한국가축위생학회지 제35권 제1호 (2012)
Korean J Vet Serv, 2012, 35(1), 77-82
ISSN 1225-6552
Available online at http://kosves.re.kr

Korean Journal of
Veterinary Service

<Case Report>

A primo vessel-like structure in a dog with inflammatory pseudotumor

Sung-Jin Cho[1], Sun-Hwa Hong[2], Sang-Jun Han[2], Okjin Kim[2,3]*

[1]*Family Animal Medical Clinic, Gunsan 573-350, Korea*
[2]*Center for Animal Resource Development, Wonkwang University, Iksan 570-749, Korea*
[3]*Digestive Disease Research Institute, Wonkwang University, Iksan 570-749, Korea*

(Received 31 January 2012; revised 11 March 2012; accepted 14 March 2012)

Abstract

Inflammatory pseudotumor (IPT) is a term defining a mass characterized microscopically by a proliferation of bland mesenchymal spindle cells infiltrated by diffuse mixed inflammatory cells with a predominance of plasma cells and lymphocytes. Here, we show the primo vessel-like structure of the primo-vascular system (PVS) in a dog with IPT. A 6-years old male Mongrel dog was diagnosed with an abnormal mass (diameter 5.5 cm, weight 22 g) near left preputial area. The dog was submitted to the surgical detectomy of the mass. During the surgical operation, we observed primo vessel-like material. After fixations, the masses appeared macroscopically as lipoid-like, firm, white to grey masses, measuring 5×8 cm. Histologically, cellular infiltration into the muscular layers was frequently seen. The mesenchymal proliferation remained the main component of the mass and was composed of myofibroblastic-like spindle cells characterized by globular, irregular nuclei containing open chromatin and a prominent nucleolus. On the basis of the histopathologic lesions, the subcutaneous mass was diagnosed as IPT. Also, we detected a primo vessel-like structures in some areas of the IPT tissues. These were observed as novel thread-like structures and bundle of tubular structures. To our knowledge, this report is the first case of primo vessel-like structure in a dog with IPT.

Key words : Inflammatory pseudotumor, Inflammatory myofibroblastic tumors, Plasma cell granuloma, Primo vessel, Dog

INTRODUCTION

Inflammatory pseudotumor (IPT), otherwise known as plasma cell granuloma, inflammatory fibrosarcoma, or myofibrohistiocytic proliferation is an uncommon non-neoplastic lesion considered to be the result of an inflammatory condition (Coffin and Fletcher, 2002). The World Health Organization defines IPT as a distinctive lesion composed of myofibroblastic spindle cells accompanied by an infiltrate of inflammatory cells such as plasma cells, lymphocytes and eosinophils (Coffin and Fletcher, 2002; Gleason and Hornick, 2008; Swain et al, 2008). They are well recognised in the human medical literature as focal, benign mass lesions that occur in a variety of locations; however, there is ongoing debate about their inflammatory versus neoplastic nature, which is reflected by numerous synonyms (Häusler et al, 2003). In veterinary medicine, case reports of IPTs are rare and most have been reported in the orbital cavity in cats and dogs (Haines and Moncure, 1973; Miller et al, 2000; Billson et al, 2006; van der Woerdt, 2008; Knight et al, 2009). IPT and IPT-like lesions have also been reported arising from the periorbita (Williams et al, 1998), subcutis (Miller et al, 1999; Wako et al, 2005; Knight et al, 2009) and thoracic and abdominal organs (Slocombe et al, 1992; Gartner et al, 2002; Boyle et al, 2004; Liu et al, 2005; Böhme et al, 2010). Also, in human medicine, only 12 case reports of spinal IPT have

*Corresponding author: Okjin Kim, Tel. +82-63-850-6668, Fax. +82-63-850-7308, E-mail. kimoj@wku.ac.kr

been reported (Seol et al, 2005; Boutarbouch et al, 2008).

Primo vessels (Bonghan ducts) are new kinds of micro-conduits and are assumed to be the mechanistic underpinning of acupuncture meridians in traditional oriental medicine. In the early 1960's, Bong-Han Kim of North Korea claimed to have discovered these ducts, named after him, which formed a novel circulatory system throughout an animal's body (Hong et al, 2010). He did not, however, disclose his method of observing the system in detail, so until recently, no exact confirmation of his work was ever accomplished despite many attempts in China, Japan, and Russia, except, for a partial reproduction by a Japanese anatomist, Fujiwara (Fujiwara and Yu, 1967). Observations of primo vessels in rabbits, rats, and mice were recently made by applying modern bio-imaging techniques (Soh, 2009), which has not only confirmed Kim's claims but also provided new findings and information, such as *in vivo* staining of the primo vessels with trypan blue (Lee et al, 2009b) and the existence of primo vessels inside fat tissues (Lee et al, 2009a) and on the surfaces of subcutaneous tumor tissues (Yoo et al, 2009). Furthermore, some evidence for a fluid-conducting function of the primo-vascular system has been provided by measurements of the flow speed (Sung et al, 2008) and the fluid viscosity (Sung et al, 2009).

Here, we report IPT case in a dog. Also, we detected a primo vessel-like structure in some area of the IPT tissues.

CASE REPORT

A 6-years old male Mongrel dog (11G4280) was diagnosed with an abnormal mass (diameter 5.5 cm, weight 22 g) near left preputial area (Fig. 1). The dog was submitted to the surgical detectomy of the mass. During the surgical operation, we observed primo vessel-like material (Fig. 1B). After detectomy, the tissues were fixed in 10% formalin, and were submitted for histopathological examination. Following fixation, several transverse sections over the tumor masses were prepared. Tissues were processed routinely and embedded into paraffin blocks. Four-micrometer-thick sections were cut and stained with hematoxylin (H&E) and

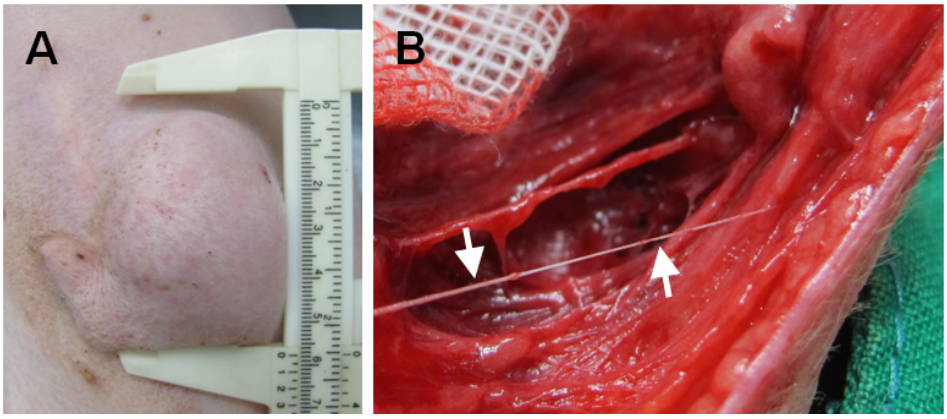

Fig. 1. Photographs of abnormal mass. (A) Preputial mass. (B) The thread-like structure (arrows) was observed during the surgical remove of preputial mass.

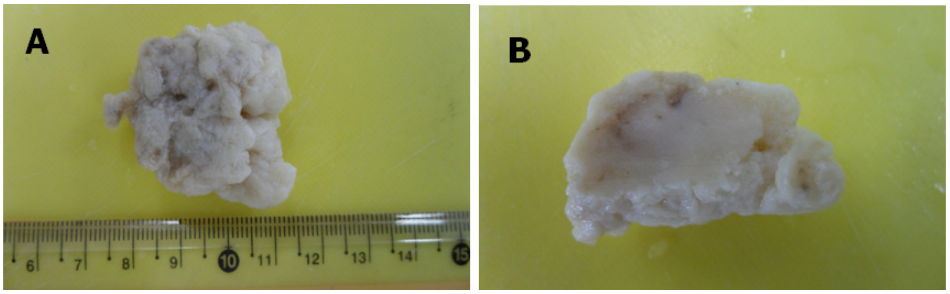

Fig. 2. Gross findings of formal-in-fixed abnormal mass. (A) Detectomied mass. (B) The cut surface of the mass.

eosin.

After fixation, the masses appeared macroscopically as lipoid-like, firm, white to grey masses, measuring 5×8 cm (Fig. 2). Histologically, the tissues were solid, superficial, of mild to moderate cellular density (Fig. 3A). Cellular infiltration into the muscular layers was frequently seen (Fig. 3B). The mesenchymal proliferation remained the main component of the mass and was composed of myofibroblastic-like spindle cells characterized by globular, irregular nuclei containing open chromatin and a prominent nucleolus. The cytoplasm was abundant, spindle-shaped and of pale eosinophilic staining. Mitotic activity was low and no abnormal mitotic figure was observed. The spindle cells adopted a storiform or fascicular pattern with occasional palisading and whirling figures (Fig. 3C). The stroma was collagenous, variably edematous and diffusely infiltrated by a variable number of lymphocytes, neutrophils and plasma cells throughout the mass (Fig. 3D). Numerous vessels adopting various orientations were present throughout the tumor. Two novel thread-like structures were observed in the white adipose near the inflammatory pseudotumor (Fig. 4A). The novel thread-like structures revealed longitudinally aligned rod-shape nuclei surrounding lumens assumed to be endothelial cells of primo vessel (Fig. 4B).

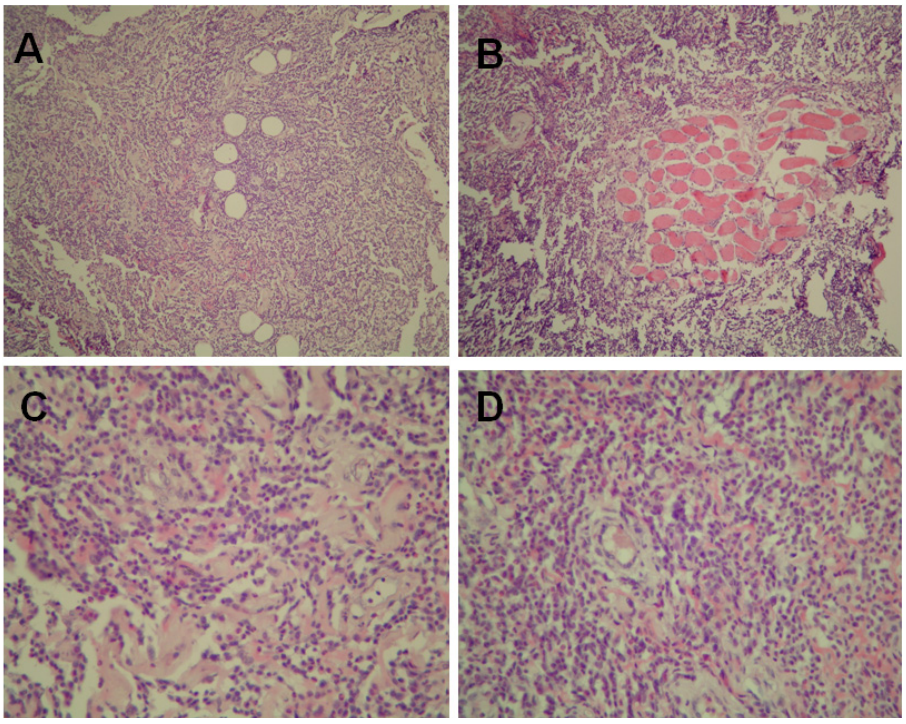

Fig. 3. Histopathological findings of inflammatory pseudotumor in abnormal mass. H&E stain. (A) The tissues were solid, superficial, of mild to moderate cellular density (×100). (B) Cellular infiltration into the muscular layers was frequently seen (×100). (C) The spindle cells adopted a storiform or fascicular pattern with occasional palisading and whirling figures (×400). (D) The stroma was collagenous, variably edematous and diffusely infiltrated by a variable number of lymphocytes, neutrophils and plasma cells throughout the mass (×400).

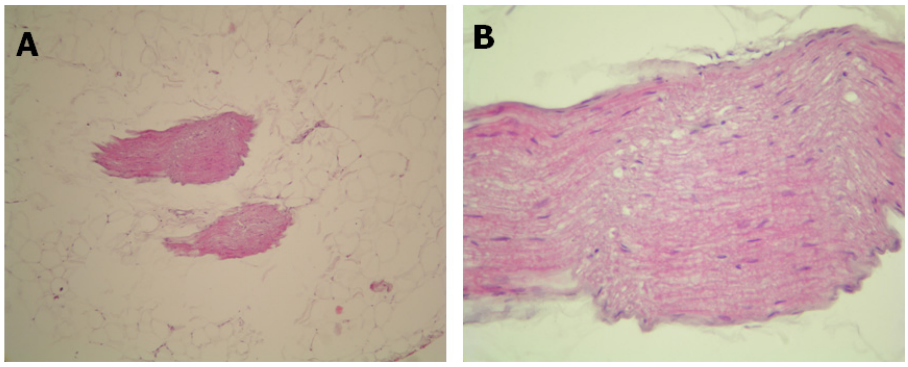

Fig. 4. Histopathological findings of primo vessel like structure in abnormal mass. H&E stain. (A) Two novel thread-like structures were observed in the white adipose tissue near the inflammatory pseudotumor (×100). (B) Novel thread-like structures revealed longitudinally aligned rod-shape nuclei surrounding lumens assumed to be endothelial cells of primo vessel (×400).

On the basis of the histopathologic lesions, the subcutaneous mass was diagnosed as inflammatory pseudotumor. Also, we detected a primo vessel-like structure in some area of the IPT tissues. It was observed as novel thread-like structures and bundle of tubular structures.

DISCUSSION

IPT is a term defining a mass characterized microscopically by a proliferation of bland mesenchymal spindle cells infiltrated by diffuse mixed inflammatory cells with a predominance of plasma cells and lymphocytes (Lott et al, 2007). Inflammatory myofibroblastic tumors (IMTs) belong to the IPT group and are characterized histologically by a mesenchymal proliferation consisting of spindle cells with globular nuclei and pale spindle cytoplasm with little mitotic activity and no abnormal mitosis. The tumor pattern may be of myxoid-vascular type, compact spindle cell type or hypocellular fibrous type. The mesenchymal component, generally regarded as having morphological and phenotypic features consistent with myofibroblasts, is admixed with inflammatory infiltrate (Coffin et al, 1995).

IPTs are rarely described in dogs: one IMT within the orbit (Lott et al, 2007), one on the mitral valve (Tursi et al, 2009) and two cases of urinary bladder IPT (Rocha et al, 2002) have been reported, but no attempt were made to differentiate a myofibroblastic component. In this study, we described the macroscopic and microscopic morphologies, as well as the immunohistochemical characteristics of IMTs arising from the urinary bladder in eight dogs.

The etiopathogenesis of IPT is unknown (Seol et al, 2005), and a variety of causes have been implicated such as an immunologic host response to infectious agents (Narla et al, 2003, Boutarbouch et al, 2008), fibrogenic cytokine production, neighbouring necrotic tissue or chronic inflammation following minor trauma, surgery or foreign bodies. More recent studies have identified cytogenetic changes which suggest that a considerable proportion of IPTs are neoplastic (Häusler et al, 2003).

Because of the apparent morphological similarity-transparent thin structure-between lymph vessels and primo vessels, distinguishing between them is critical. A distinction based on gross anatomical features (Shin et al, 2005) and histological details (Ogay et al, 2009) in rabbits was reported before. The primo vessels floating inside the flow of lymph vessels of rats and rabbits manifestly demonstrated that they are two different systems (Lee et al, 2006; Johng et al, 2007; Lee and Soh, 2008). Hematoxylin & Eosin staining revealed multiple lumens surrounded with loose collagen fibers in primo vessels, and those multi-lumen structures were distinct from the single-lumen structure of lymph or blood vessels. This result shows that primo vessels cannot be mistaken for lymphatic vessels, coagulated fibrins, or other artifacts (Ogay et al, 2009). Rod-shaped nuclei aligned longitudinally around the lumens of primo vessels, and although these nuclei were assumed to belong to endothelial cells, they were not lymphatic endothelial cells (Ogay et al, 2009). In this study, we found the novel thread-like structures which longitudinally aligned rod-shape nuclei surrounding lumens assumed to be endothelial cells of primo vessel. The structure was differentiated with lymphatic vessels, coagulated fibrins, or blood vessels.

Primo vessels can exist both around and inside cancer tumors and inflammatory lesions (Yoo et al, 2009). The primo vascular system has been found in lung cancer and the ovarian cancer mouse models alongside blood vessels and lymphatic vessels (Yoo et al, 2009). The density of primo vessels is positively correlated with tumor growth and inflammatory lesions (Yoo et al, 2009), suggesting that primo vessels play important roles in cancer development and other inflammatory diseases. In this study, we found primo vessel-like structure with IPT. Primo vessels may play an important role in shaping the microenvironment for inflammatory pseudotumor development. In particular, the close relationship between white adipose tissue and primo vessels suggest the importance of white adipose tissue in the development of primo vessels and IPT. Further studies are required to prove the exact relationship between the primo vessels and the diseases including IPT or other cancers.

To our knowledge, this report is the first case of primo vessel-like structure in a dog with inflammatory

pseudotumor.

REFERENCES

Billson FM, Miller-Michau T, Mould JRB, Davidson MG. 2006. Idiopathic sclerosing orbital pseudotumor in seven cats. Vet Ophthalmol 9: 45-51.

Böhme B, Ngendahayo P, Hamaide A, Heimann M. 2010. Inflammatory pseudotumours of the urinary bladder in dogs resembling human myofibroblastic tumours: a report of eight cases and comparative pathology. Vet J 183: 89-94.

Boutarbouch M, Arkha Y, Rifi L, Derraz S, El Ouahabi A, El Khamlichi A. 2008. Intradural cervical inflammatory pseudotumor mimicking epidural hematoma in a pregnant woman: case report and review of the literature. Surg Neurol 69: 302-305.

Boyle AG, Higgins JC, Durando MM, Galuppo LD, Werner JA, Decock HE. 2004. Management of hemodynamic changes associated with removal of a large abdominal myofibroblastic tumor in a pony. J Am Vet Med Assoc 225: 1079-1083.

Coffin CDM, Fletcher JA. 2002. Inflammatory myofibroblastic tumor. pp. 91-93. In: World Health Organization Classification of Tumours. Pathology and Genetics of Tumours of Soft Tissue and Bone. Lyon: IARC Press, France.

Coffin CM, Watterson J, Priest JR, Dehner LP. 1995. Extrapulmonary myofibroblastic tumor (inflammatory pseudotumor). A clinico-pathologic and immunohistological study of 84 cases. Am J Surg Pathol 19: 859-872.

Fujiwara S, Yu S. 1967. Bonghan theory: morphological studies. Igakuro Ayumi 60: 567-577.

Gartner F, Santos M, Gillette D, Schmitt F. 2002. Inflammatory pseudotumour of the spleen in a dog. Vet Rec 150: 697-698.

Gleason BC, Hornick JL. 2008. Inflammatory myofibroblastic tumours: where are we now? J Clin Pathol 61: 428-437.

Haines DE, Moncure CW. 1973. Pseudotumor of orbit in a prosimian primate (lesser bushbaby; *Galago senegalensis*). J Med Primatol 2: 369-377.

Häusler M, Schaade L, Ramaekers VT, Doenges M, Heimann G, Sellhaus B. 2003. Inflammatory pseudotumors of the central nervous system: report of 3 cases and a literature review. Hum Pathol 34: 253-262.

Hong S, Lee HA, Cho SJ, Kim O. 2010. A New Method for the Histological Tissue Processing of Bonghan Ducts. J Vet Clin 27: 415-420.

Johng HM, Yoo JS, Yoon TJ, Shin HS, Lee BC, Lee C, Lee JK, Soh KS. 2007. Use of magnetic nanoparticles to visualize threadlike structures inside lymphatic vessels of rats. Evid Based Complement Alternat Med 4: 77-82.

Knight C, Fan E, Riis R, McDonough S. 2009. Inflammatory myofibroblastic tumors in two dogs. Vet Pathol 46: 273-276.

Lee BC, Bae KH, Jhon GJ, Soh KS. 2009a. Bonghan system as mesenchymal stem cell niches and pathways of macrophages in adipose tissues. J Acupunct Meridian Stud 2: 79-82.

Lee BC, Kim KW, Soh KS. 2009b. Visualizing the network of bonghan ducts in the omentum and peritoneum by using Trypan blue. J Acupunct Meridian Stud 2: 66-70.

Lee BC, Soh KS. 2008. Contrast-enhancing optical method to observe a Bonghan duct floating inside a lymph vessel of a rabbit. Lymphology 41: 178-185.

Lee C, Seol SK, Lee BC, Hong YK, Je JH, Soh KS. 2006. Alcian blue staining method to visualize bonghan threads inside large caliber lymphatic vessels and X-ray microtomography to reveal their microchannels. Lymphat Res Biol 4: 181-190.

Liu CH, Chen IP, Chen A, Chang CH. 2005. Peritoneal inflammatory myofibroblastic tumor in a brush-tailed porcupine (*Atherurus Macrourus*). J Zoo Wildl Med 36: 349-352.

Lott S, Lopez-Beltran A, Maclennan GT, Montironi R, Cheng L. 2007. Soft tissue tumors of the urinary bladder, Part I: myofibroblastic proliferations, benign neoplasms, and tumors of uncertain malignant potential. Hum Pathol 38: 807-823.

Miller MA, Fales WH, McCracken WS, O'Bryan MA, Jarnagin JJ, Payeur JB. 1999. Inflammatory pseudotumor in a cat with cutaneous mycobacteriosis. Vet Pathol 36: 161-163.

Miller SA, van der Woerdt A, Bartick TE. 2000. Retrobulbar pseudotumor of the orbit in a cat. J Am Vet Med Assoc 216: 356-358.

Narla LD, Newman B, Spottswood SS, Narla S, Kolli R. 2003. Inflammatory pseudotumor. Radiographics 23: 719-729.

Ogay V, Bae KH, Kim KW, Soh KS. 2009. Comparison of the characteristic features of Bonghan ducts, blood and lymphatic capillaries. J Acupunct Meridian Stud 2: 107-117.

Rocha NS, Tostes RA, Ranzani JJT, Schmidt FC. 2002. Inflammatory pseudotumor of the urinary bladder in dogs: two cases. Arq Bras Med Vet Zootec 54: 450-453.

Seol HJ, Kim SS, Kim JE, Lee SH, Won JY. 2005. Inflammatory pseudotumor in the epidural space of the thoracic spine: a case report and literature review of MR imaging findings. AJNR 26: 2667-2670.

Shin HS, Johng HM, Lee BC, Cho SI, Soh KS, Baik KY, Yoo JS, Soh KS. 2005. Feulgen reaction study of novel threadlike structures (Bonghan ducts) on the surfaces of mammalian organs. Anat Rec B New Anat 284: 35-40.

Slocombe RF, Miller CL, Maclean AA. 1992. Pulmonary plasma-cell granuloma (inflammatory pseudotumor) in a horse. Equine Vet J 24: 492-493.

Soh KS. 2009. Bonghan circulatory system as an extension of acupuncture meridians. J Acupunct Meridian Stud 2: 93-106.

Sung B, Kim MS, Corrigan A, Donald AM, Soh KS. 2009. *In situ* microextraction method to determine the viscosity of biofluid in threadlike structures on the surfaces of mammalian organs. Phys Rev E Stat Nonlin Soft Matter Phys 79: 022901.

Sung B, Kim MS, Lee BC, Yoo JS, Lee SH, Kim YJ, Kim KW, Soh KS. 2008. Measurement of flow speed in the channels of novel thread-like structures on the surfaces of mammalian organs. Naturwissenschaften 95: 117-124.

Swain RS, Tihan T, Horvai AE, Di Vizio D, Loda M, Burger PC, Scheithauer BW, Kim GE. 2008. Inflammatory myofibroblastic tumor of the central nervous system and its relationship to inflammatory pseudotumor. Hum Pathol 39: 410-419.

Tursi M, Garofalo L, Muscio M, Galloni M, Zanatta R, Borgarelli M, Pucci A. 2009. Verrucoid lesions of mitral valve in a dog with features of inflammatory myofibroblastic tumor. Cardiovasc Pathol 18: 315-316.

van der Woerdt A. 2008. Orbital inflammatory disease and pseudotumor in dogs and cats. Vet Clin North Am Small Anim Pract 38: 389-401.

Wako Y, Okazaki Y, Tomonari Y, Doi T, Kanno T, Katsuta O, Tsuchitani M. 2005. A pseudotumorous nodular lesion of the subcutis in a beagle dog comparable to calcifying fibrous pseudotumor in human. J Toxicol Pathol 18: 199-202.

Williams DL, Long RD, Barnett KC. 1998. Lacrimal pseudotumour in a young bull terrier. J Small Anim Pract 39: 30-32.

Yoo JS, Kim HB, Ogay V, Lee BC, Ahn S, Soh KS. 2009. Bonghan ducts as possible pathways for cancer metastasis. J Acupunct Meridian Stud 2: 118-123.