The Pancreas

Grégoire Lason & Luc Peeters
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1. Introduction

The pancreas is an important organ in the human glucose metabolism.

In the last years, the number of diabetics has increased worldwide. Bad nutritional habits and people getting older are causing this worldwide problem.

The osteopath can contribute to reducing this problem that is very costly to society.

Pancreas dysfunction causes trophic changes to the organ itself and also can cause complaints in the muscular and vascular systems.

The first signs of a pancreatic problem can be found in the case history and especially when examining the patient’s musculoskeletal system. A somatic dysfunction at the level of the segments T₆ to T₉ is the first indication for poor functioning of the upper digestive tract. A detailed manual visceral examination could potentially show pancreas congestion.

Osteopathicy the osteopath can influence the pancreas function by correcting the mobility of the organ under the influence of the diaphragm, by treating the vascular supply to the organ and by treating the autonomic segmental relationship. Changing nutritional habits and lifestyle can also influence the pancreas.

This e-book discusses the osteopathic view on pancreas dysfunction and the way osteopaths deal with classical medical findings and use them in an adequate osteopathic and holistic treatment.

For readers not yet familiar with the osteopathic visceral concept, there is chapter 12 included at the end of this e-book.
2. Anatomy


2.1. Position and Important Anatomical Data

The pancreas (Figure 1, 5, 6 and 9) is a soft, lobulated retroperitoneal organ that lies imbedded with his head in the loops of the duodenum.

The organ is grey-pink and weights approximately 70 to 100 gr.

The craniocaudal diameter of the pancreas is 3 to 5 cm and the anteroposterior diameter is 2 to 3 cm.

The organ's length is 18 cm.

The tail points toward the left and runs posterior to the stomach, reaching the spleen. (Figure 2).

The pancreas is separated from the stomach by the omental bursa (Figure 3).

The pancreatic duct (Duct of Wirsung) runs through the entire length of the pancreas (Figure 6).

It drains into the duodenum II via the biliary pancreatic ampulla and has 20 secondary branches.

The pressure in this pancreatic duct is 15-30 mmHg versus 7-17 mmHg in the duodenum. This way, duodenal content cannot enter the pancreas. The pancreatic accessory duct (Duct of Santorini) drains the upper part of the pancreatic head separately into the duodenum II, above the biliary pancreatic ampulla.

Figure 1 - The pancreas
Topography of the pancreas in the frontal plane (Figure 2).

Topography of the pancreas in the sagittal plane (Figure 3).
Topography of the pancreas in the horizontal plane (Figure 4).

Figure 4 - Topography of the pancreas in the horizontal plane

Topography of the pancreas (scan) (Figure 5).

Figure 5 - Topography of the pancreas in the horizontal plane
3. Function  

3.1. General
The pancreas has two functions (Figure 10):

- Endocrine function.
- Exocrine function.

![Figure 9 - Pancreas section](image)

3.2. Exocrine Function
The acinar cells perform the exocrine function of the pancreas.

These cells form 80 to 90% of the pancreas.

Acinar cells produce digestive enzymes of which the three most important are:
amylase, lipase and trypsin.

Ductal cells regulate, besides drainage, electrolyte and water balance.

The final product that leaves the pancreas is an alkaline fluid with digestive enzymes
(amylase, lipase and trypsinogen) who intervene in carbohydrate-, fat- and protein
digestion.

This way, the pancreas secretes 500 to 800 ml per day.

The alkaline fluid neutralizes the stomach acid as well as the acidity of the intestines.

The hormones secretin, cholecystokinin and gastrin as well as the parasympathetic
neurotransmitter acetylcholine stimulate the pancreas secretions.

These secretions are inhibited by atropine, somatostatine, pancreatic polypeptides
and glucagon.
These enzymes become active in the duodenum.

**Enzymes:**

- **Amylase:**
  - Works best with a pH of 7.
  - Hydrolyses fibres and changes glycogen into glucose, maltose, maltotriose and dextrin.

- **Lipase:**
  - Works best with a pH of 7 to 9.
  - Emulsifies and hydrolyses fat in the presence of gal salt.

- **Protease:**
  - Important in the digestion of proteins.

An antiproteolytic enzyme neutralizes the action of these enzymes in the pancreas.

### 3.3. Endocrine Function

During and immediately after a meal, carbohydrates are split into sugar molecules (i.e. glucose) and proteins into amino acids.

After a meal, glucose and amino acids are resorbed by the intestines and enter the bloodstream. The glucose level in the blood rises and this is referred to as the postprandial level.

The rise of glucose in the blood triggers the beta cells in the pancreas to start producing insulin that is secreted into the bloodstream. Within 10 minutes after a meal the insulin in the blood rises to a peek level.

The function of insulin is to make sure that glucose and amino acids can enter the human cells, especially the muscle and liver cells. Insulin and other hormones will then determine whether glucose must be stored or must be immediately available for use. The brain and nerve cells do not depend on insulin. The central nervous system glucose regulation is done by other systems.

When the insulin level is high, the liver stops releasing glucose and stocks it under another form until the body needs it again. When the blood sugar level reaches a peek, the pancreas will reduce the production of insulin.

Two to four hours after a meal, both blood sugar level as well as insulin level are at their lowest. However the insulin level is just a little bit higher than the blood sugar level. To maintain this condition only 2% of the pancreas mass is responsible.

The beta cells belong to the islands of Langerhans (2% of the pancreas mass).
The islands of Langerhans contain different types of cells amongst which:

- Alpha (α) cells that produce glucagon which raises the blood sugar level.
- Beta cells (β) that secrete insulin (70% of the island cells and most central in the islands), which lowers the blood sugar.
- Delta cells (Δ) that secrete somatostatin.
- F cells that secrete pancreatic polypeptides.

**Glucagon**

- Glucagon raises the sugar level in the blood.
- Amino acids, cholinergic fibres and β-sympathetic fibres stimulate the production.
- Glucose, insulin, somatostatin and α-sympathetic fibres inhibit the production.

**Insulin**

Insulin stimulating products are glucose, amino acids, glucagon, GIP, CCK, sulfonylurea components and β-sympathetic fibres.

Insulin production is also stimulated by growth hormones (acromegaly), glucocorticoids (Cushing), prolactin (breast feeding), placentary lactogens (pregnancy) and sex hormones.

Insulin inhibiting products are somatostatin, amylin, pancreastatin, α-sympathetic fibres.

50 % of the insulin is produced basally.

The glucose level in the blood stimulates 50 % of the production.

**Role of insulin:**

- Insulin is an anabolic, energy-storing hormone.
- Synthesis of glycogen in muscle- and liver cells from glucose.
- Synthesis of fatty acids.
- Synthesis of proteins especially in muscle tissue.
- Transport of glucose through the cells to release it for metabolism (this lowers the blood sugar level) and inhibits the break down of fats and glycogen.
- It regulates the blood sugar level together with glucagon and adrenalin.
- It has an antagonistic action to glucagon and adrenalin.
- If no insulin is produced in the pancreas the result is diabetes mellitus type I.
- If sufficient insulin is produced but the body cells react insufficiently the result is diabetes mellitus type II.
4. Mobility

(Bhasin 2006, Chu 1993, Kivisaari 1982)

The mobility of the pancreas under the influence of the diaphragm (Figure 11) has always been considered as very limited. Especially when compared with the liver, stomach or kidneys. This seems to be due to the fixation of the pancreas to the posterior parietal peritoneum.

However the pancreas has a considerable amount of mobility which is important for its functioning. This is known since 1980.

The pancreas tail is more mobile than the pancreas head.

The average mobility during diaphragmatic respiration is maximum 2 cm, with deep inhalation of 4 cm.

The average mobility of the pancreas tail is 9 cm. This is more than the mobility of the kidney.

The pancreas is without a doubt mobile. It has also been shown that the pancreatic duct increases its diameter during inhalation. The normal diameter of the pancreatic duct is 2.5 mm and the difference between deep in- and exhalation is 1 mm.

This increase in diameter is probably due to the inwards movement of the pancreas tail during inhalation.

When treating pancreas cancer with radiation, this has to be considered to keep the radiation effective. Through the changing position of the pancreas during respiration, the focus on the pancreas tumour could be difficult and normal tissues could be damaged.

![Figure 12 - Mobility of the pancreas during inhalation](image-url)
5. Pathology

5.1. Congenital Deformities

Annular pancreas:

- The pancreas forms a ring around the duodenum therefore there is the possibility of stenosis.
- The disorder is seen more in men than in women 3/1.
- The disorder is often associated with trisomy 21.
- This deformity finds its origin in the movement of the ventral pancreas during the embryological development. The pancreas then doesn’t move posteriorly of the duodenum but stays ventral.
- Common symptom, caused by stenosis is vomiting.

Pancreas divisum:

- There is no anastomosis between the two duct systems.
- This disorder is seen in 5 % of the population.

Ectopic pancreatic tissue:

- Ectopic pancreatic tissue can be found in the duodenum, the stomach, the jejunum and in the Meckel diverticulum. It occurs from an embryological dysfunction during the formation of pancreatic tissue.

5.2. Genetic Disorders

Cystic fibrosis - CF:

- Cystic fibrosis is a disease of the exocrine glands, especially the mucus secreting glands and the sweat glands.
- Cystic fibrosis is more than a lung disease. The sticky mucus causes digestive problems. In the pancreas, the small drainage channels get obstructed so the digestive enzymes don’t reach the intestines any more. The consequence is that the body doesn’t get the necessary nutrients, especially fat.
- Beside respirational and digestive problems, some cystic fibrosis patients have also diabetes and constipation.
- The cause is a genetic defect that is seen in 1/2500 of the births.
- At birth the pancreas is normal but the organ degenerates fast under the influence of cysts filled with a viscous fluid.
5.3. Acute Pancreatitis
(Steinberg & Schlesselman 1987)

This is an acute destruction of the pancreas by the organ's digestive enzymes. The pancreas digests itself.

In 70% of the cases the cause is chronic alcoholism or obstruction of the sphincter of Oddi from gallstones.

In 30% of the cases the cause is shock, trauma, post-surgical, hyperparathyroidism, genetics, medication or a viral disease (e.g. parotitis).

Appearance:

- Sudden mid-abdominal (epigastric) or left abdominal (sub-diaphragmatic) pain that radiates towards the back and shoulders.
- Nausea and vomiting.
- Mid- to low thoracic pain is often present and can be acute.
- The palpation of the pancreas area will be painful.
- Severe abdominal pain.

Acute pancreatitis is in 70% to 90% of the cases a mild process and the mortality is therefore low (3%). Acute pancreatitis can also be severe. In 10% to 30% of the cases a longstanding treatment is necessary, often in the intensive care of the hospital.

The mortality rate for severe acute pancreatitis is high (30% to 70%).

Osteopathy is not appropriate here.
5.4. Chronic Pancreatitis
This disease is often seen after recurrent acute pancreatitis.

In 90% of the cases alcoholism is the major cause. In 10% of the cases a genetic factor is the culprit. The disease can also be idiopathic or seen in patients with hyperparathyroidism.

Cystic fibrosis is another possible cause.

The acinar cells degenerate and the pancreas scleroses.

Chronic pancreatitis is a disease that is known for its changing process.

Calm periods are interspersed with periods of severe symptoms.

The most important complaints are abdominal pain and/or back and disturbances because of shortness in pancreas enzymes and hormones.

The complaints can be severe and recurrent.

After every inflammation, scar tissue is formed. This can narrow the ducts.

If there are narrowed ducts, the pressure in the organ increases and this creates pain and possibly new inflammation.

In the latent phase, the osteopath can mobilize the region with care and below the pain threshold. This could be useful to stretch scar tissue.

The most important complications of pancreatitis are:

• The formation of pseudo cysts. The inflammatory fluid increases and forms cysts. These pseudo cysts can persist but in most cases they reduce in size or disappear spontaneously within weeks.
• Jaundice. Scar tissue in the pancreas head can increase its size. This can compress the gall ducts and cause jaundice.
6. Functional Disorders

6.1. Pancreas Congestion
Pancreas congestion is often found as a part of congestion of the whole digestive system.

The associated findings are congestion of the diaphragm, liver, stomach, spleen and duodenum.

This functional condition gives similar clinical signs as diabetes and can be treated osteopathically.

The osteopathic approach will be:

• Treatment of the upper thoracic region and stretching the intra-thoracic fascia.
• Treatment of diaphragmatic dysfunctions (mostly lesions are in inhalation).
• Decongestion of the liver.
• Stretch of the lesser omentum.
• Treatment of somatic dysfunctions in the segments OAA and T₆-₉.
• Mobilisation of the pancreas in craniocaudal and mediolateral direction.
• Nutritional corrections concerning carbohydrate intake.

Pancreas congestion is often seen in relation with asthenia in children. The consequence of pancreas congestion is that the diaphragm goes into exhalation position (weak diaphragm) and the thoracic spine follows into kyphosis. The other curves compensate which results in a kypholordotic posture.
7. Clinical Diagnosis

7.1. Palpation of the Pancreas

The patient is sitting and the osteopath stands behind him.

With both hands at the level of the umbilicus, the osteopath palpates in a dorsal direction.

Palpate in the direction of the head of the pancreas: on the right side of the spine in a dorsomedial direction.

Palpate in the direction of the tail of the pancreas: on the left side, also in a dorsomedial direction.

Both hands stay in a horizontal plane.

It is normal to feel more resistance on the right side because of the right position of the organ's head.

The pancreas cannot be palpated as an anatomical structure but the resistance can be evaluated with some expertise.

Too much resistance and an unpleasant feeling for the patient, sometimes with nausea indicate pancreas congestion.

Congestion presents itself with congestion of the whole upper digestive tract.

Video 1 - Palpation of the pancreas
8. Osteopathic Techniques

8.1. Laterolateral Mobilisation of the Pancreas
The patient is sitting and the osteopath stands behind him.

With the fingertips of both hands the osteopath palpates the pancreas and mobilizes the organ in laterolateraal direction until a better mobility is felt.

This mobilisation is most efficient while the patient exhales.

Video 6 - Laterolateral mobilisation of the pancreas

8.2. Mobilisation - Supine
The patient is supine, both legs flexed.

The osteopath contacts the pancreas on the lateral right with the thumbs and the lateral left with the fingertips.

He mobilizes rhythmically in a figure of eight. This mobilisation is synchronized with the respiration of the patient.

Video 7 - Mobilisation - supine
10. About the Authors

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Both authors are holders of university degrees, namely the Master of Science in Osteopathy – University of Applied Sciences, and are very active with the promotion and academic structuring of osteopathy in Europe. In 1987 they began The International Academy of Osteopathy (IAO) and are, to this day, the joint-principals of this academy. The IAO is since several years the largest teaching institute for osteopathy in Europe. Both osteopaths are members of diverse professional organisations, including the American Academy of Osteopathy (AAO), the International Osteopathic Alliance (IOA) and the World Osteopathic Health Organisation (WOHO), as part of their mission to improve osteopathic development.

This osteopathic encyclopaedia aims to demonstrate the concept that a proper osteopathic examination and treatment is based upon the integration of three systems: the musculoskeletal, visceral and craniosacral systems.
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