ABDOMINOPELVIC FASCIAE [1]

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TWENTY-FOUR FIGURES

INTRODUCTION

In this study, an attempt is made to correlate fascial configurations in the abdomen and pelvis of the adult as they are interrelated one to the other. The method of approach is developmental, following the progressive alterations in the transition from a simple primitive state to the complex adult pattern. The alteration exhibits a logical sequence toward predictable adult fasciae. Minor vagaries and discrepancies occur but the process is remarkable in the precision that is exhibited.

Within the abdominopelvic cavity, three basic embryonic tissues are concerned in the evolution of adult fasciae: the young mesenchymal tissue intimately associated with the developing musculature of the parietes; the loose mesenchymal tissue ubiquitously distributed between the developing intrinsic fascia of the muscles and the maturing celomic epithelium; and the celomic epithelium itself. The growth and modification of these three developing tissues produce the

completely formed fasciae, and their developmental history is
basic to the adult disposition of fasciae.

The alterations occurring in the loose mesenchymal tissue
destined to become the adult extraperitoneal connective tissue
were first noted by His (1874) who developed elaborate me-
chanical theories as to differential growth patterns and the
part they play in the apparent migrations of organs. He re-
garded primary growth as a relational change in an organ;
secondary growth was defined as enlargement and matura-
tion in situ. Additional factors in the structural alterations
of embryonic connective tissue were described by Grossfeld
('31) who described the alterations in tissue growth caused
by the character of the medium, and by Bauman ('45) who
emphasized the importance of stress and strain.

Accepting these factors as operative in development, it
may be presumed that, during the apparent migration of or-
gans due to differential and intrinsic growth, characteristic
and predictable changes must occur in the spongy loose mesen-
chymal tissue surrounding them. As development continues,
the primitive cellular tissue gradually assumes the adult
morphological pattern. Apparent migration produces a linear
orientation of the young connective tissue fibers, which are
further compressed in their linear orientation by secondary
growth. Such mechanisms provide a basis for the concept of
"migration fascia." It should be stressed, however, that
sharp lines of demarcation of this type of fascia are not de-
monstrable. By the very nature of their source and mode of
production, these connective tissue coverings will be continu-
ous everywhere with, and blend into, the general extraperi-
toneal connective tissue.

Alterations involving the celomic epithelium produce a tis-
sue modification which provides the starting point for a second
type of fascia in the abdominopelvic cavity. The intimate ap-
position of two mesothelially covered surfaces is followed by
the disappearance of all the mesothelial cells, leaving only
the young connective tissue of the developing tunica propria
of the peritoneum. Two such naked connective tissue layers

thus brought into contact fuse intimately, producing a single inseparable layer. In this study such a fascia is designated as a "fusion fascia." That this process operates in development was recognized half a century ago by Cuneo and Veau (1899). Augier ('21) has pointed out, however, that in the period in which these changes occur the connective tissue of the embryonic peritoneum has not yet acquired its characteristic adult fibrous structure.

Fusion fasciae differ materially from migration fasciae. In a fusion fascia, the layer is a thin, membranous one with definite limits, whose distribution is not uniform from specimen to specimen. In contrast to a migration fascia it has only one major criterion to satisfy: it must be continuous at least at one edge with the tunica propria of two peritoneal surfaces.

MATERIAL AND METHODS

This study is based on an examination of a closely graded series of human embryos, fetuses, newborn infants, and adults.

Table 1 summarizes the embryological material studied and the method of its use. All the embryonic material was sectioned serially. Whenever possible specimens in the same general age range were studied in three planes of section in order to correlate better the findings. The embryos indicated by an asterisk were used for microdissection studies. Those designated by a cross were prepared in the following way. The entire specimen was frozen, sectioned at a thickness of 1 to 2 mm in the indicated plane, and then dissected under a wide-field binocular microscope. The dissection having been completed, the sections were dehydrated, cleared in xylol and benzyl benzoate, and then embedded in discs of ethyl methacrylate.

Several term fetuses and newborn infants were dissected to develop as complete as possible a series of specimens. The age range for preparations of this type spanned the period from the 7th fetal month through newborn infants and specimens from early postnatal life. Comparisons were made between the anatomical findings in these specimens and ana-

tomical studies in the adult which were carried out over a period of two years in the gross anatomical laboratories of the University of Michigan Medical School. The adult studies also included special regional dissections and analyses of transverse sections.

TABLE 1

COLLECTION NUMBER	C-R LENGTH	AGE	PLANE OF SECTION	STAINING METHOD
	mm	*weeks*		
EH 242	23	7 +	sagittal	Masson
EH 216	27	8 —	frontal	Masson
EH 15b	30	8	sagittal	Hematoxylin and Congo red
EH 404	31	8 +	sagittal	Masson
EH 301d	48	10	sagittal	Masson
EH 370a	53	10	frontal	Masson
EH 269a	67	11	sagittal	Masson
EH 148	80	12	* 1	* 1
EH 228c	84	12 +	frontal	Masson
EH 300j	89	late 13	frontal	Masson
EH 26	90	13	sagittal	Hematoxylin and Congo red
EH 296g	104	14	sagittal	Masson
EH 181a	105	14	sagittal	Masson
EH 121	111	14–15	* 1	* 3
EH 364a	115	14–15	frontal	Masson
EH 439	180	20	frontal	+ 2
EH 321	180	20	sagittal	+ 2
EH 440	180	20	transverse	+ 2
EH 31	180	21.5	sagittal	Hematoxylin and Congo red
EH 441	279	28 +	transverse	+ 2

[1] * Used for dissection.

[2] + See method of handling in text.

[3] Ages from table in Patten ('46).

Migration fascia

A. Perirenal fascia. The migration of the kidney is a well documented embryological phenomenon (Pohlman, '04; Jackson, '09; Kelly and Burnam, '22). The juxtaposition of the kidney to the suprarenal gland is established at 25 mm (8th week) (Ivanow, '27).

Tobin ('44) did not find the differentiation of perirenal connective tissue until 145 mm; but at 23 mm the kidneys and suprarenal glands are dorsal to the primitive celomic epithelium, embedded in loose mesenchymal tissue which also includes the aorta, subcardinal veins, renal vessels, and ureters. This layer is continuous caudally into the pelvis and and cephalad onto the diaphragm and is the precursor of the general extraperitoneal connective tissue.

Figure 14, a photomicrograph of a 67-mm embryo (11th week), indicates the presence of a very definite perirenal layer of connective tissue. This envelope is several laminae in thickness and encloses the suprarenal gland and kidney in one compartment. Continuous with this common outer investment is a thin but definite partition between the two organs. The common outer investment crosses the midline only in the region of the renal pedicle where it is in intimate relation with the loose connective tissue surrounding the great vessels. It continues caudally around the ureter. The more ventrally located fusion fascia of the colon, which develops later and complicates the relations in this region, has not appeared as yet.

Secondary growth in these structures accentuates the presence of the perirenal fascia. In sagittal sections of one embryo and dissections of two others of 180 mm (20th week), the fascial layers appear more definite and where they enclose the great prevertebral vessels, they show one lamina ventral and one dorsal to them. The two laminae are now intimately associated with the adventitia of the great vessels and no open communication exists from side to side. The ventral perirenal fascia is much thinner than the dorsal, accounting for the contentions by Luschka (1863), Zuckerkandl (1883), and Baumann ('45) that no ventral fascia exists.

Further increase in absolute size of the kidney accounts for progressive compacting of the accumulated perirenal connective tissue layers. Thus practically the adult configuration is demonstrable in dissected transverse sections of a 279-mm fetus (fig. 13).

The concept of a prerenal and retrorenal layer of the perirenal fascia was originally stated by Gerota (1895) and supported by others (Sappey, 1879; Charpy, 1890; Disse, 1896; Augier, '21). Another group of observers (Lewis, '04; Southam, '23; Rouvière, '24;.and Gray, '36) held views approaching Gerota's except they believed there was no closure of the perirenal compartment caudally until the two layers were lost in the adipose tissue of the iliac fossa. Callander ('39) has described the perirenal laminae as resulting from a splitting of the transversalis fascia. Congdon and Edson ('41) and Congdon et al. ('42), describing the conal fascia, apparently have combined extraperitoneal connective tissue with the lamella resulting from peritoneal fusions. Such a dual origin of perirenal fascia was also suggested by Fredet ('04a, b). The conclusions of Vecchi ('10) that the perirenal fascia is a closed envelope are completely supported by the results of the present study.

B. *Perisuprarenal fascia.* A direct parallel to the formation of the perirenal fascia exists in the establishment of fasciae covering the suprarenal gland. Bartlakowski ('24–'25) and Ivanow ('27) have described the migration of the suprarenal gland to its junction with the kidney and the adult position and interrelations of the two organs. The present investigation shows the suprarenal gland to be included within the duplication of extraperitoneal connective tissue around the kidney but not in immediate contact with the kidney. It is common knowledge that the gland is surrounded by, and separated from the kidney by, a continuous layer of adipose tissue (Knight, 1893; Billington, '10; Vecchi, '10; Augier, '21; Rouvière, '24; and Bleicher, '31). The concentration of connective tissue between the kidney and suprarenal gland is illustrated in figure 17 from an 84-mm embryo (12th week). In summary, the perirenal fascia produces a closed sac which is partitioned into two individual spaces by the inter-suprarenal-renal fascia.

C. *Perirectal fascia.* In the young embryo the rectum is ensheathed by a thick layer of splanchnic mesoderm. Disse (1889) described the descent of the pelvic organs in the proc-

ess of growth. This descent provides an orienting force to the loose mesenchymal tissue surrounding the various organs which migrate into the pelvis.

Figure 20, a photomicrograph of a 53-mm embryo (10th week), shows the predescent configuration of the rectum and pelvic colon and its covering of loose mesenchymal tissue. Figure 21, a similar figure of an 89-mm embryo (late in 13th week), illustrates the greater depth of the true pelvis at this age. The orientation and definite ensheathing character of the perirectal connective fascia is here apparent and its character as a migration fascia is becoming evident.

Luschka (1863) presented the first detailed description of the perirectal visceral fascia and its continuities with endo-pelvic fascia. Waldeyer (1899), in his excellent text on pelvic anatomy, described in detail the fasciae of the pelvis, including a sheath existing between rectal musculature and the discrete fascia recti (probably fusion fascia). This loose connective tissue, often containing fat, carries the branches of the superior hemorrhoidal vessels and is the perirectal migration fascia of this account.

D. Umbilical vesical fascia. The development and descent of the bladder, with the formation and disappearance of its temporary mesentery, have been described by Cuneo and Veau (1899), Felix ('12) and Begg ('30). Prior to the formation of its mesentery, the bladder and umbilical arteries are surrounded by a generous envelope of loose mesenchymal tissue. The developing mesentery enfolds the urachus and umbilical arteries together with the mesenchymal tissue surrounding them and persists until about the 7th fetal month. Figure 15, a photomicrograph of a parasagittal section of a 67-mm specimen (11th week), shows the lateral peritoneal cul-de-sac of the mesentery and the concentration of developing connective tissue around the umbilical arteries and the bladder.

Though the trend of development is evident at this age, the final position of the bladder and the configuration of its fascia is established in the postnatal period. The findings of this

study for older fetal specimens and for newborn infants fully agree with the observations of Disse (1889). The connective tissue surrounding the bladder and associated structures is continuous with the extraperitoneal connective tissue. Only because of the differential growth migration of, and the secondary growth in, the visceral structures involved does it assume a more sheath-like character.

The umbilical vesical fascia was described in the adult by Hammond, Yglesias and Davis ('41) but the exact limits and continuities of the layer were not given by them. Waldeyer (1899) suggested the presence of such a fascial sheet but did not describe its origin or its complete extent. Other investigators, in referring to the space of Retzius, have suggested its existence (Hyrtl, 1858; Charpy, 1892; Hinman, '37).

Fusion fasciae

The alterations which the gastro-intestinal tract undergoes in company with its supporting and related mesenteries in the course of development have been described by many authors (Braune, 1877; His, 1878, 1880–1885; Hoffmann and Rauber, 1886; Henke, 1891; Mall, 1891, 1897, 1898; Sernoff, 1894; Weinberg, 1896; Jackson, '05, '09; Frazer and Robbins, '13; Pernkopf, '22–'28; and Dott, '23).

A. The ventral mesentery and its derivatives. The primary ventral mesentery undergoes less drastic changes than other peritoneal segments because above the umbilicus it persists as a complete mesentery with essentially its original attachments. With growth of the abdominal walls and with the expansion of the liver, the mesenteric support of the umbilical vein is tightened and flattened against the ventral portion of the abdominal wall. Subsequently, there is direct apposition of the visceral and parietal layers of peritoneum of the cul-de-sacs lateral to the peritoneum applied to the umbilical vein. With the further reduction in caliber of the umbilical vein by its obliteration, there is an additional impetus toward fusion of the opposing peritoneal surfaces. The lat-

eral limits of the fascia concerned with the adult ligamentum teres are determined by the width of the parietal attachment of the falciform ligament after fusion is completed.

A second modification of the ventral mesentery is in the region of the gallbladder. The mesentery of the gallbladder is recognizable at 7 weeks (Bloom, '26; Boyden, '26). With increasing growth of both the liver and the gallbladder, their adjoining peritoneal surfaces are compressed together with resulting fusion. In the adult the gallbladder's position varies from complete inclusion within the liver substance to free suspension on a well-defined mesentery (Kehr, '13; Schachner, '16; Walter and Nieman, '31; Gross, '36; Walters, Snell and Clagett, '47).

The third structural modification of the ventral mesentery concerns the peritoneal ligaments on the cephalic surface of the liver. As the liver expands, its original cephalic peritoneal covering is forced against the parietal peritoneum of the diaphragm. Centrally, there is the area in which the liver retains its primitive relation to the embryonic septum transversum. This becomes the nonfascial area of the liver while, completing the bare area of the liver, is the surrounding region of the fused hepatic and diaphragmatic peritoneal surfaces.

B. *Dorsal mesogastrium and its derivatives.* There are many alterations in the basic plan of the dorsal mesogastrium. Examination of a frontal section from a 28-mm (8 week) embryo reveals the peritoneal relations of the structures involved, their essential rotational shifts completed, but no fusion of peritoneum begun. This condition persists until about the third month of fetal life (Poirier and Charpy, 1898). At this age, the apposed mesogastrium and parietal peritoneum first begin to fuse, as illustrated in the region of the spleen and in the region between the dorsal surface of the pancreas and the peritoneal covering of the left kidney (fig. 23). As stated by Poirier and Charpy, the lamina of the dorsal mesogastrium directly dorsal to the bursa omentalis fuses first, and the process then extends progressively to the left

until there remains little of the original dorsal mesogastrium on the left side. In the adult, there remain only the gastrophrenic ligament, the gastrosplenic ligament and the latter's continuations, the lienophrenic and lienorenal ligaments. The body and tail of the pancreas develop in the dorsal mesogastrium and they, too, are involved in this fusion, though incompletely. The fusion extends to the left as far as the adult pancreatico-lienal ligament which is the peritonealized tip of the tail of the pancreas and the splenic vessels (Rouvière, '24). The caudal limit of this obliterative process is marked by the fusion of the peritoneum covering the original right side of the pancreas to the dorsal body wall. Caudally, from this line, the dorsal mesogastrium forms the greater omentum ventral to the duodenum. The completeness of obliteration of the omental cavity itself determines the length of the gastrocolic omentum and the depth of the inferior recess of the lesser peritoneal cavity (Broman, '04).

C. Mesoduodenum and its derivatives. The serous surface of the mesoduodenum that is lost in the fusion process is its original right side which overlay the duodenal loop and the head of the pancreas. Figure 18, a photomicrograph of a 104-mm embryo (14th week), illustrates the fusion process in the retropancreatic area. Figure 13 illustrates the condition of the duodenal mesentery at the 28th fetal week. The only portion of the mesoduodenum concerned in the fusion is the part lying to the right of the midline. That part of the primary dorsal mesentery which suspends the 3rd and 4th parts of the duodenum is absorbed directly into the body wall by differential growth (Patten, '46).

The earliest description of the retropancreatic fusion fascia was by Treitz (1853) and his name is frequently employed in referring to it. That such a layer exists has been confirmed by other observers (Toldt, 1879; Broman, 1896; Rouvière, '24). Broman (1896) explains Toldt's confusing remark that a similar layer is often present ventral to the pancreas by stating that the prepancreatic layer is found only when the

transverse mesocolon inserts well cephalically on the pancreas and then is found only caudal to that line of insertion.

D. The mesentery. The duodenocolic isthmus in young embryos of 10 to 15 mm is an extremely narrow space (Dott, '23). If this area were to grow comparably to the body wall area which it encompasses, it would delineate the area represented in the adult by the distance between the duodeno-jejunal flexure and the attachment at the midline of the mesentery of the splenic flexure of the colon, outlining an intestinal segment supplied completely by the superior mesenteric artery. Correlation of the two facts of arterial supply within a true mesentery and the disproportionate growth of the mesentery, makes it evident that the mesentery in its adult form has escaped any fusion.

E. Mesentery of the large gut. Two segments of gut together with their associated mesenteries are concerned. These segments are divided by a convenient reference point, the ''colic angle'' (Frazer and Robbins, '15). The segment proximal to this point is actively engaged in the process of reduction of the physiologic umbilical hernia of development (Mall, 1897; Jackson, '09; Frazer and Robbins, '15; Dott, '23). The distal segment is shifted from its midline position, passively, with loss of the left peritoneal covering by the loops of small bowel crowding back into the abdominal cavity. This forces the caudal segment to the left and dorsad. The proximal limit of the large gut comes to lie cephalic and ventral to the loops of small gut.

Very early evidence of fusion of the mesentery of the left colon to the parietal peritoneum is seen in figure 19, a photomicrograph of a frontal section from an 84-mm embryo (12th week). It shows fusion of the colic mesenteries commencing at about 12 weeks of age which is in good agreement with the observations of Ancel and Cavaillon ('07) and Dott ('23).

Figure 24, from a 104-mm (14-week) embryo, shows the descending colon with its fusion process ventral to the left kidney and extending over the parietal wall. The fusion of the transverse mesocolon to the ventral surface of the pan-

creas is shown in figure 18. It was named by Rouvière ('24) the submescolic prepancreatic fusion fascia of Fredet. It was described earlier but not named by Treitz (1853) and by Toldt (1879).

F. Mesorectum. Participating in the formation of the fascial covering of the rectum is the rectovesical fascia or Denonvillier's fascia. This layer, as its name implies, is related to both rectum and bladder. Denonvillier (1836, 1837), who first described the fascial layer, did not discuss its development. Cuneo and Veau (1899), describing the formation of the umbilical prevesical layer of fascia, stated that Denonvillier's fascia had a similar development. According to them there are at first two peritoneal pouches dorsal to the bladder, one extending to the pelvic floor dorsal to the prostate and seminal vesicles, and one dipping between the seminal vesicles and bladder. Their study of sagittal sections of progressively older embryos showed the gradual replacement of these two pouches by single fibrous connective tissue layers (also Rouvière, '24). Tobin and Benjamin ('45) in their excellent restudy of Denonvillier's fascia noted that the pelvic cul-de-sac extends laterally around the rectum.

The peritoneal relations of the mesorectum are illustrated in figure 16 from a 27-mm (8-week) embryo. At this early stage of pelvic development it is possible to visualize the pelvis as a flattened, inverted, empty cone lined by peritoneum. There are two structures bulging into this cavity: the dorsally located rectum and the ventrally located urogenital sinus each suspended from the midline by its mesentery. The deep apex of the cone lies between the two at the level of the developing pelvic diaphragm. The conical effect is accentuated by the peritoneal reflections onto the levator ani muscles. A kinetic process involving descent of the pelvic floor and secondary growth of the viscera occurs, resulting in not only the apposition of the peritoneum of the pouch between the two visceral systems in a frontal plane, but also the circumferential

apposition of visceral to parietal peritoneum in all areas of contact.

The fusion involving the perirectal peritoneum progresses in a caudal to cephalic direction. Figure 22, a photomicrograph of a frontal section of a 53-mm (10-week) embryo, illustrates both the peritoneal layers and the product of their fusion laterally.

The concept of the rectovesical fascia as a simple V-shaped wedge frontally disposed in the pelvis is no longer tenable. The dorsal and ventral limbs extending from the lateral cephalic apices must be included as integral parts of this fascia extending ventrolaterally around the bladder and continuing with the dorsal extensions of the umbilical prevesical fascia and dorsolaterally with the lateral parts of the perirectal fusion fascia.

G. *Meso-urachus and mesocyst.* At the 45-mm stage the allantoic stalk is suspended freely in the peritoneal cavity, attached ventrally in the midline by a primitive mesentery, which also surrounds the umbilical arteries (Cuneo and Veau, 1899; Felix, '12). Rouvière ('24) noted that the primitive ventral mesentery also invested the bladder as the mesocyst. A more recent study of this subject by Hammond, Yglesias and Davis ('41) did not describe the caudal limits and the lateral connections of the fascial layer resulting from fusions in this region.

A photomicrograph (fig. 15) of a parasagittal section of a 67-mm embryo (11th-week) shows that the peritoneal pouches extend caudally on the ventral surface of the bladder. In dissections of fetuses at 20 and 28 weeks, and of newborn infants, the fused elements of the original lateral peritoneal pouches are demonstrable as definite membranous sheets indicating that the descent of the pelvis cannot be the primary factor in the production of the fascia ventral to the bladder. It is evident, nevertheless, that the ultimate caudal limit of this lamella will depend on the extent of the bladder's descent in postnatal life.

Secondary growth contributes the dorsolateral extensions and continuity with the rectovesical fascia. A definite fascia results from this lateral vesical fusion, the paravesical fusion fascia.

Transversalis fascia

The transversalis fascia has been the subject of a variety of interpretations in standard texts of anatomy (Piersol, '30; Davis, '34; Callander, '39; Morris, '42; Grant, '44; Gray, '48). That the transversalis fascia has an extent greater than that of the transversus abdominis muscle is one point on which there is unanimity of opinion. Nearly all anatomists maintain that the transversalis fascia forms the dorsal layer of the rectus abdominis sheath, at least caudal to the linea semicircularis; some extend it as the fascia of the quadratus lumborum and of the diaphragm. As a matter of fact, the layer itself has an even greater extent. Many conflicting descriptions of the parietal fascia are in anatomical literature (Cooper, 1807, 1844; Hesselbach, 1808; Scarpa, 1809; Bogros, 1823; Bassini, 1890; Halsted, 1893; Gerota, 1895; Vecchi, '10; Rouvière, '24; Anson and McVay, '38; McVay and Anson, '40; Zieman, '42; Tobin, '44).

Embryologically, the most cephalic attachment of the levator ani muscle is at the superior pubic ramus. It is only with later differential growth and fusion to the obturator fascia that the origin of the levator ani muscle moves caudad to its arcuate line. In fetuses of 20 and 28 weeks, it is easy to free the levator ani muscles all the way to the pubic ramus. It seems justifiable to describe the fascia on the inner face of of the rectus abdominis and transversus muscles as continuous with the fascia of the cephalic surface of the levator ani muscle as do Martin ('47) and Power ('48). These considerations suggest the concept of a fascial layer everywhere lining the abdominopelvic cavity, since this fascia develops as the innermost layer of the musculoskeletal wall of the cavity. All visceral structures penetrating the body wall must perforate this fascial layer, and in the process of differential

growth perforating structures may carry an investment of this layer a variable distance with them. An adequate descriptive term for such a fascial layer would be *parietal fascia* or *fascia parietalis,* greater specificity being allowed by the application of adjectives referring to the abdomen or pelvis; such a general term is in line with the idea of Waldeyer (1899) in suggesting the term "fascia endo-abdominalis."

Thus far the modifications suggested are based on observable facts. In addition, Grant ('44) states that the psoas muscle is a part of the iliacus that has migrated above the iliac crest, comparable to certain muscles of the pectoral girdle. The pectoral girdle has been applied to the trunk for greater motion; the pelvic girdle has been assimilated into the trunk wall for greater stability. From this point it is theorized on a phylogenetic basis that the introduction of pelvic girdle structures into the body wall requires that the fascial coverings of these structures accompany them.

Dissections of fetuses at 20 and 28 weeks of age show the parietal fascia overlying the fascial covering of the iliacus and psoas muscles. It is also evident at 84 mm (13th week) as illustrated in figure 19. This layer is thinner in character but definitely separated from the aponeurotic fascia of the iliopsoas muscle by a thin layer of developing adipose tissue. Extending the investigation to adult dissections, it is found that as the parietal fascia passes from the ventral surface of the quadratus lumborum into the iliac fossa, it fuses to the inner labrum of the iliac crest adjacent to the origin of the iliac fascia. The attachment to the iliac crest extends ventrally along the inguinal ligament (fig. 11). There the parietal fascia fuses with the ligament as far medial as the vascular compartment. The internal abdominal ring is formed by the parietal fascia as it funnels out through the inguinal canal and continues over the cord as the internal spermatic fascia.

At the vascular compartment the parietal fascia passes caudally to begin its pelvic continuity. At the emergence of the femoral vessels (fig. 11) there is a prolongation of the parietal fascia forming a complete femoral sheath dorsal and

ventral to the vessels, which to this point are embedded in extraperitoneal connective tissue (also Luschka, 1863). The ventral rim of the abdominal orifice of the femoral canal is moderately thickened parietal fascia, the deep crural arch. Medial to the femoral vein the curve of the parietal fascia from abdominal lining to attachment on the vessels as femoral sheath produces the femoral canal. Dorsal to the vessels and to the insertion of the conjoined tendon, the parietal fascia attaches to the superior pubic ramus and to the pubic crest and then continues into the pelvis.

Cephalic to the iliac crest and dorsomedial from its lining position on the transversus abdominis muscle, the parietal fascia extends onto the quadratus lumborum muscle (fig. 12). At the lateral edge of this muscle, the parietal fascia splits into two laminae to enclose partially the quadratus muscle. This line of separation often is fused to the tendon of union of the two layers of lumbodorsal fascia; in many instances it remains free. The dorsal lamina attaches to the tips of the transverse processes of the lumbar vertebrae. The ventral lamina passes ventrally to the muscle to attach to the sides of the lumbar vertebral bodies. It is then reflected ventral to the psoas muscle, with the fascia of which it may fuse more or less completely, to pass ventral to the vertebral bodies and dorsal to all the prevertebral visceral structures, continuing into its counterpart of the opposite side.

A thickened band of parietal fascia over the quadratus lumborum muscle forms the lateral lumbocostal arch serving as a part of the origin of the diaphragm. A thickening of the psoas fascia forms the medial arch and is covered by fused parietal fascia (fig. 12). From the inner surface of the psoas, quadratus, and transversus muscles the parietal fascia continues onto the caudal surface of the diaphragm. This fascia follows the structures traversing the diaphragm and at these points the cephalic and caudal fasciae of the diaphragm merge.

Progressing ventrally from the diaphragm, the parietal fascia is the innermost covering of the dorsal layer of the rectus sheath. It is most evident caudal to the semicircular

folds of Douglas, where it persists as the only fascial cover-
ing of the dorsal surface of the rectus abdominis muscle. At
the pubis the rectus muscle inserts onto the ventral surface
of the symphysis, and the parietal fascia passes to cross the
dorsal surface of the pubis, blending with the periosteum.
This produces the triangular suprapubic space (fig. 11).

At all points along the line marking the entrance to the
true pelvis, the parietal abdominal fascia continues in the
same anatomical plane as the parietal pelvic fascia, cover-
ing the pubes and the obturator internus fascia caudally to
the line of origin of the levator ani muscle, thence onto the
cephalic surface of that muscle (fig. 11). In the midline ven-
trally, at the interlevator cleft, the parietal fascia fuses with
the superior fascial layer of the urogenital diaphragm.

At the site of exit of the nerves and blood vessels from the
pelvis a funneling evagination of the parietal fascia compar-
able to the femoral sheath is produced.

Fascial relations of the adult

Three basic subdivisions of the lining layers of the ab-
dominopelvic cavity emerge from the foregoing detailed con-
siderations. These consist of parietal fascia (outermost layer),
extraperitoneal connective tissue (intermediate layer), and
the peritoneum (the innermost layer).

The parietal fascia has been discussed, leaving the special-
izations of the other two layers to be considered.

A. Migration fasciae. The perirenal fascia is an enveloping
sheath of fibroelastic connective tissue which closely follows
the contours of the kidney and suprarenal gland, separated
from these organs by the perirenal adipose tissue (fig. 3).
There is a complete though thin and delicate septum between
the suprarenal gland and the kidney creating an individual
compartment for each (fig. 4). The ventral lamina of the
perirenal fascia is somewhat thinner than the dorsal and
both laminae merge at the margins of the kidney where the
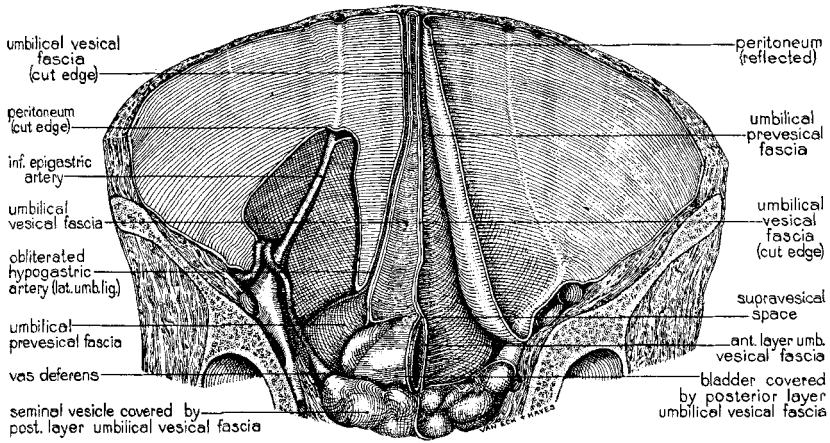fascia loses its individuality in continuity with the extra-

Fig. 1 Schematic view of the ventral abdominal wall viewed from within. On the right nearly all the umbilical vesical fascia has been removed, revealing the umbilical prevesical fascia. On the left, only a part of the umbilical vesical fascia has been removed to show its distribution enveloping the bladder, the ductus deferens, and the seminal vesicles.
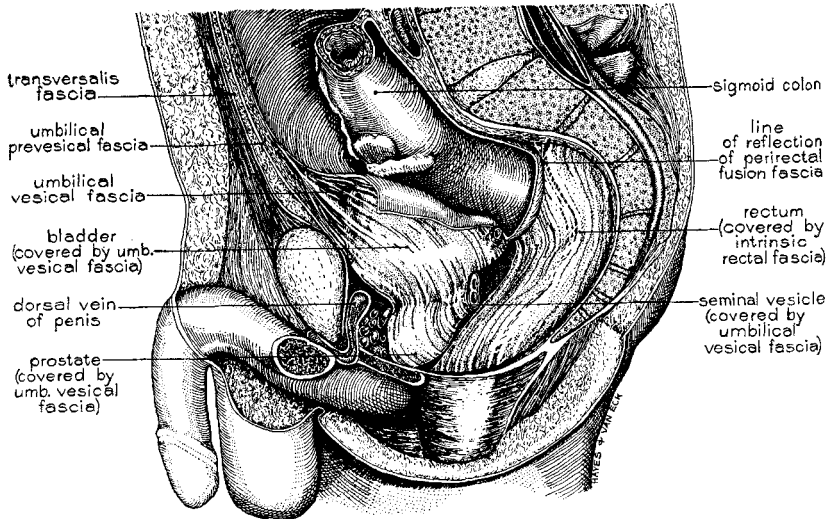

Fig. 2 Semischematic drawing of a pelvic dissection to show the extra-peritoneal migration fasciae of the urogenital apparatus and of the rectum. The apex of the bladder has been removed to demonstrate the, enveloping character of this fascia and the location of the supravesical space. The continuities around ureter and vas deferens are shown.

peritoneal connective tissue. Medially the two laminae merge except in the hilar region, where the two remain separate and continue dorsal and ventral to the renal vessels and the prevertebral vessels, continuing into their counterparts of the opposite side (fig. 3). These fascial extensions are in such intimate relation to the connective tissue surrounding the vessels that no free communication exists between the renal compartments of the two sides.
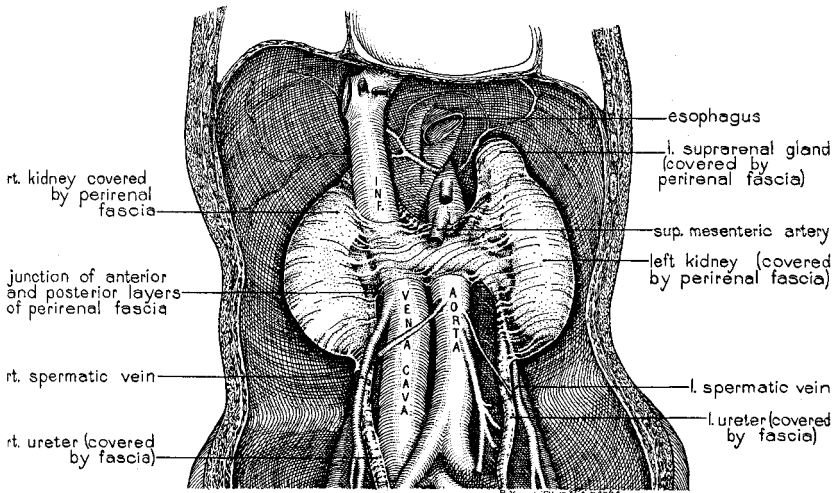

Fig. 3 Semischematic dissection of the dorsal abdominal region; only the vascular and renal systems are shown. The extraperitoneal connective tissue condensation around the kidneys, suprarenal glands, and ureters, and the inclusion of the prevertebral great vessels within this connective tissue sheath are shown.

The perirenal fascia extends caudally as the periureteric fascia (figs. 3, 4). The periureteric part may be regarded as beginning where the layer sweeps out caudally from the renal pelvis. This tubular fascia surrounds the ureter for the entire length of its course and passes onto the bladder in continuity with the umbilical vesical fascia.

The umbilical vesical fascia (fig. 2) is a specialization of extraperitoneal connective tissue enclosing the bladder and associated structures. It is a triangularly disposed fascia

(fig. 1), the apex of which may reach to the umbilicus and encloses the urachus and both obliterated hypogastric arteries. Caudally the fascia ensheathes the bladder, seminal vesicles, and prostate gland (figs. 1 and 2). Local condensations of this fascia form the lateral true ligaments of the bladder and the puboprostatic ligaments. At the apex of the
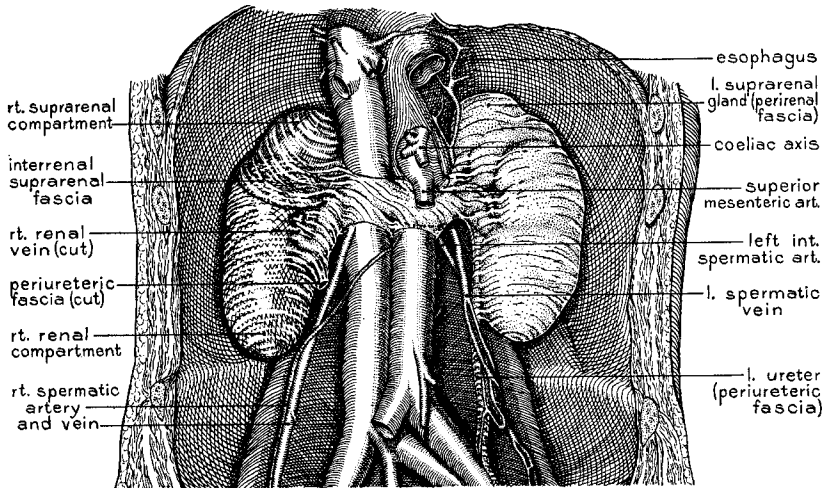

Fig. 4 Schematized drawing to demonstrate the septum dividing the renal compartment from the suprarenal, and the septum's continuity with the perirenal fascia. The left kidney and suprarenal gland have been removed, making it possible to show the perirenal fascia as a continuous envelope. The caudal extension of the periureteric fascia is indicated on the left as cut.

bladder, the umbilical vesical fascia can be opened, demonstrating a conical potential space, the base of which is bladder musculature, the *supravesical space* (fig. 2). An extension of fascia is continued along the ductus deferens (fig. 1) to blend with the extraperitoneal connective tissue common to the components of the spermatic cord.

The perirectal migration fascia is a simple tubular fascia which extends from the line of peritoneal reflection of the rectosigmoid to terminate at the exit of the rectum through the pelvic diaphragm (fig. 2). It lies just peripheral to the

tunica muscularis of the rectum and in it course the vessels, nerves, and lymphatics of the rectum.

Another migration fascia of less significance is the condensation about the lumbosacral nerve plexus and the associated branchings of the internal iliac vascular system. Of
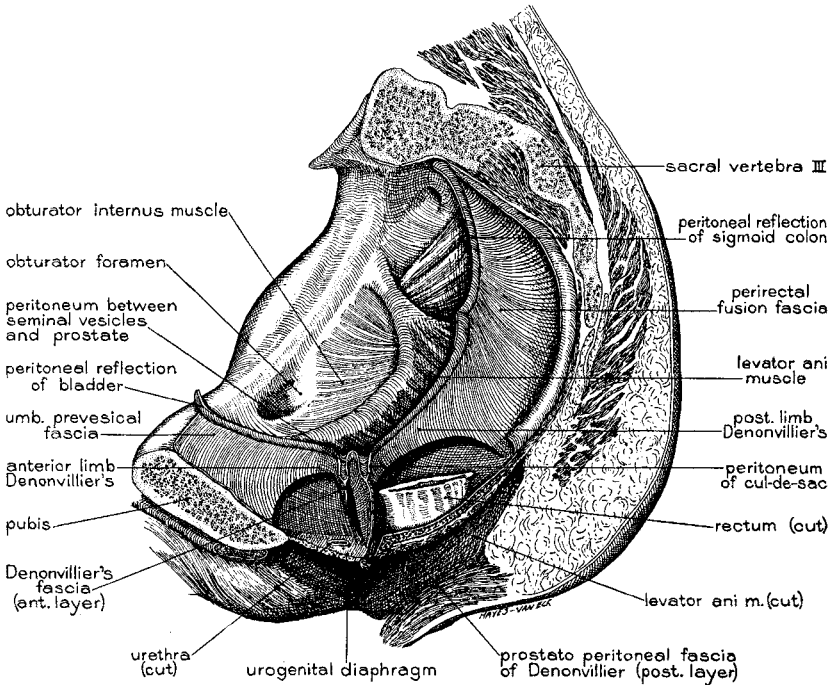

obturator internus muscle

obturator foramen

peritoneum between seminal vesicles and prostate

peritoneal reflection of bladder

umb. prevesical fascia

anterior limb Denonvillier's

pubis

Denonvillier's fascia (ant. layer)

urethra (cut)

urogenital diaphragm

sacral vertebra III

peritoneal reflection of sigmoid colon

perirectal fusion fascia

levator ani muscle

post. limb Denonvillier's

peritoneum of cul-de-sac

rectum (cut)

levator ani m. (cut)

prostato peritoneal fascia of Denonvillier (post. layer)

Fig. 5 Semischematic drawing of a dissection of the pelvis to show the various interconnections and continuities of all the fusion fasciae of the pelvis. The urogenital apparatus and most of the rectum have been removed.

the same type is the fascia associated with the ligamentum teres hepatis and contained in the falciform liagment.

B. *Fusion fasciae.* The fusion fascia lying dorsal to the lesser peritoneal cavity extends from the midline to the left as far as the line of reflection of the persisting portion of the dorsal mesogastrium. These persisting portions may be divided into gastrophrenic, lienophrenic, lienorenal, and

pancreaticolienal ligaments (fig. 8). The cephalic limit of
the fascia is the bare area of the esophagus. Its caudal limit
is the caudal border of that part of the pancreas lying to the
left of the midline. The right border of this fascial plane is
the midline as far caudal as the beginning of the retro-
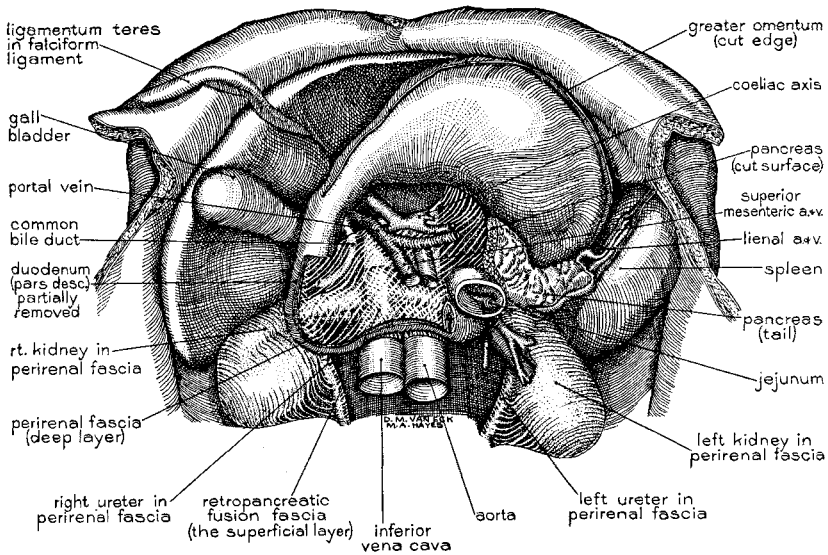peritoneal portion of the first part of the duodenum. Below

Fig. 6 Semischematic drawing of a dissection to show the relation of the
retropancreatic fusion fascia lying ventral to the perirenal extraperitoneal migra-
tion fascia. The cephalic extension of the retropancreatic layer into the dorsal
mesogastrium fusion layer is shown in part.

this level the fusion fascia extends to the right of the mid-
line as far as the parietal reflection of the visceral peritoneum
from the first and second parts, and a portion of the third
part of the duodenum. The perirenal fascia is dorsal to this
layer (fig. 6). This fusion layer covers the hilar region and the
medial border of the right kidney and the most medial part of
the right suprarenal gland; it crosses the middle third of the
left kidney and overlies most of the medial aspect of the ce-
phalic pole of the left kidney and most of the left suprarenal

gland. The main vascular channels such as the left gastric artery and the splenic vessels course in the tissue between this fusion fascia and the retained peritoneum of the lesser peritoneal cavity, the duodenum, and the pancreas (figs. 6, 8).

The fusion fasciae of the colon have a more extensive distribution (fig. 7). The fascia resulting from the fusion

hepatic vein entering
inferior vena cava

bare area(for liver)

hepatic root

rt.triangular ligament

duodenum

right kidney

line of attachment
root of common
mesentery

right colon fusion
fascia

peritoneal reflection
lateral side
asc. colon

median
umbilical ligament

falciform ligament

l. triangular ligament

esophagus
line of attachment
greater omentum

pancreas

attachment of
transverse mesocolon

left kidney

left colon
fusion fascia

peritoneal reflection
lateral side
desc. colon

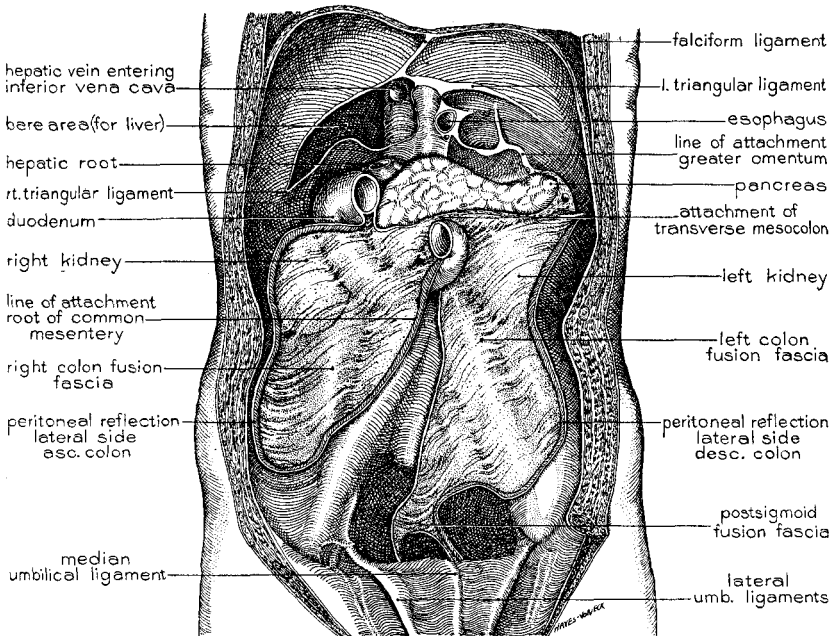postsigmoid
fusion fascia

lateral
umb. ligaments

Fig. 7 Semischematic drawing of a dissection showing the fusion fasciae associated with the colon. The stomach, jejunum, ileum, and entire colon have been removed. The mesentery and the persisting peritoneum of the colon have all been removed, showing only the fibrous layer which remains after fusion.

of the right side of the ascending colon extends from the root of the mesentery to the right as far as the line of reflection of the peritoneum from the colon to the parietal wall, laterally. Its caudal limit is determined by the degree of fusion that has occurred between the cecum and the peritoneum of the dorsal body wall. Similarly, the lateral cephalic limit of this layer will depend on the amount of

freedom existing in the mesentery of the hepatic flexure.
More medially, the cephalic limit is determined by the line
of attachment of the transverse mesocolon. In its usual loca-
tion, it covers the ventral surface of the caudal half of the
right kidney, portions of the second and third parts of the
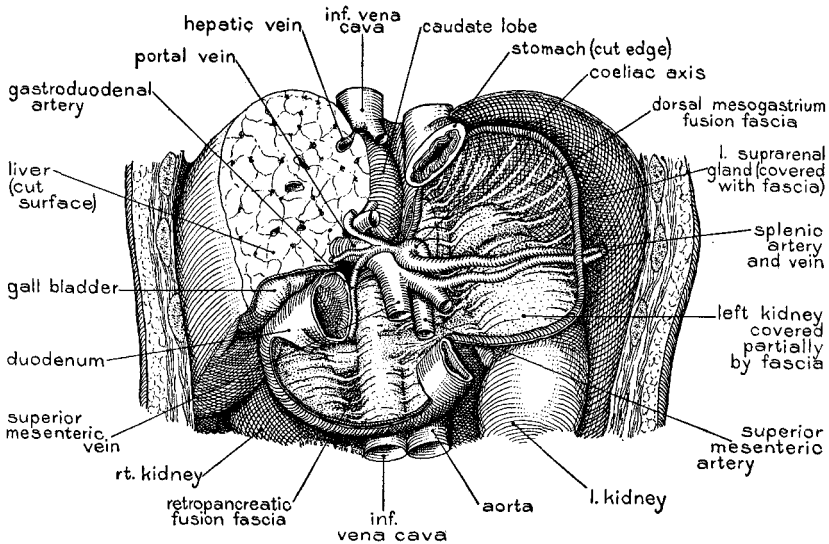duodenum, and a part of the head of the pancreas.

Fig. 8   Schematized dissection to show the fascia resulting from the fusion
of the left side of the dorsal mesogastrium to the dorsal body wall. The duo-
denum has been partially cut away. The peritoneum of the gastrophrenic, lieno-
renal, and gastrocolic ligaments has been reflected at the edge of the fascial
layer.

The mesentery of the descending colon produces a similar
picture on the left side of the body cavity (fig. 7). In the
abdominal cavity proper the right border of this fascia is
the midline and the left is the line of reflection of the peri-
toneum from the colon to the body wall. In the region of the
sigmoid mesocolon the left border is at the left side of the
attachment of the mesosigmoid to the body wall. There is
no fusion fascia in the intersigmoid recess. This fusion fas-

cia covers the ventral surface of the most caudal edge of the body of the pancreas and the caudal third of the left kidney.

At the entrance to the pelvis the mesentery of the large bowel retains its midline suspension. At the level of the third sacral vertebra the rectosigmoid segment begins to lose its complete peritoneal investment. The crescentic lines of reflection of peritoneum from gut to parietes indicate the cephalic limit of the perirectal fusion fascia (fig. 5). From this peritoneal reflection the fascia extends caudally as a tubular structure encircling the rectum almost to the site of its passage through the pelvic diaphragm and external to the perirectal migration fascia. The ventral segment of this circular fusion fascial sheet forms the rectovesical septum or fascia of Denonvillier and dorsally attaches at the midline, the original root of its mesentery.

The umbilical prevesical fascia is a triangularly shaped fascial sheet with its apex at the umbilicus (fig. 1). The dorsal surface of this fascia is free; the ventral surface has a sagittal attachment at the midline, extending caudally from the umbilicus and indicating the line of attachment of the former meso-urachus and mesocyst. Its lateral limits are the lateral umbilical ligaments or the parietal attachments of the mesenteries of these structures. The caudal limit of this fascia is quite variable. The usual location is dorsal to the pubis at the level of the puboprostatic ligaments. The umbilical prevesical fascia is ventral to the umbilical vesical fascia (fig. 1). The cephalic limits of the dorsal limbs of this fascia are the obliterated hypogastric arteries and their continuations, the superior vesical arteries. The dorsal extensions passing laterally to the bladder are in direct continuity with the rectovesical fascia.

These facts provide material for simplification of the conflicting views concerning the "space of Retzius" (1858). Many observers have given different boundaries for this space (Hyrtl, 1858; Charpy, 1892; Waldeyer, 1899; Rouvière, '24; Hinman, '37; Callander, '39) necessitating re-evaluation of the anatomy concerned. In view of the several fasciae and

falciform ligament
right lobe
peritoneal reflection of the coronary ligament
fusion fascia
left triangular ligament
right triangular ligament
impression for esophagus
fossa for lig. ductus venosus
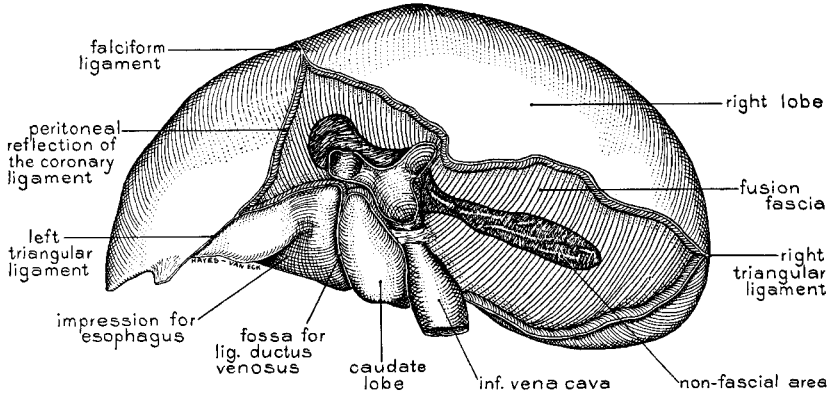caudate lobe
inf. vena cava
non-fascial area

Fig. 9   Schematic view of the cephalic surface of the liver to show the fusion fascia of the coronary ligament area. The parietal peritoneum is shown reflected at the periphery of the fascia. This diagram also shows the relative expanses of the fascial and non-fascial areas of the liver.

inf. vena cava
ligament of vena cava
fusion fascia of coronary lig.
esophageal impression
caudate lobe
peritoneum (reflected)
left lobe
right lobe
gastric impression
portal vein
left and rt. br. hepatic art.
cystic duct
hepatic duct
cystic art.
gall bladder (cut edge)
renal impression
falciform ligament
duodenal impression
ligamentum teres
quadrate lobe
gall bladder fusion fascia
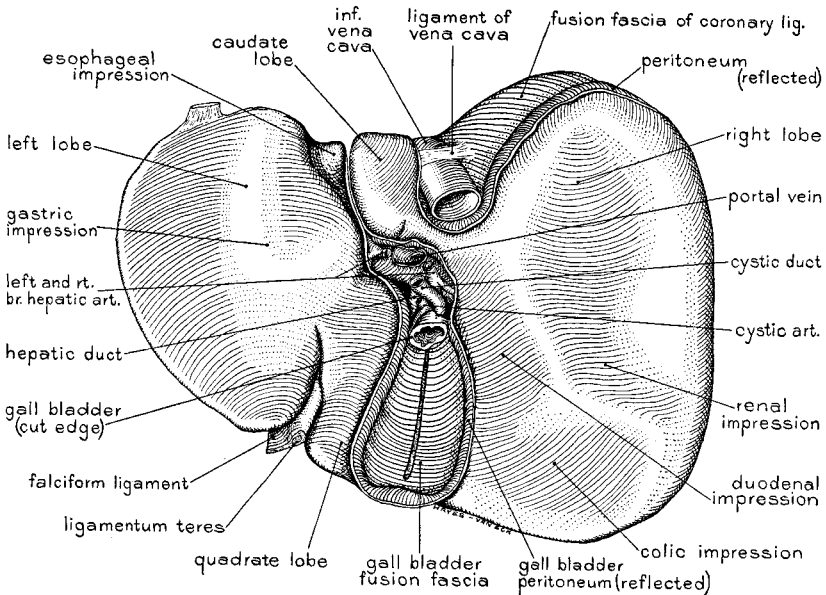gall bladder peritoneum (reflected)
colic impression

Fig. 10   Illustration of the caudal surface of the liver. The peritoneum of the gallbladder has been reflected and the neck of the gallbladder transected, with the major part removed. The fascia resulting from the fusion of the gall bladder mesentery is shown.

interfascial clefts present it is no longer possible to consider the "space of Retzius" as a single anatomical entity. In its place a new concept of multiple fascial spaces in this region is suggested. The most ventral of these spaces is the *suprapubic space* bounded ventrally by the rectus abdominis muscle, dorsally by parietal fascia, caudally by the pubis.

Left side labels (top to bottom):
transversalis fascia(cut)
inf. epigastric artery
ductus deferens
deep crural arch
falx inguinalis
femoral canal
transversalis sheath of obturator art. and nerve
supra pubic space
bladder
symphysis pubis
prostate
transversalis fascia on sup. layer U.G. diaphragm

Right side labels (top to bottom):
deep circumflex iliac artery
common iliac vein
common iliac art.
internal spermatic artery and vein
external iliac art.
hypogastric art.
external iliac vein
obturator nerve and artery
inf. gluteal art.
int. pudendal art.
levator ani musc. covered by transversalis fascia
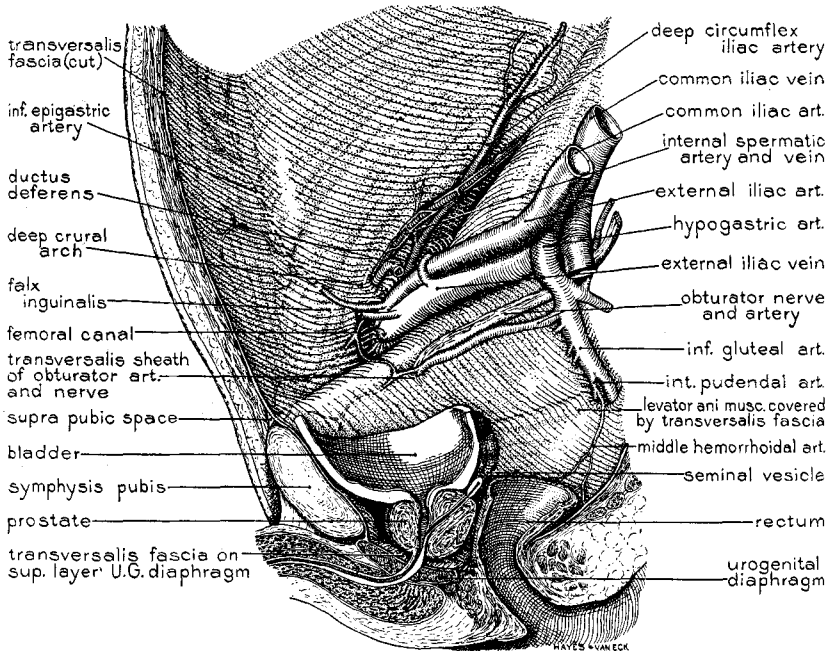middle hemorrhoidal art.
seminal vesicle
rectum
urogenital diaphragm

Fig. 11 Schematic drawing of a dissection of the pelvis to show the continuity of the parietal abdominal fascia into the pelvis as the parietal pelvic fascia. The formation of the femoral sheath and deep crural arch is shown. The structures perforating the parietal fascia are shown.

Next in order is the space bounded ventrally by the parietal fascia, dorsally by the umbilical prevesical fascia and for which the term *umbilical vesical prefascial space* is suggested. This space has dorsal extensions guided by the dorsal limbs of the umbilical prevesical fascia to the region of the pelvic side of the acetabulum. The next space to consider is bounded ventrally by the umbilical prevesical fascia and

dorsally by the umbilical vesical fascia, the *umbilical vesical interfascial space*. Another more dorsal space is the *supravesical space*, previously described (p. 138). The most dorsal space is bounded by the umbilical vesical fascia ventrally and the peritoneum dorsally, the *umbilical vesical retrofascial space*.

hiatus for inf. vena cava

esophageal hiatus

aortic hiatus

lateral lumbo-costal arch (parietal fascia)

parietal fascia splitting to surround quadratus lumborum musc.

parietal fascia attachment to iliac crest

iliacus and psoas muscles and fascia covered by parietal fascia

parietal fascia (femoral sheath)

parietal fascia (reflected)

medial lumbo-costal arch (psoas fascia)

diaphragm musc.(cut) origin from lat.arch

psoas fascia (cut)

quadratus lumborum muscle

femoral nerve

iliacus fascia

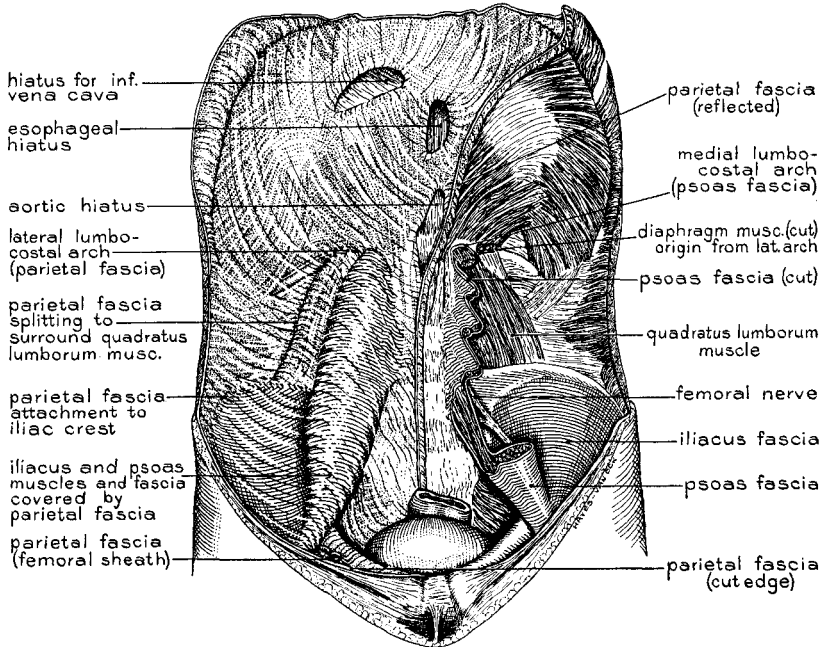psoas fascia

parietal fascia (cut edge)

Fig. 12   Schematized dissection of the dorsal body wall to show adult relations of the parietal fascia. This fascia has been removed from the left part, leaving the iliopsoas fascia, illustrating the latter's relations and the formation of the medial lumbocostal arch. On the right the continuity of the parietal fascia with the fascia of the cephalic surface of the diaphragm at the openings is shown. The thickening to form the lateral lumbocostal arch and attachment to the crest of the ilium are illustrated. The parietal fascia lines the iliac fossa and covers the iliopsoas fascia.

The fusion fascia associated with the falciform ligament is comparable to the umbilical prevesical fascia in its mode of production and its disposition. This fascia is triangular in shape with its apex at the umbilicus and its base at the umbilical notch of the liver. In a few instances, it is pos-

sible to identify a continuity of it with the fusion fascia of
the bare area of the liver. The lateral limits of this fascia are
determined by the width of the base of the falciform liga-
ment.

The "bare area" of the liver needs redefinition in that it
has two components, the *fascial area* and the *non-fascial area*.
There is a fusion fascia bordering the entire periphery of
the non-fascial area, or the primitive attachment of the liver
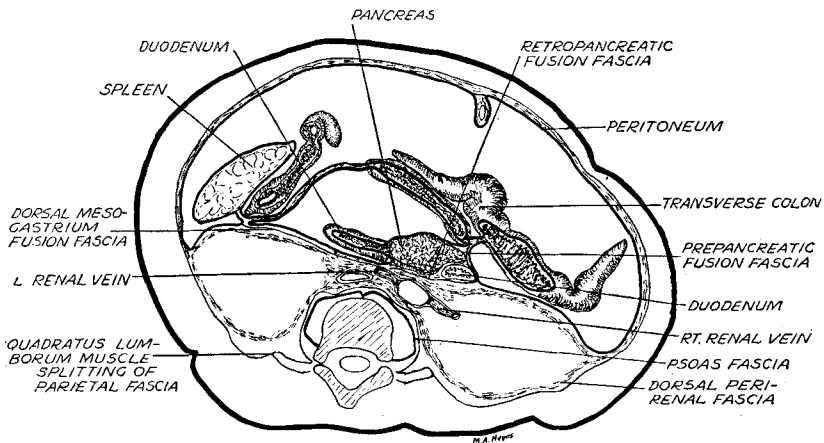to the septum transversum (fig. 9), and extending to the line

Fig. 13 Transverse section through the abdominal cavity of a human fetus
of 279 mm (28 + weeks). The level is at the top of the second lumbar vertebra.
Extraperitoneal connective tissue fasciae and fusion fasciae at this level are
well shown. Schematic line drawing of a specimen prepared by dissection and
embedding in ethyl methacrylate. (× 1.5, University of Michigan Coll., EH 441.)

of reflection of the coronary ligament onto the diaphragm.
Great variations in extents may be noted here; generally, the
bare area is largely fascial.

Finally, the fusion fascia of the gallbladder fossa may be
considered. This fascia (fig. 10) closely conforms to the
hepatic contour of the fossa, and is intimately associated with
the underlying liver tissue and is bound to it by a fibrous
attachment, the original mesenteric attachment. The fascia
is continuous at the periphery with the line of reflection of
the peritoneum from the liver to the gallbladder.

SUMMARY AND CONCLUSIONS

An investigation of adult abdominopelvic fasciae has been made, employing a developmental approach. The studies involved the sequential development of visceral changes as observed in a closely graded series of human embryos, fetuses, newborn infants, and adults.

Examination of the sequence of developmental events and the evaluation of each intermediate stage in such a sequence unfolds and integrates a story that is essentially predictable in its final pattern.

Two processes of development produce different types of fasciae in the adult. Organ migrations produce regional specializations of the adult extraperitoneal connective tissue, designated *migration fasciae.*

The fasciae resulting from fusions of primitive mesenteries are termed *fusion fasciae.*

The third type of fascia is intrinsic to the structures in the wall of the developing abdominopelvic cavity. This fascia is the *parietal fascia.*

With an understanding of the embryological changes that occur it is possible to predict and confirm the presence of the abdominopelvic fasciae; their presence and modifications are presented as the logical end results of normal development.

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PLATES

EXPLANATION OF FIGURES

14   Parasagittal section through the left kidney of a 67 mm (11-week) human embryo, showing the perirenal mesenchymal condensation (perirenal connective tissue). The condensation also includes the suprarenal gland with a septum between the two structures. The thin parietal fascia is shown. (Photomicrograph, × 14, from University of Michigan Coll., EH 269a.)

15   Parasagittal section through the pelvic region of a human embryo of 67 mm (11 weeks) to show fascial relations. The lateral paravesical peritoneal relations, perivesical mesenchymal tissue, as well as the parietal fascia are shown. (Photomicrograph, × 9, from University of Michigan Coll., EH 269a.)

16   Frontal section through the abdominal and pelvic cavities of a human embryo of 27 mm (8 weeks) to show the mesenchymal concentrations around the kidney and ureter. The lateral peritoneal relations of the rectosigmoid are shown and incipient fusion is apparent. (Photomicrograph, × 15, from University of Michigan Coll., EH 216.)
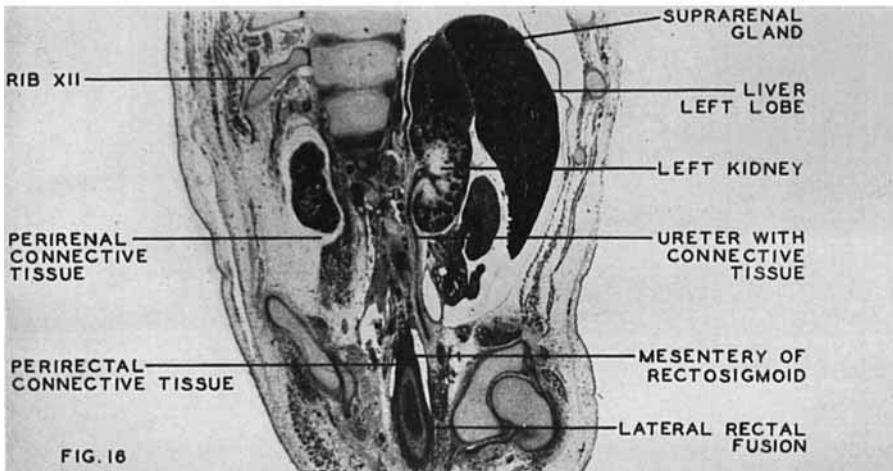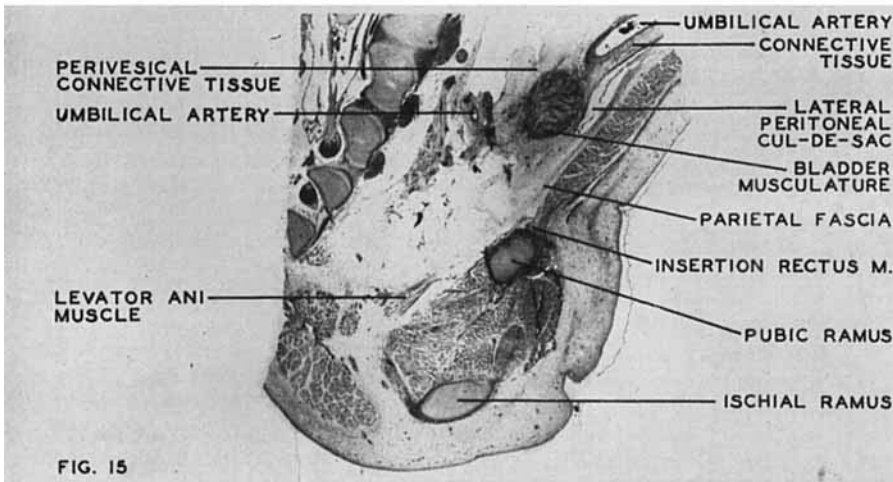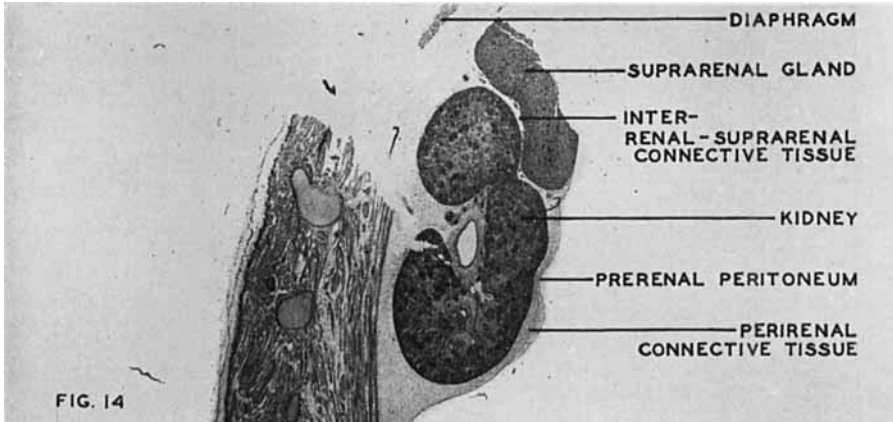
FIG. 14

— DIAPHRAGM
— SUPRARENAL GLAND
— INTER-RENAL-SUPRARENAL CONNECTIVE TISSUE
— KIDNEY
— PRERENAL PERITONEUM
— PERIRENAL CONNECTIVE TISSUE

FIG. 15

PERIVESICAL CONNECTIVE TISSUE
UMBILICAL ARTERY
LEVATOR ANI MUSCLE

— UMBILICAL ARTERY
— CONNECTIVE TISSUE
— LATERAL PERITONEAL CUL-DE-SAC
— BLADDER MUSCULATURE
— PARIETAL FASCIA
— INSERTION RECTUS M.
— PUBIC RAMUS
— ISCHIAL RAMUS

FIG. 16

RIB XII
PERIRENAL CONNECTIVE TISSUE
PERIRECTAL CONNECTIVE TISSUE

— SUPRARENAL GLAND
— LIVER LEFT LOBE
— LEFT KIDNEY
— URETER WITH CONNECTIVE TISSUE
— MESENTERY OF RECTOSIGMOID
— LATERAL RECTAL FUSION

PLATE 2

17 Frontal section through the abdominal cavity of a human embryo of 84 mm (12 + weeks) to show relations of the various parts of the duodenum and associated fusion areas. The left prerenal fusion and the free duodenal segments are shown. The fusion of the transverse mesocolon ventral to the duodenum and pancreas appears. The retropancreatic fusion of the dorsal mesogastrium is well illustrated. (Photomicrograph, × 8.5, from University of Michigan Coll., EH 228c.)

18 Parasagittal section through the head of the pancreas of a human embryo of 104 mm (14 weeks) to show peritoneal fusion in the region of the pancreas, duodenum, and transverse colon. (Photomicrograph, × 5.5, from University of Michigan Coll., EH 296g.)

19 Frontal section of the abdominal cavity of a human embryo of 84 mm (12 + weeks) to show migration and fusion fasciae. The colon fusion on the right and the perirenal fascia on the left are well shown. This view demonstrates the relations of parietal and iliopsoas fasciae at their attachments to the crest of the ilium. (Photomicrograph, × 11.5, from University of Michigan Coll., EH 288c.)
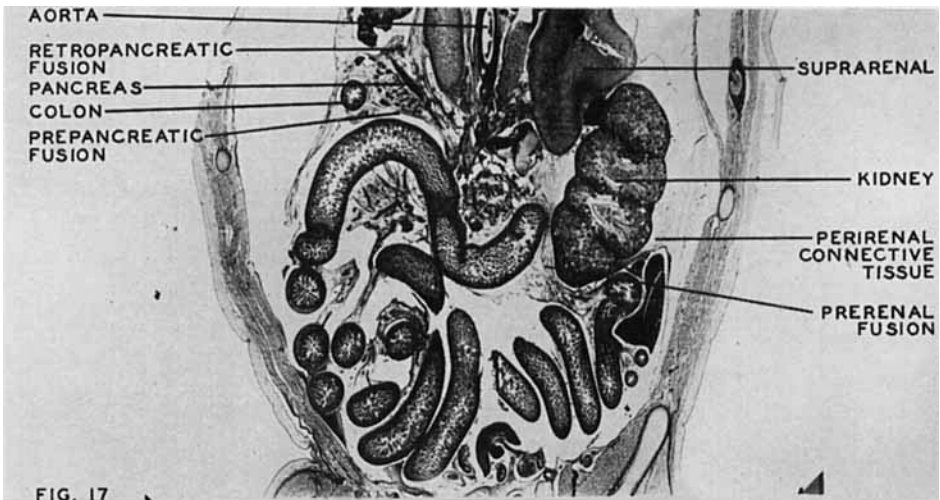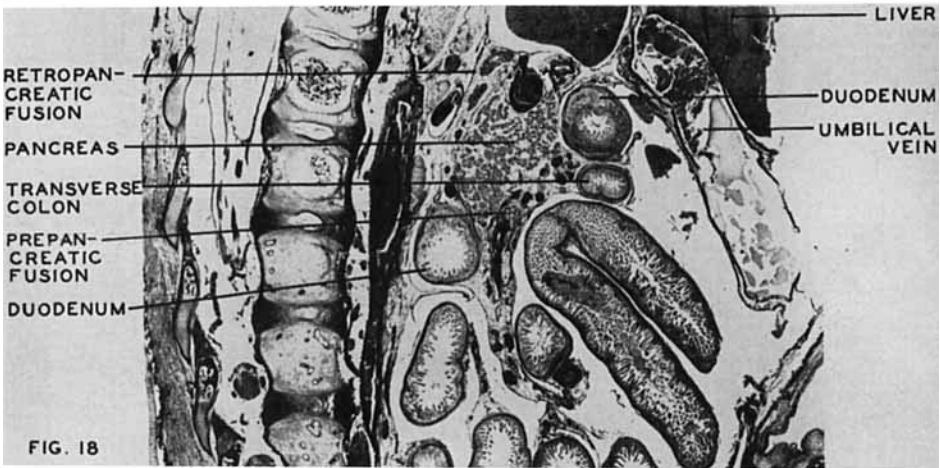
FIG. 17

AORTA
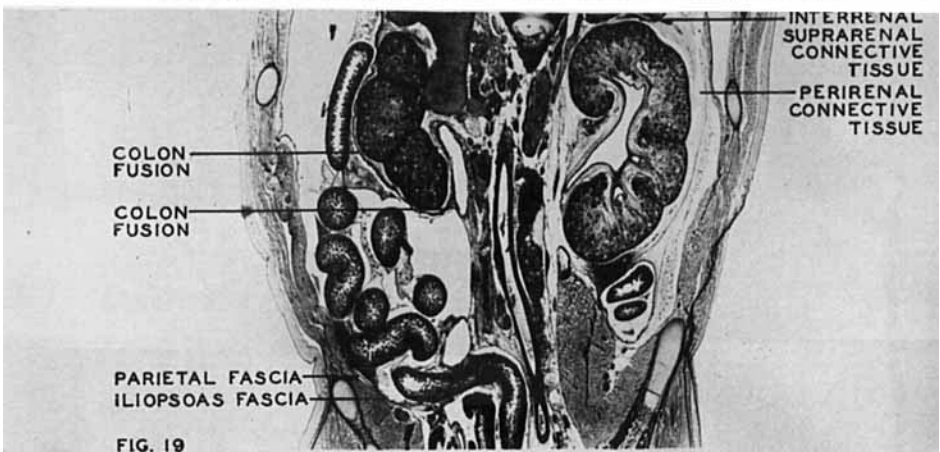RETROPANCREATIC FUSION
PANCREAS
COLON
PREPANCREATIC FUSION

SUPRARENAL
KIDNEY
PERIRENAL CONNECTIVE TISSUE
PRERENAL FUSION

FIG. 18

RETROPAN-CREATIC FUSION
PANCREAS
TRANSVERSE COLON
PREPAN-CREATIC FUSION
DUODENUM

LIVER
DUODENUM
UMBILICAL VEIN

FIG. 19

COLON FUSION
COLON FUSION
PARIETAL FASCIA
ILIOPSOAS FASCIA

INTERRENAL SUPRARENAL CONNECTIVE TISSUE
PERIRENAL CONNECTIVE TISSUE

PLATE 3

20 Frontal section of the pelvic region of a human embryo of 33 mm (10 weeks) to show fascial and peritoneal relations. The rectosigmoid mesentery persists. Early perirectal fascia is apparent. The parietal fascia extends up to the pelvic brim on the right, and its relation to the obturator fascia is illustrated. (Photomicrograph, ✕ 10, from University of Michigan Coll., EH 370a.)

21 Frontal section of the dorsal region of the pelvic cavity of a human embryo of 89 mm (late 13th week) which shows perirectal fusion fascia in the process of formation at the depth of the lateral cul-de-sac. The levator ani muscle extends nearly to the pelvic brim. The branches of the superior hemorrhoidal artery are included in the perirectal migration fascia. (Photomicrograph, ✕ 12, from University of Michigan Coll., EH 300j.)

22 Frontal section of the pelvic region of a human embryo of 53 mm (10 weeks) to show fascial relations in the dorsal part of the pelvis. The lateral rectal cul-de-sac with attaching fusion fasciae are shown. The parietal fascia is distinct from the obturator fascia. (Photomicrograph, ✕ 8.5, from University of Michigan Coll., EH 370a.)
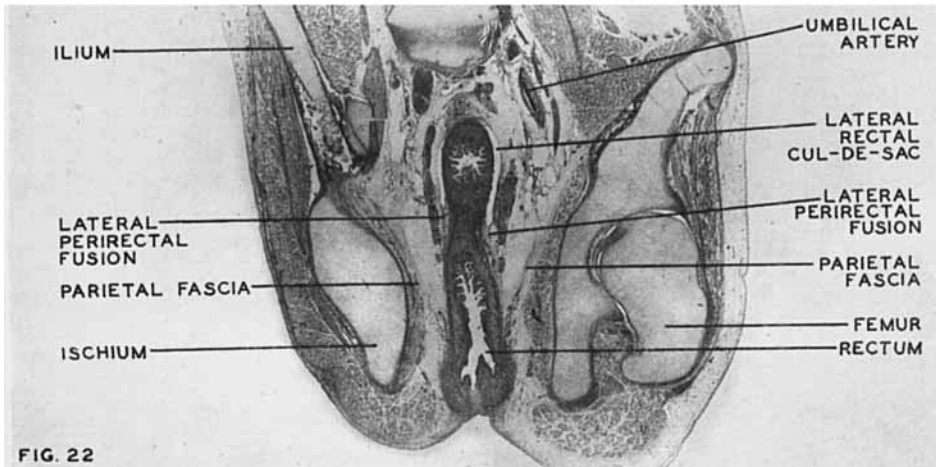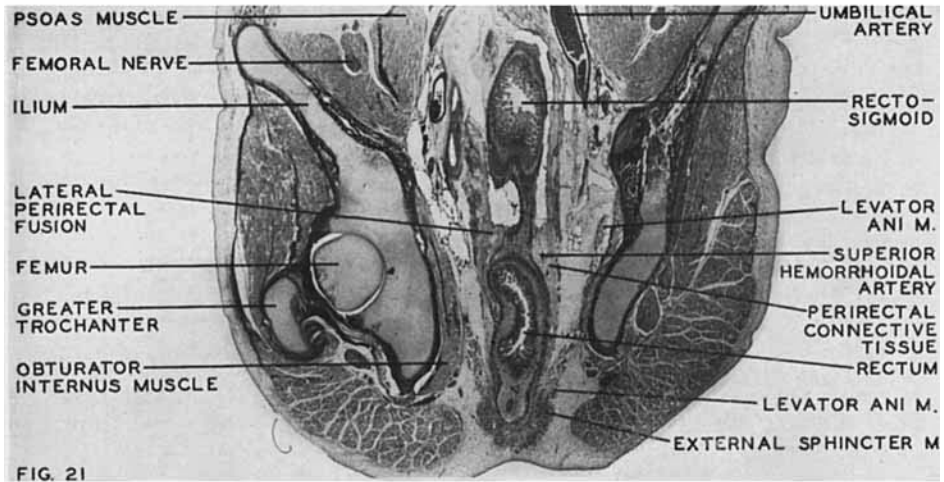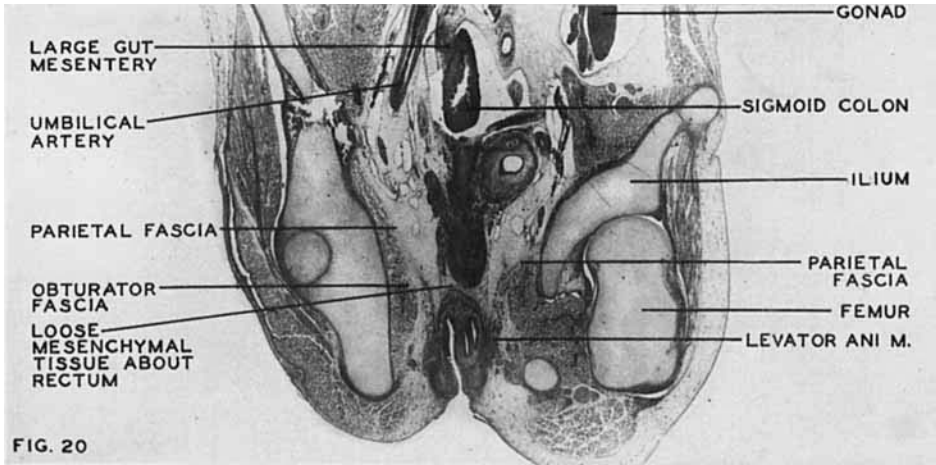
GONAD
LARGE GUT MESENTERY
UMBILICAL ARTERY
SIGMOID COLON
ILIUM
PARIETAL FASCIA
PARIETAL FASCIA
OBTURATOR FASCIA
FEMUR
LOOSE MESENCHYMAL TISSUE ABOUT RECTUM
LEVATOR ANI M.

FIG. 20

PSOAS MUSCLE
UMBILICAL ARTERY
FEMORAL NERVE
ILIUM
RECTO-SIGMOID
LATERAL PERIRECTAL FUSION
LEVATOR ANI M.
FEMUR
SUPERIOR HEMORRHOIDAL ARTERY
GREATER TROCHANTER
PERIRECTAL CONNECTIVE TISSUE
OBTURATOR INTERNUS MUSCLE
RECTUM
LEVATOR ANI M.
EXTERNAL SPHINCTER M

FIG. 21

ILIUM
UMBILICAL ARTERY
LATERAL RECTAL CUL-DE-SAC
LATERAL PERIRECTAL FUSION
LATERAL PERIRECTAL FUSION
PARIETAL FASCIA
PARIETAL FASCIA
FEMUR
ISCHIUM
RECTUM

FIG. 22

PLATE 4

23 Parasagittal section through the left kidney area of a human embryo of 104 mm (14 weeks). Colon fusion fascia ventral to the kidney is shown with its continuity into the attachment of the transverse mesocolon caudal to the body of the pancreas. Fusion of the dorsal mesogastrium (retropancreatic) is well established. The gastrocolic ligament is not yet formed. (Photomicrograph, × 6, from University of Michigan Coll., EH 296g.)

24 Parasagittal section through the left kidney area of a human embryo of 104 mm (14 weeks) to show perirenal and interrenal-suprarenal migration fascia. Prerenal colon fusion fascia and retropancreatic fusion ventral to the left suprarenal gland are also well shown. (Photomicrograph, × 6, from University of Michigan Coll., EH 296g.)

FIG. 23

FIG. 24