10 The Pancreas

Anatomy

General Facts
The pancreas is 14–18 cm long and weighs 70–80 g. It is a gland with exocrine and endocrine features.

Division
- head of pancreas with the uncinate process
- body of pancreas
- tail of pancreas
- pancreatic duct (Wirsung)
- accessory pancreatic duct (Santorini)

Location
The pancreas is a secondarily retroperitoneal organ. It lies on the median line roughly at the level L1–L2, with the head lower than the tail: the axis of the body is inclined toward the upper left approximately 30° to the horizontal line.

The accessory pancreatic duct, if present, enters the duodenum 2–3 cm above the major duodenal papilla.

Topographic Relationships
- duodenum
- L2–L3 (head of pancreas), covered by the right crus of the diaphragm
- common bile duct
- aorta
- inferior vena cava
- left renal vein

Fig. 10.1 Topographic relationships of the pancreas.
The Pancreas

- pylorus
- superior mesenteric artery and vein
- duodenojejunal flexure
- omental bursa
- stomach
- kidneys
- transverse mesocolon (divides the pancreas into a sub- and a supramesocolic part)
- transverse colon
- left colic flexure
- splenic vein
- peritoneum
- spleen
- lesser omentum
- portal vein

Attachments/Suspensions
- organ pressure
- turgor
- attachments of connective tissue in the retroperitoneal space
- pancreaticosplenic ligament
- retropancreatic fascia (Treitz)
- transverse mesocolon
- duodenum

Circulation

Arterial
- superior mesenteric artery
- gastroduodenal artery (from the common hepatic artery)
- splenic artery

Venous
- superior mesenteric vein
- portal vein (from the splenic vein and pancreaticoduodenal veins)

Lymph Drainage
- direct lymphatic connections to nearby organs (duodenum)
- via celiac lymph nodes to the gastric and hepatic lymph nodes on the left side of the body
- mediastinal and cervical lymph nodes
- pancreaticocolic lymph node and pylorus
- mesenteric and periaortal lymph nodes

Innervation
- sympathetic nervous system from T5 to T9 (sometimes also T10 and T11) via the major splanchnic nerve, with switching in the celiac plexus
- vagus nerve

Organ Clock
Maximal time: 9–11 a.m.
Minimal time: 9–11 p.m.

Organ–Tooth Interrelationship
For basic information, see page 34.

- First back tooth in the lower jaw, right side
- First molar in the upper jaw on the right side

Movement Physiology according to Barral

Mobility
Due to the good fascial anchoring in the retroperitoneal space, it is impossible to detect a separate mobility. Nevertheless, the movements of the neighboring organs and the diaphragm cause pushing and pulling on the pancreas.

Motility
With a hand that rests on the projection of the pancreas on the abdomen (fingers pointing to the tail, thenar lies above the head), we can detect a wave from the heel of the hand to the fingertips during exhalation. During inhalation, the wave runs in the opposite direction.

Physiology

The pancreas is a gland with exocrine and endocrine features. The endocrine parts, the islets of Langerhans, are distributed throughout the entire pancreas with accumulations in the body and tail. The cells in the islets of Langerhans produce the hormones that are responsible for regulating blood sugar: insulin, glucagon, and somatostatin.

Insulin
Insulin is synthesized in the β cells of the islets of Langerhans (approximately 2 mg/day) and lowers the blood sugar level by making the cell wall of each body cell permeable to glucose. In addition, insulin assists in the uptake of different amino acids into the cell.
In the liver, it initiates a variety of metabolic processes:
- glycogen synthesis and inhibition of glycogenolysis
- synthesis of lipids and inhibition of lipolysis
- inhibition of protein breakdown

**Glucagon**

Glucagon is produced in the α cells of the islets. It is the “insulin antagonist”: by promoting glycogenolysis and gluconeogenesis in the liver, it raises the blood sugar level.

**Somatostatin**

The δ cells synthesize this hormone. It suppresses the release of insulin and glucagons, and decreases digestive activity by reducing intestinal peristalsis and inhibiting the secretion of digestive juices. Its function is to maintain the glucose level as much as possible.

The exocrine gland part of the pancreas secretes juice into the pancreatic duct. As a result of its activity, approximately 1–1.5 L of “abdominal saliva” thus reaches the duodenum per day.

This secretion consists of:
- bicarbonate to neutralize the acidic chyme from the stomach
- trypsinogen and chymotrypsinogen (enzymes for digesting protein)
- α-amylase (also present in the saliva of the mouth) for cleaving carbohydrates
- lipase (enzyme for cleaving fat)

The enzymes of this “abdominal saliva” are not yet activated in the pancreas. It is only after contact with bile or the enterokinase in the duodenal juice that they are activated and begin working. If this activation takes place in the pancreas, it results in autodigestion and the symptoms of acute pancreatitis.

**Pathologies**

**Symptoms that Require Medical Clarification**

- Icterus
- Pain in the depth of the upper abdomen with back pain in the area of the lower thoracic spinal column, radiating beltlike from the back to the front
- “Rubber stomach”

**Acute Pancreatitis**

*Definition.* Inflammation of the pancreas with disturbance of exocrine and endocrine functions.

*Causes*
- biliary tract disorders (40–50%)
- alcohol abuse (30–40%)
- idiopathic (10–30%)

Rare causes include:
- medications (diuretics, β blockers, glucocorticoids, antibiotics, nonsteroidal antiinflammatics)
- trauma
- infections (mumps, Coxsackievirus)
- hypercalcemia (e.g., hyperparathyroidism)
- hyperlipoproteinemia
- papillary stenosis

*Clinical*
- guiding symptom: severe upper abdominal pain, arising approximately 8–12 hours after a large meal or alcohol abuse, with pain radiating into the back and ringlike to the left around the torso
- shock

**Chronic Pancreatitis**

*Definition.* Chronic inflammation of the pancreas is characterized by persistent or recurrent pain with usually irreversible morphologic changes in the pancreatic parenchyma and functional disturbances in the pancreas.

*Causes*
- alcohol (70–90%)
- idiopathic (10–25%)

Rare causes include:
- anomalies in the pancreatic duct system
- hyperparathyroidism
- trauma
- abuse of analgesics

*aus: Hebgen, Visceral Manipulation in Osteopathy (ISBN 9783131472014) © 2010 Georg Thieme Verlag KG*
Osteopathic Tests and Treatment

Fascial Stretch of the Pancreas in Longitudinal Axis according to Barral

Starting Position
The patient is in the supine position, legs bent. The practitioner stands on the patient’s right side at the height of the pelvis.

Procedure
Place your left hand on the abdomen, with the fingers on the projection of the head of the pancreas. The right hand is placed with the thenar on the projection of the tail of the pancreas. Now apply gentle pressure posteriorly with both hands, compressing the superficial tissue on top of the pancreas. When you have reached the fascial plane of the pancreas, stretch with both hands simultaneously along the longitudinal axis of the pancreas and hold the pull until you notice a fascial release.

Test and Treatment of Pancreatic Motility according to Barral

Starting Position
The patient is in the supine position, legs stretched out. The practitioner sits by the patient’s right side.

Procedure
The right hand of the practitioner rests without pressure on the projection of the pancreas on the abdomen—the thenar on the head, the fingertips on the tail. The forearm also rests on the abdomen.

During exhalation, you will notice a wavelike movement from the heel of the hand to the fingertips, during inhalation it is in the opposite direction.

Testing Sequence
Detect the motility motion and evaluate the amplitude and direction of the inspiratory and expiratory movements as well as the rhythm of the movement as a whole. If a disturbance is present in one or both aspects of the motility movement, treat the patient.

Treatment
Motility is treated indirectly by following the unimpaired movement, remaining at the end-point of this movement for several cycles, and then following the impaired movement to the new end-point.

You can also try to increase the range of the free movement (induction), afterward checking whether the limited movement direction has improved.

Repeat this movement again and again until the motility has returned to normal in terms of rhythm, direction, and amplitude.
Fascial Technique according to Finet and Williame

Starting Position
The patient is in the supine position, legs stretched out. The practitioner stands on the patient’s right side.

Procedure
Place your right hand on the projection of the pancreas with the heel of the hand on the head and the fingertips on the tail. Place your left hand on the posterior projection of the pancreas with the heel of the hand on the head and the fingertips on the tail.

Treatment
During inhalation, pull caudally with both hands at the same time; during exhalation hold the position reached. Repeat this procedure until you have reached the end of the fascial movement. In the next exhalation, release the pull. Repeat the whole treatment four or five times.

Circulatory Techniques according to Kuchera

Arterial Stimulation
- stimulation of the celiac trunk and superior mesenteric artery by working on the spinal column
- diaphragm techniques

Venous Stimulation
- liver pump
- stretching the hepatoduodenal ligament
- diaphragm techniques

Lymphatic Stimulation
- lymph drainage on thorax and abdomen
- diaphragm techniques

Vegetative Harmonization

Sympathetic nervous system:
Stimulation of the sympathetic trunk T5–T9 by:
- rib raising
- inhibiting the paravertebral muscles
- vibrations
- manipulations
- Maitland technique
- stimulation of the celiac plexus
- diaphragm techniques

Parasympathetic nervous system:
Stimulation of the vagus nerve by:
- craniosacral therapy
- laryngeal techniques
- thoracic techniques (recoil)
- diaphragm techniques

Reflex Point Treatment according to Chapman

Location
Anterior. Intercostal space between ribs 7 and 8 on the right side, near the rib cartilage.

Posterior. Between the two transverse processes of T7 and T8, halfway between the spinous process and the tip of the transverse process; present only on the right side.

Treatment Principle
Make contact with the reflex point. For this purpose, very gently place a finger on the point and press only lightly. Reflex points are often very sensitive, and it is therefore important to proceed with caution.

The finger remains on the point and treatment is by gentle rotations.
**Lateral.** Both halves of the lung. In this space, we find a large number of important structures that are essential for the vitality of the entire body:

- heart with pericardium
- the major arteries and veins of the body:
  - aorta
  - pulmonary artery
  - SVC
  - pulmonary veins
- esophagus
- trachea
- main bronchi
- vagus nerve
- phrenic nerve
- sympathetic trunk
- thymus
- azygos vein
- hemiazygos vein
- thoracic duct

These organs and circulatory structures are linked to each other by connective tissue. This ensures good fixation in the mediastinum. However, sufficient mobility must be present to follow the movements of the torso, arm, and head and neck, e.g., the esophagus and other organs must be able to stretch in a craniocaudal direction during a neck extension.

Another factor that requires mobility is the expansion of the lung and the movements caused by diaphragmatic breathing. The mediastinum thus experiences alternating pushing and pulling.

Lastly, heartbeats, in the sense of oscillations, also have an impact on the mediastinal structures.

Thus we can see that continuous, even if partly only minor, movements in this apparently motionless space affect the organs of the mediastinum. This fact is particularly significant for the blood flow back into the heart, which is influenced by the suction effect of respiration, and for the nerve structures that are stimulated in the osteopathic sense by this constant movement.

The mediastinum is tied into the fascial system of the “central tendon.” It constitutes the thoracic aspect of a fascial pull that reaches from the base of the skull down to the lesser pelvis. As a result, we can see fascial structural adaptations in the mediastinum that could lead to symptoms in the thorax but have their cause in a different location in the body.

As a result of the vital importance of the mediastinal structures, abnormal fascial pulls can lead to significant functional changes. Here, we might consider the vagus innervation or the clinical picture of a hiatus hernia.

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*Fig. 17.6 Topography of the mediastinum: transverse view.*
Movement Physiology

Respiration is the motor for the regular movement of the thorax. An average of 12–14 breaths/min require the chest to expand and contract rhythmically in its sagittal and transverse diameters.

In biomechanical terms, we distinguish between two movement directions of the ribs: the rotational axis of the upper ribs that runs through the costotransverse and costovertebral joints lies almost parallel to the frontal plane—during inhalation, the result is mainly an expansion of the sagittal diameter of the chest.

The rotational axis of the lower ribs lies almost in the sagittal plane. By raising the ribs during inhalation, the result is thus primarily an enlargement of the transverse diameter of the thorax.

The central ribs have a movement axis that forms a 45° angle to the sagittal plane. Inhalations here lead to an expansion in the sagittal and transverse diameters.

In the sternum, the movement of the ribs causes a rise cranially and an increase in the distance to the spinal column—the sternum moves anteriorly and superiorly during inhalation. Movements therefore occur in both the sternocostal and the chondrocostal joints.

In the chondrocostal junction, the rib cartilages experience a torsion that is of great significance for the elastic and passive return of the thorax from the inhalatory position to the respiratory rest position.

Inhalation is a process that is directed by respiratory muscles: easy respiration involves the diaphragm and the scalene and intercartilaginous muscles. These extend—as described above—the chest in its sagittal and transverse diameters; the diaphragm increases the thorax diameter caudally and raises the lower ribs.

The contraction of the diaphragm causes a movement caudally while pushing the abdominal organs inferiorly and anteriorly. The movement anteriorly results from the soft abdominal wall, which does not provide active resistance against the displacement of the abdominal organs during inhalation.

In easy respiration, exhalation is a passive process, directed by the elastic restorative force of the thorax.

In deep inhalations, additional muscles assist in the expansion of the thorax. These accessory inhalatory muscles include the:

- external intercostals
- serratus posterior superior
- serratus anterior
- greater pectoral
- smaller pectoral
- sternocleidomastoid
- erector muscle of the spine

Deep inhalations cause an extension in the spinal column, as a result of which the extensors of the spinal column can also be included indirectly among the inspiratory muscles.

Forced exhalations likewise involve further accessory expirators:

- abdominal muscles (internal and external oblique, rectus abdominis, transversus abdominis)
- internal intercostal muscle
- subcostal muscle
- transversus thoracis
- serratus posterior superior
- latissimus dorsi

Physiology

- Physiology of the Heart

Here, we describe the mechanical heart action of the left heart. The same processes take place in the right heart.

Systole

Contraction Phase

- ventricle is filled with blood
- phase starts when the contraction of the ventricle starts

As a result of the contraction of the ventricle, intraventricular pressure rises. When this pressure is greater than the pressure in the atrium, the AV valves close (the semilunar valves are still closed). Tendinous fibers and papillary muscles prevent the AV valves from blowing through into the atrium. The surfaces of the individual flaps are greater than the opening to be closed. By broadly juxtaposing the edges of the flaps, closure of the valve is ensured even when the ventricular size changes. In the ventricle, no change in volume occurs, but only a reshaping of the ventricle into the form of a ball (= isovolumetric contraction). All muscle fibers change their length actively or passively.

Duration of this phase: 60 ms when the body is at rest.

Ejection Phase

This phase starts when the pressure in the left ventricle is greater than the diastolic pressure in the aorta (80 mmHg). The semilunar valves open and pressure continues to rise until it reaches the systolic blood pressure value (approximately 120–130 mmHg). Finally, the ventricular contraction is released and the pressure drops back down. When the pressure is lower than the aortic pressure, the semilunar valve closes and systole is thereby concluded.

During rest, approximately half the contents of the ventricle (130 mL) is ejected (= stroke volume).
Test and Treatment of the Costoclavicular Ligament according to Barral

Starting Position
The patient is in the supine position. The practitioner stands on the side to be treated.

Procedure
Palpate the costoclavicular ligament for sensitivity.
To treat, apply frictions or inhibitions to the sensitive areas until the pain has disappeared. Pressure on the sensitive areas should therefore be just strong enough to barely cross the pain threshold. Treatment success can then be evaluated sufficiently.

Compression and Decompression of the Clavicle Along the Longitudinal Axis according to Barral

Starting Position
The patient is in the supine position. The practitioner stands on the side to be treated.

Procedure in Compression
With the lateral hand, hold the acromial end of the clavicle between the thenar and hypothenar. With the medial hand, hold the sternal end of the clavicle in the same way. Place the fingers of both hands on top of each other over the clavicle.

Testing Sequence in Compression
Compress the clavicle simultaneously with both hands. Take note of intrasosseous and fascial tensions as well as of sensitivity to the compression. In a second step, translate the clavicle laterally and medially.

Treatment in Compression
Translate the clavicle mediolaterally.
For an additional treatment option, you can apply fascial unwinding to the clavicle under compression.
You can conclude treatment with a recoil: increase the compression for one or two breaths during exhalations and maintain during inhalations. When you have reached the greatest possible compression, abruptly release it at the start of the next inhalation.