer side, and within, by a mucous membrane. The latter is highly vascular, so that when injected with red sise, by the arteries, and dried, it is sure to be highly reddened by the injection.

Of the Gland.

The mammary ducts begin directly from the glandular structure, in very fine and minutely divided radiated branches,

and after becoming larger and larger as they approach the areola, they terminate in the reservoirs.

The gland is constituted by the union of a number of glandules, which are connected by means of the fibrous or fascial tissue of the gland.

When injected and unravelled, they appear of considerable size; but when further examined, these larger bodies are divided into small glandules.

Between these glandules, the mammary tubes may be observed to ramify, and from these bodies their branches directly spring.

When these glandules are filled with injection, and for a long time macerated in water, and unravelled, they are found to be disposed in lobuli; and when a branch of a mammary tube is separated, with the glandules attached, the part appears like a bunch of fruit hanging by its stalk.

The body of the gland is formed by the union of these little glands, everywhere interspersed through it, and united by fibrous tissue.

Their size depends upon the state of the breast; after puberty they exist, but are not easily separated or unravelled.

In lactation they are large, may be minutely injected, and distinctly developed. In age they diminish gradually, and after a time disappear, leaving the ducts still distinctly ramifying, but without the true glandular structure.

On the anterior surface of the breast, the glandules are drawn towards the skin by means of the ligamenta suspensoria, and form folds or loops which resemble the petals of flowers, as, for example, the rose when unfolded.

Upon these folds of the ligamenta suspensoria, the glandules are seen injected. *(See Plate.)*

By this disposition of the glandules, the surface for secretion is greatly increased, whilst the space which the breast occupies, remains the same in regard to its circumference.

This formation of the gland also renders it more prominent, and the nipple, consequently, of easier access to the lips of the infant.

The margin of the gland is extremely irregular; for it forms numerous processes, which proceed into the surrounding fibrous and cellular tissue.

The lower and outer part of the gland, *viz.*, the axillary and abdominal aspects, are some of them folded upon the anterior, and some upon the posterior surface of the gland at its edge, giving it there additional thickness, and assisting in forming the cushion already mentioned.

Also at the lower and outer part of the gland, the number of ducts and glandules is greater than elsewhere, and they are placed one before the other, so as to give to the gland great additional density.

The posterior surface of the breast is not folded and looped up like the anterior; but the ducts and glandules are, in the larger part of this surface, disposed in ridges connected by a fibrous membrane, which mats them together, and enters between the ridges into the interior of the gland.

The breast then is made up of an assemblage of glandules, united by a fibrous tissue, and is therefore called conglomerate, because it is constituted of a number of glandules conglomerated together.

When put into boiling water, the best idea of its form is obtained, as, like other albuminous structures, it becomes hardened, so as to be easily preserved: the nipple will then be seen to be not exactly in the centre of the gland.

From the nipple, the gland begins to form little petals, like those of a blooming rose, and they are turned forwards to the skin, to which they are connected by the ligamenta suspensoria; and in the depressions between them, the fat is lodged. *(See Plate.)*

On the clavicular and sternal edge, the disk of the gland is very irregular in the length of its radii from the nipple, some parts projecting much further than others; but on the axillary and abdominal margin, the gland is turned upon itself at its edge, and forms a kind of *hem*.

The posterior surface of the gland is smoother than the

anterior, and forms a number of rows, and the depressions between them being less, there is not so much fat deposited as on the anterior surface of the gland.

The glandules vary in their size, from that of the head of a pin to the bulk of a small tare, when the breast is in a state of lactation.

Their figure is oval when they are uninjected, and they are more pointed at the extremity farthest from the nipple, than at the place at which the mammary duct enters them.

They require that the breast, when in lactation, should be long macerated to render much of them distinct and separate, as they appear in my plate. They are there seen with the ducts connected, in the progress of maceration; and they have been minutely unravelled, and the mammary tubes traced into them.

They are, when uninjected, rather flattened upon their surfaces; but when filled with injection, they become rounded and partially divided by several depressions.

They appear upon the festoons or loops which the ligamenta suspensoria support, upon the fore part of the breast.

But the best view, showing one of the lactiferous tubes from the nipple to the margin of the breasts, is that in one of my plates. In this the small origin of the mamillary lactiferous tube appears, and its conical shape is seen: then

it forms the reservoir into which mammary lactiferous tubes are entering at different angles. Next the foldings of the gland appear, and upon five of these folds more particularly the glandules are injected and displayed, so as to give to them an exact demonstration of their appearance when in a state of lactation.

Of the Milk Cells.

When the lactiferous tubes are minutely injected, they are found to proceed from each glandule, and when an injection is made of the glandules with quicksilver, sise, or wax, they will be seen to be composed, in their interior, of numerous cellules, which are the milk cells.

Their number is very great; it varies much, and it would therefore be an act of folly and inutility to endeavour to reckon them. The glandules themselves differ in their size, and therefore the number of the cells will be proportioned to the magnitude of each glandule.

Their size in full lactation is that of a hole pricked in paper by the point of a very fine pin; so that the cellules are, when distended with quicksilver or milk, just visible to the naked eye.

They are rather oval than round, being slightly elongated

where the branch of the lactiferous tube springs from them; but they appear more rounded to quicksilver, and when distended with milk, than when filled with wax.

When well injected and dried, the glandules form a kind of foliage in the breast, and each leaf is filled with these cellules. In the fullness of lactation, these leaves are full of cells, which can be readily injected and demonstrated; but at other periods they do not admit of being filled, and a most minute injection may then be made of the lactiferous tubes, yet no cells appear. In one of the plates these cells will be seen injected with quicksilver, and magnified four times; but in the same plate they are seen injected with yellow wax, and magnified six times, to render them easily demonstrable.

The lactiferous tubes I have seen become cellular, as they spring from the milk cells, but only just at their commencement, and under very minute injections.

The cells are lined with a continuation of the same mucous membrane as that which lines the inner surface of the lactiferous tubes. Of this, I judge by minute injections of the arteries, where the inner membrane is seen to possess the high vascularity of a mucous membrane, rather than the minor arterial supply of a serous surface. Also in the larger animals, as in the cow and the rhinoceros, the mucous mem-

brane lining the ducts has no break in it, but may be seen to be continued so far as the parts can be traced by the eye, and by magnifying powers*.

The milk cells possess a considerable degree of elasticity, but in the human subject less than in other animals.

The arteries which supply these cells with blood, secrete the milk, and they become very large in lactation; but their divisions, as will be seen in the plate, become extremely minute on the glandules, and around the cells. From the blood which they convey, the milk is secreted and poured into the interior of the cells.

The veins return into the general circulation that blood which is not converted into milk.

Absorbent vessels arise in great numbers from the milk cells of all the animals I have minutely injected. In my plate of the absorbents, they will be seen abundantly arising from the milk cells and lactiferous tubes; for the preparation is principally composed of these vessels, but a few milk cells and tubes are also filled, from which the absorbent vessels have arisen.

The absorbents upon the surface of the breast are injected by single vessels from the base of the nipple.

* Also after the secretion of milk has ceased, the secretory structure is often loaded with mucus.

These vessels perform the double function in the breast, of absorbing the more watery part of the milk, so as to render it more nutrient than under its first secretion; but they are also employed under great accumulations, in the absence of the child, when they relieve and unload the vessels.

Still accumulations of milk do occasionally occur, in one or more of the milk tubes, producing great enlargement, pain, and distension, and rendering it necessary that the surgeon should discharge the fluid by the lancet. See my work on those diseases of the breast which are not malignant.

The *nerves* which enter the secretory structure of the gland are extremely minute, and their smallest branches accompany those of the arteries, and are distributed with, and supported by, them, to sustain by their presence the secretion of the milk.

From this description of the structure of the parts the function of this organ appears to be easily explained.

The milk is secreted by the arteries into the *milk cells*, from which it is forced forwards by two causes; first, by the elasticity of the cells, which is proved to exist in many animals by injecting the cells minutely with quicksilver, and then if one of the ducts be pricked with a needle, all the lactiferous tubes become instantly emptied: but in woman this occurs less than other animals.

Secondly, by the vis a tergo of the continued secretion, one portion of milk forcing forward the other, in a minor degree when the child is not applied, but when the draught occurs, a sudden rush of blood increases the secretion, and rapidly hurries the milk forwards to the nipple, to supply the wants of the infant.

The milk is conveyed from the cells which are found in every point of the gland into the *mammary ducts*, which form radii, converging all of them towards the areola; and as these vessels are increasing in their diameters, little opposition is made to the progress of the milk, as it courses from the smaller to the larger tubes.

When the milk is thus brought by the mammary tubes to the areola, it is received into the *reservoirs*, and in these, and in the mammary ducts, it is retained until the infant begins to suck; and here it will be seen that the form of the tube is reversed, for the mammary tubes are constantly increasing towards the nipple; but the reservoirs are large towards the gland, and become smaller towards the nipple, which gives them a power of retention until the discharge of the milk is required.

The milk next passes into the mamillary ducts, or straight tubes of the nipple.

These, like the reservoirs, are conical, with the apex of

the cone turned to the point of the nipple, and as their orifices at the nipple are very small and unyielding, the milk is also again retained until the act of sucking removes it; and when the draught occurs, abundance of milk is hurried forwards to the reservoirs and mamillary tubes.

The infant's lips and gums, and the suction produced by the exhaustion of the air in the mouth, not only mechanically empty the mamillary tubes, and overcome the resistance of their orifices, but also, by rendering them finer capillary tubes, assist, upon hydraulic principles, in giving rapidity to the passage of the milk.