J Invest Cosmetol
Vol. 12, No. 4, pp. 295-298 (2016)
https://doi.org/10.15810/jic.2016.12.4.001
pISSN: 1738-7574 **Original Article**

Journal of Investigative Cosmetology
Official Journal of Korean Society for Investigative Cosmetology
Available Online at http://www.ekst2005.com

Tubular Structures Believed to be Meridian Line Found from the Membrane of Abdominal wall in Rabbit

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(Received October 24, 2016; Revised December 14, 2016; Accepted December 19, 2016)

토끼 복부 내벽으로부터 분리된 경락으로 믿어지는 관조직

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Investigation of meridian line and acupoints as anatomical entities should be very important, as acupuncture and meridian massage for medical purpose in the hospital or for skin care in beauty shop are each based on the traditional meridian theory. We isolated tubular structures under the skin of rabbits where the traditional meridian lines are located. The characteristics of these tubular structures isolated from the abdominal wall matches those of Bonghan tubes and Bonghan tubules found by Bong Han Kim. The Bonghan theory established by Bong Han Kim suggests that meridian lines consist of Bonghan tubes and Bonghan tubules. We could observe the presence of large cells inside the Bonghan tubule and the presence of small granules referred to as Sanal in Bonghan theory inside the striae consisting of the Bonghan tubules. Present research suggests that there exist a third unique tubular structure where Sanals flow other than Bonghan tube and Bonghan tubules.

Keywords : Acupoints, Bonghan tube, Bonghan tubule, Meridian line, Sanal

INTRODUCTION

In the early 1960's the North Korean Bong Han Kim showed the anatomical entity of the acupoints, and showed the meridian system as the concrete tubular structures (Kim, 1964; Kim, 1965). Bong Han Kim further showed that meridian system is not confined to under the skin as traditionally believed, but is ubiquitous. They exist inside blood vessel (intravascular Bonghan tube), outside blood vessel (extravascular Bonghan tube), along the surface of internal organ (intra-extravascular Bonghan tube), and along the central and peripheral nervous system (neural Bonghan tube). Kim & Kong (2002) reviewed Bonghan theory. Recently, Soh and his research team published many data demonstrating the presence of tubular structures inside blood vessel and lymphatic vessel called as 'primo' (Soh et al., 2013), both of which are mentioned as 'intravascu-

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lar Bonghan tube' in Bonghan theory.

Acupuncture is the representative therapy of oriental medicine. The principle of acupuncture lies in meridian theory. It explains that there are energy transmission lines called meridians under the skin, through which life energy called Qi flows, and along which the acupuncture points (acupoints) are distributed. Acupuncture stimulate acupoints with needle. Bonghan theory explains that meridians are the concrete tubular system in which a liquid containing certain granules called Sanal flows (Kim, 1964; Kim, 1965). Acupuncture stimulate the flow of Sanal through the meridian line.

Investigation of meridian line and acupoints should be very important, as acupuncture and meridian massage for medical purpose in the hospital or for skin care in beauty shop are all based on traditional meridian theory. However, recent investigations regarding Bonghan theory are mostly focused on 'intravascular' Bonghan tube (Soh et al., 2013).

In this article it is believed that we isolated Bonghan tube and Bonhan tubules from the abdominal wall where the traditional meridian lines are located, and we discussed their properties.

MATERIALS AND METHODS

Animals and Materials. We used 3 female New Zealand white rabbits aged 4-5 months weighing 2.0-2.5 kg. The animals were acclimated before the study for over 1 week, at constant temperature (22 ± 1°C) and humidity (55 ± 5%) with unrestricted access to food and water and maintained for 12 h under alternating light and dark conditions and were housed in plastic cages. All experimental procedures and protocols were in accordance with IACUC (Institutional Animal Care and Use Committee). Care was taken to minimize suffering for the animals. All surgical procedures were performed under general anesthesia.

Isolation of Bonghan tube. Tubular structures were isolated from the membranes of the abdominal wall and of the umbilical cord. Methylene blue solution (0.1%) was spread to the surface before isolation. The blue lines from the abdominal wall could be picked with pincers and pulled out.

Cryosection. Tubular structure was embedded in optimal cutting temperature (OCT) compound (Sakura Finetek, USA) without fixation. Subsequently, tissue was cut with a cryomicrotome (SM1800, Leica, Germany), and stained with cresyl violet (Sigma, USA). The stained section was observed and measured for size under the light microscope (CX-41, Olympus, Japan).

RESULTS

Fiber-like structure inside abdominal membrane. The tubular structures were obtained from the abdominal wall below the skin, where the traditional meridian lines are located. By spraying 0.1% methylene blue to the surface membrane of abdominal wall, blue line could be observed and isolated with pincers. Isolated fiber-like structures from the membrane were very elastic, and shrinks very once cut.

Tubular structures isolated from the membrane. Tubular structures isolated from the membrane of the abdominal wall was already lightly stained with methylene blue and could be observed with light microscope (Fig. 1).

According to Bonghan theory (Kim, 1964; Kim, 1965), the diameter of Bonghan tube is about 100 μm and consisted of a bundle of Bonghan tubules whose diameter is about 5-15 μm. The tubular structures isolated from the membrane below abdominal wall in this research showed a bundle of tubules. The diameter of the tube and tubule was about 70-100 μm and 5-10 μm, respectively, which matches those of Bonghan tube and Bonghan tubule. From now on they are called as Bonghan tube and Bonghan tubule.

Bonghan tube and Bonghan tubule. Expanded view of Bonghan tube shows the fiber-like striae inside Bonghan tubules (Fig. 2). Blue color of methylene blue appears inside Bonghan tubule, indicating Bonghan tubule is the tubular structure through which materials flow. The presence of relative large cells through Bonghan tubule and Sanals through narrower tubules could be observed. Bonghan theory mentioned the presence of very small granules whose diameter is about 1 μm, which was named as Sanal (meaning 'living egg' in Korean).

Cryosection of Bonghan tube. Cryosection of the tubular structures stained with cresyl violet showed many lines of the rod shaped nuclei distributed as broken-line stripes (Fig. 3), which confirms the identity of the isolated tubular structure as Bonghan tube.

Observation of Sanals from other source. Bong Han Kim showed that meridian system is not confined to under the skin as traditionally believed, but is ubiquitous. Sanals could be observed from various sources. The following picture shows narrow lining of Sanals (1 μm) from the umbilical cord (Fig. 4). These suggest that Sanals flow through much narrower tubular structures than the Bonghan tubule.

Observation of large rod shaped cells through Bonghan tubule. The following picture shows Bonghan tube isolated from the peritoneum of rabbit. Large cells whose length is about 20 μm could be observed through Bonghan tubules (Fig. 5).

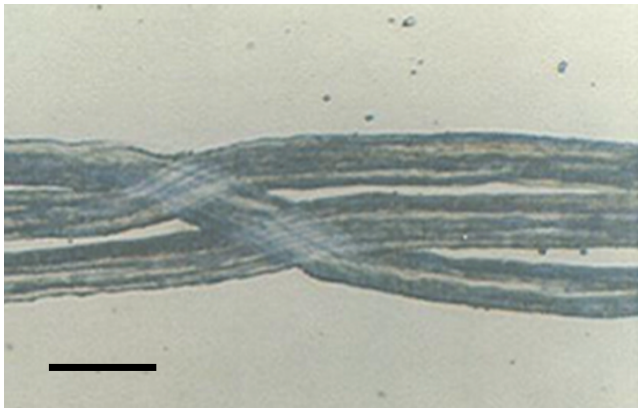

Figure 1. Three layers of Bonghan tubes isolated from the membrane of abdominal wall in rabbit. Scale bar = 100 μm.

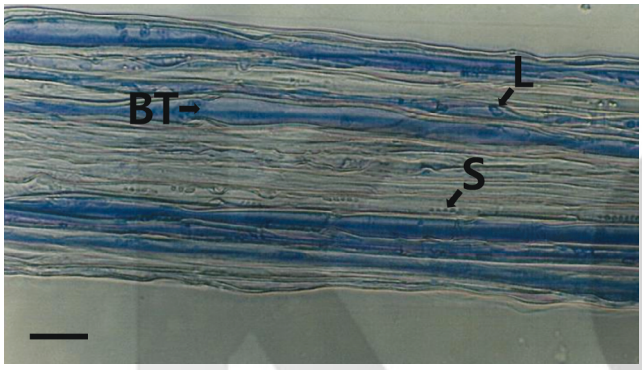

Figure 2. Expanded view of Bonghan tube. Bonghan tube was consisted of Bonghan tubule. The presence of relative large cells inside Bonghan tubule and the lining of Sanals through narrower tubules inside Bonghan tubule could be observed. Scale bar = 20 μm. BT, Bonghan tubule; L, large cell; S, Sanal.

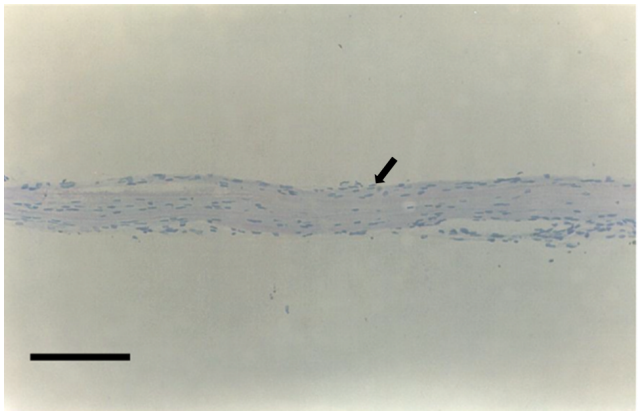

Figure 3. Cryosection of Bonghan tube. Cryosection of the tubular structures stained with cresyl violet showed many lines of the rod shaped nuclei (arrow) distributed as broken-line stripes. Scale bar = 100 μm.

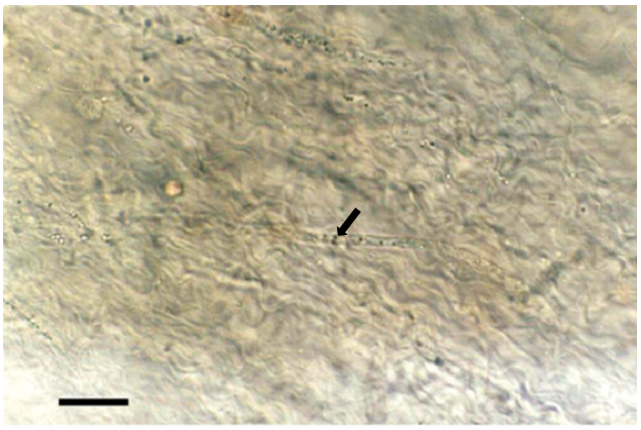

Figure 4. The small granules observed from umbilical cord. Narrow lines of small granules (arrow), which are Sanals, could be observed inside the very narrow tubular structures. Scale bar = 20 μm.

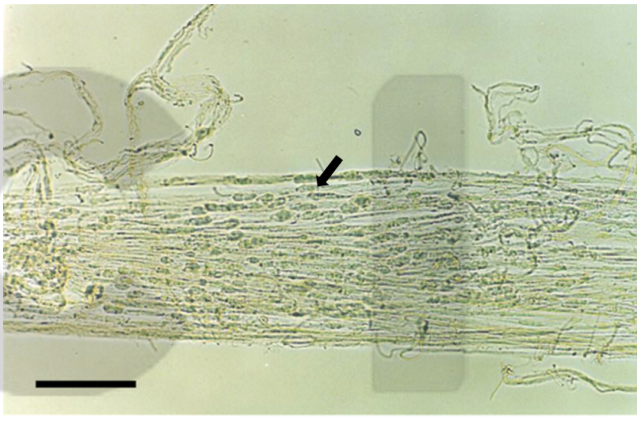

Figure 5. Large cells observed inside Bonghan tube. Relative large rod shaped cells (arrow) could be observed inside Bonghan tubules. Scale bar = 100 μm.

DISCUSSION

Recently it was shown that ^{99m}Tc injected to a specific acupoint of triple warmer meridian flowed upward as suggested by traditional meridian theory (Sohn & Kim, 2016). X-ray tracing of lipiodol injected to Owegan also showed time dependent migration of lipiodol flowing upward along the triple warmer meridian time (Park et al., 2004). These results demonstrate that the substance injected to acupoint flows through the meridian line. In our study blue color of methylene blue stain appears inside Bonghan tubule (Fig. 2), indicating that Bonghan tubule is tubular structure through which materials flow.

According to Bonghan theory, Bonghan tube consisted of a bundle of tubules (Fig. 6) through which the small granules flow (Kim, 1964; Kim, 1965). However, our light microscop-

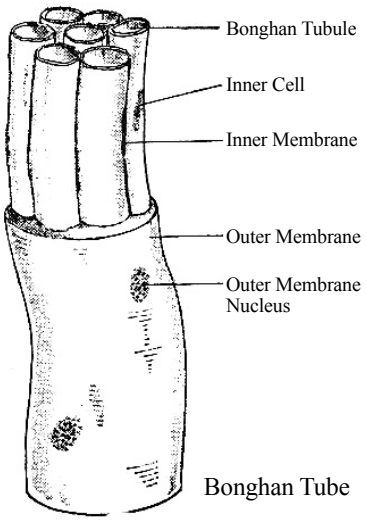

Figure 6. Model of Bonghan tube and Bonghan tubule according to Bonghan theory. Source: Kim, 1964.

ic observation shows both the presence of large cells (20 μm) inside the Bonghan tubule (Fig. 5) and the presence of small granules (1 μm), which are Sanals, forming very narrow line (Fig. 4). As their size difference is too big, it is not likely that they flow through the same tubular structures.

Our microscopic picture shows that each Bonghan tubule consisted of fiber-like striae. Aligning of Sanals in line could suggest that the striae forming Bonghan tubule themselves are tubular structures. It is likely that the Bonghan tubule and the striae forming the Bonghan tubule represent the different levels of tubular structures inside Bonghan duct.

According to Bonghan theory, the small granules contain DNAs and aggregate to form specific type of cells inside Bonghan ducts. It is suggested that the cells thus formed function as stem cells (Kim & Kong, 2002). Recently Soh et al. (2013) suggested that the granule inside Bonghan duct could be the source of biophoton which carry life essential information, such as repair and regeneration in damaged tissue (Yang et al., 2004).

The presence of large cells inside the Bonghan tubule and the presence of small Sanals inside the striae consisting the Bonghan tubule might further suggest that the Sanals in the striae come out and aggregate to form large rod shaped cells inside the tubule when needed. Further investigations are expected.

CONCLUSION

We isolated tubular structures which is believed to be Bonghan tube and Bonhan tubules under the skin of rabbit where the traditional meridian lines are located. The characteristics of tubular structures matches with those of Bonghan tube and Bonghan tubules reported by Bong Han Kim. Present research also showed that there are smaller unique tubular structures inside Bonghan tubules through which Sanals flow. We also suggest that these unique small tubular structure forms Bonghan tubule.

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