

원저

## 중완혈에서 췌장으로 이어지는 새로운 순환적 연결

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**목적** : 피부의 경혈(CV12)로부터 췌장으로 액체가 흘러가는 경로가 있음을 보임.

**방법** : 생쥐의 중완혈에 푸른색 염료(Alcian blue) 1% 용액을 주입하고, 2시간이 경과한 후 개복하여 내장장기의 표면들을 실체 현미경으로 관찰한다.

**결과** : 췌장 위에 있으며, 췌장의 머리부분과 꼬리부분, 췌장과 위장, 췌장과 비장을 연결해주는 망막상의 지방줄(omental fat band)에 Alcian blue가 도달, 착색되었다.

**결론** : 중완혈로부터 췌장을 경과하여 망막상의 지방줄에 이르는 액체 순환경로가 있다.

### Novel circulatory connection from the acupoint Zhong Wan(CV12) to pancreas

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#### ABSTRACT

**Objectives** Demonstrating a novel circulatory path from the acupoint(CV12) to the pancreas.

**Method** Alcian blue(1% solution, 20 $\mu$ l, pH 7.4) was injected into the acupoint(CV12). Two hours later the surfaces of internal organs were observed by using a stereomicroscope.

**Results** Alcian blue arrived and colored the omental fat band(OFB) on the pancreas. The OFB connected the head and tail of the pancreas, the pancreas and the spleen, and the pancreas and the stomach.

**Conclusion** The existence of a novel circulatory path from the acupoint CV12 to the pancreas and its OFB was demonstrated.

**key words** Zhong Wan(CV12), Pancreas, Circulatory, Acupuncture, Alcian blue

## 1. Introduction

The acupoint Zhong Wan(CV12) is known as the stomach control points in Korean medicine and is located on the abdominal wall associated with the

pancreas<sup>1)</sup>. It is considered as an effective therapeutic point for diseases of digestive organs such as stomach, pancreas, and spleen even though it is located on a conception vessel line. For example, electric stimulation at the CV12 was used

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for treatment of diabetic rats<sup>2,3)</sup>

The omental fat band(OFB) is a fatty structure that connects different parts of pancreas, pancreas and stomach, and pancreas and spleen(Fig. 1A). It contains abundant milky spots which was studied by many investigators<sup>4)7)</sup>. In normal mice, the omentum comprises the omental membranes and a perivascular fat band. This OFB contains many vascularized milky spots, which are composed of abundant lymphocytes and plasma cells including B and T-cells<sup>8)</sup> with macrophages, monocytes, neutrophils, eosinophils, mast cells and various stromal cells. Neutrophilic myelopoiesis<sup>9)</sup> and erythropoiesis in the OFB was studied<sup>10)</sup>. Cellular composition<sup>11)</sup>, immune responses<sup>12)</sup>, and ontogeny<sup>13)</sup> of milky spots in omentum were also investigated. Omental milky spots are known to function as a major immune system in the peritoneal cavity<sup>6)8)</sup>, and to produce and provide free peritoneal cells, such as macrophages/monocytes and lymphocytes<sup>14)15)</sup>.

In this paper we report on the discovery of a novel circulatory connection from the acupoint CV12 to the OFB via the pancreas of a mouse.

We injected a non-toxic dye Alcian blue subcutaneously at CV12 and observed the appearance of the dye at the OFB that connected pancreas, spleen and stomach. It did not appear at the surface of other abdominal organs. Alcian blue injected at other points did not show up at the OFB. Thus our experiments demonstrated a circulatory connection from the specific acupoint CV12 to the OFB via pancreas.

The connection of CV12 to the OFB connecting pancreas, spleen and stomach provides scientific support for the function of the CV12 of acupuncture theory, and can be used to elucidate the mechanism behind therapeutic effects of acupuncture treatment at CV12. Furthermore, this circulatory connection can be used for pharmacopuncture to treat pancreas related diseases such as diabetes, pancreatic cancer or pancreatitis.

## II. Materials and Methods

The animal preparation and surgical procedures were performed as follows. Eight male hairless mice of six weeks and seven male Balb/c mice of eight weeks were obtained from Jung Ang Lab Animal for use in this study. All of the animals were fixed at 12 hr light-dark cycle, and has ad libitum access to food and water. The animals were housed in a constant temperature-controlled environment(23°C) with 60% relative humidity. The procedure was in full compliance with the institutional guide lines of Seoul National University. The mice were anesthetized with urethane(1.5g/kg) administered intraperitoneally, and all experimental procedures were performed under general anesthesia.

The acupoint CV12 was determined by traditional chart at the midpoint between the umbilicus and the xiphoid process along the white line. We pinpointed the acupoint as the lowest electrical resistance point by using an electrical acupoint detector(HAMTECK, YNS 202-S, KOREA)

We injected the filtered 1% Alcian blue solution (2.0mg/ml, pH7.4) into the subcutaneous space at CV12, by using an injection system (KD310 NanoPump, KD Scientific, MA, USA) and a 1 mL syringe(Becton Dickinson Korea Ltd., Gumi, Korea) with a 33 gauge needle.

Alcian blue was injected continuously in the rate of 0.1 $\mu$ l/min for two or three hours. In another method 30 $\mu$ l of Alcian blue was administered in the subcutaneous space by one injection with an insulin syringe of 31 gauge. The injection procedure was performed under a stereomicroscope, and special care was taken not to pierce the abdominal wall so that Alcian blue did not leak to the intraperitoneal cavity.

After injection of Alcian blue the mice were sacrificed by cervical dislocation, and the abdomen were incised with careful hemostasis so that blood flow over the organ surfaces was minimized.

The search for Alcian blue on the surfaces of abdominal organs was done under a stereomicroscope. When there was no Alcian blue leakage, we observed the pancreas, and found the omental fat band(OFB) contained Alcian blue inside. Thus we verified that the Alcian blue arrived at the OFB via the pancreas from the acupoint CV12. The OFB and its associated organs such as pancreas, stomach, spleen, and duodenum was observed and recorded by using the CCD camera(Olympus DP70) combined with the stereomicroscope(Olympus SZX12).

### III. Results

Fig. 1A is an illustration of omental fat bands(OFB) with milky spots in the abdominal cavity of a mouse. The OFBs are located on the pancreas, and connect different part of pancreas or pancreas and spleen. Gastroepiploic artery and vein run through the OFB.

Fig. 1B shows a stereomicroscopic image of the OFB, pancreas, spleen, stomach and duodenum of a

normal mouse. There is no inherent blue color in the OFB.

Fig.2 demonstrates that Alcian blue arrived and colored an OFB on the pancreas very strongly. 20 $\mu$ l of 1% Alcian blue solution was injected at the acupoint CV12 of a mouse and the observation was done after two hours from injection. The OFB was pulled to one side from the attached point of the pancreas in order to show better.

Fig. 3 is a magnified view of an OFB on the pancreas of a hairless mouse after two hours of continuous injection of Alcian blue solution. The amount of arrived Alcian blue was apparently less than the previous one(Fig. 2). The Alcian blue was accumulated in transparent regions which are milky spots.

Sometimes the Alcian blue appeared in the omentum surrounding the pancreas tail as shown in Fig. 4.

### IV. Discussion

We found that Alcian blue injected at the

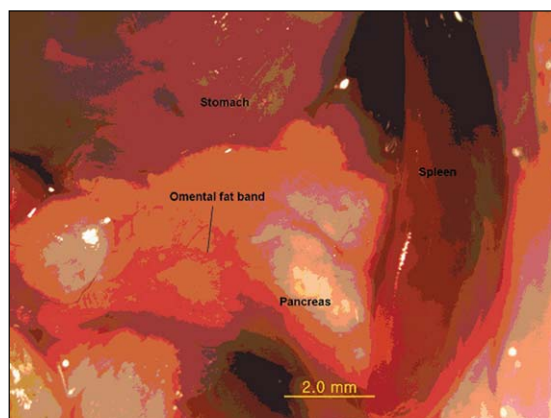
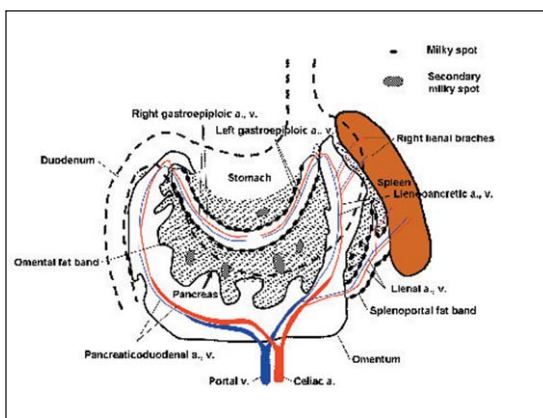


Fig. 1. An omental fat band(OFB), pancreas, spleen and stomach. (A) is an illustration. The pancreas is the dotted area in the middle and the spleen is the shaded area in the right. The stomach and duodenum are depicted by broken curves. On the pancreas is the OFB through which gastroepiploic artery and vein are located, and on the boundary of which are milky spots. Another OFB, splenoportal fat band connects the pancreas and spleen. (B) is a stereomicroscopic image of the OFB, the pancreas, spleen and stomach of a mouse.

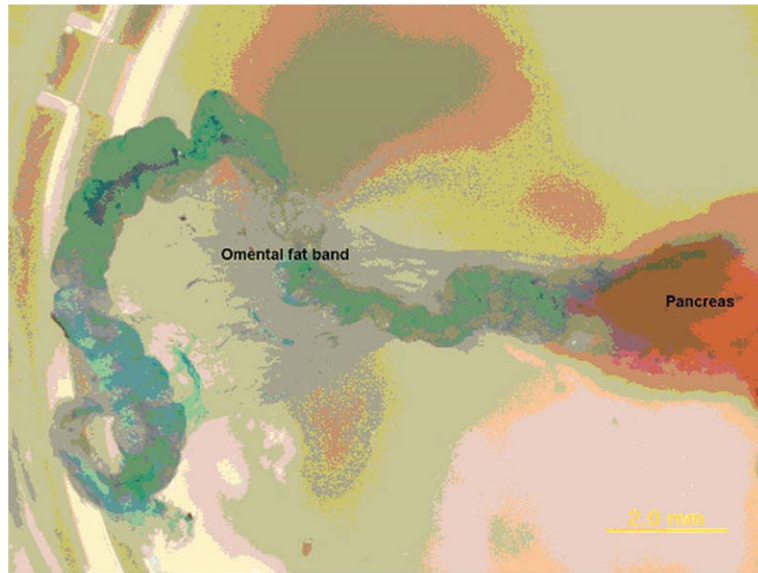


Fig. 2. A stereomicroscopic image of an OFB in which Alcian blue arrived abundantly after two hours from injection into CV12. The OFB was pulled to one side from the attached point of the pancreas in order to better present the colored OFB.

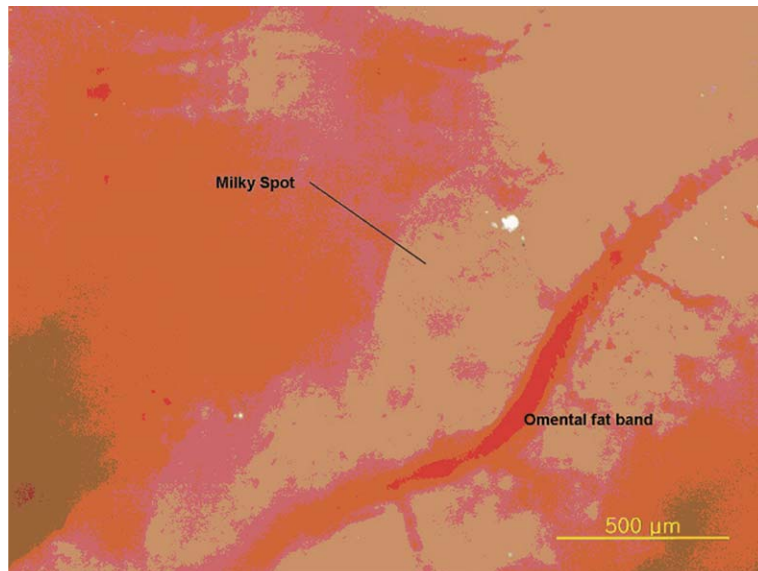


Fig. 3. A magnified view of an OFB where the Alcian blue is accumulated at the milky spot of the OFB.

acupoint CV12 flowed to pancreas and appeared in the omental fat bands. This implies that there is a circulatory path from the particular acupoint CV12 in skin to the corresponding internal organ,

pancreas. In order to check whether this route is a specific path we injected at other acupoints(CV8, CV14, St25, GB25) in the abdomen, and lumbosacral point(LSP), BL23 in the dorsal skin, and the result

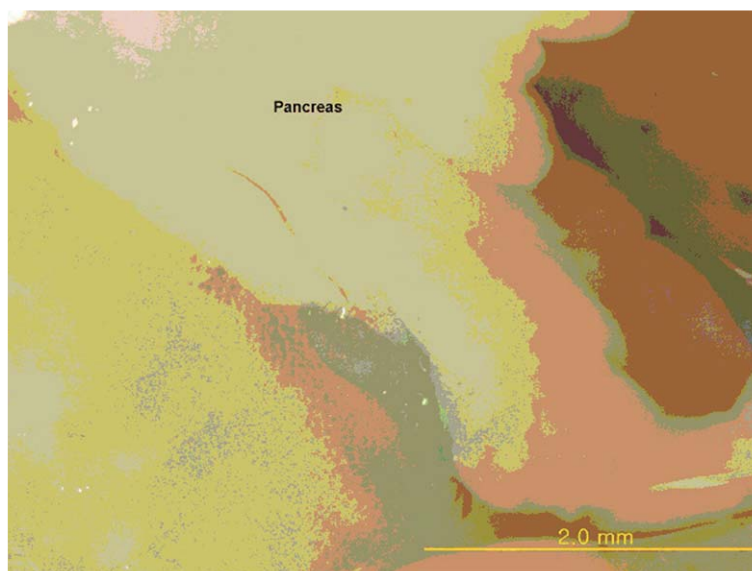


Fig. 4. The Alcian blue appeared at the omentum surrounding the pancreas tail.

was similar to the non-injected case in Fig. 1B. Other groups' works with rabbits showed that intravenously injected Alcian blue principally colored the kidney parenchyma, but did not report any noticeable coloring of the OFB<sup>16,17</sup>.

Subcutaneous injection into the interscapular area of the back did not show up any prominent coloring of the OFB<sup>18</sup>. Thus, the acupoint CV12 is a specific gate in skin to reach pancreas and its associated OFB.

Even though we found the circulatory connection between the CV12 and pancreas we were not able to identify the path. We only conjecture that the anatomical structure corresponding to the acupuncture meridian like Bong-Han ducts may be the novel circulatory path<sup>19-20</sup>.

This novel path is a strong scientific support for the traditional Korean medicine where the acupoint CV12 is a control point of pancreas, spleen and stomach function. Our finding suggests that there can be a transport of liquid, and signal communication through this path from the CV12 to pancreas and also to spleen and stomach via the

omental fat band. This path can be utilized for pharmacopuncture and also as a new drug delivery path from skin toward pancreas. Thus it may provide new modalities of treatments for pancreas related diseases such as diabetes, pancreatitis, and pancreatic cancer.

The current work is only an initial stage of finding a circulatory path from an acupoint to its corresponding internal organs. Further investigations are needed to find the starting point more precisely in the diffused area of Alcian blue around the injection point. If the intermediated route between the CV12 and the omental fat band is found it will open a vast area of research and medical applications.

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