Achievements of PVS (Primo Vascular System) Research from a Historical Perspective

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Received June 28, 2021
Revised October 27, 2021
Accepted December 6, 2021

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The purpose of this paper is to compare the biological research carried out in North Korea with the modern outcomes in the same field, from a historical perspective. In the 1960s, the group led by Bong-Han Kim asserted the existence of a fundamental circulatory system in the human body. Their findings were introduced in five papers as well as in the newspaper *Rodong Sinmun*. The size of the group, the range of equipment, and their findings expanded gradually, and the final paper on blood cells would be only published one of over sixty papers reported at that time. In the five papers, some unclear and inconsistent contents were found. Meanwhile, in the 2000s, PVS (primo vascular system) researchers have published over one hundred papers to prove the existence of this novel system. Some trends have emerged in approximately sixty papers as follows: The research on the identification of the anatomical and histological characteristics has gradually expanded to encompass the system's own functioning. Also, new visual results (e.g. before and after dyeing, and its comparison with blood clots) and the exploration of possible medical applications (e.g. cancer metastasis channels or stem cells location) have been proposed. However, it is difficult to identify papers which comprehensively represented the elements claimed by Bong-Han Kim's group. In addition, papers have been published more in alternative or Oriental medicine journals than in Western biomedical journals. It seems necessary to report more existence of the system in one laboratory animal and in more influential journals.

Keywords: Bong-Han Kim, Fundamental circulatory system, PVS (primo vascular system), Historical perspective, Dyeing and microscopic observation, Anatomical and histological characteristics, Cancer metastasis, Stem cells

INTRODUCTION

In the 1960s, Professor Bong-Han Kim (1916-?) and his research group (hereafter the BK group) at the Pyongyang Medical College in North Korea asserted the existence of a fundamental circulatory system in the human body that was structurally and functionally distinct from the blood, lymphatic, and nervous systems in five papers [1-5]. They made the groundbreaking claim that the system must be the anatomical entity of the *Kyungrak* (acupuncture meridian) system of Oriental medicine, and that the *sanals* (live eggs) inside the system grew into cells through continuous renewal processes.

That claim, however, was not successfully confirmed in the international scientific community until a research group examining the primo vascular system (hereafter the PVS group) in South Korea started to report some anatomical

evidence from laboratory animals in the early 2000s that strongly suggested the findings of the BK group were correct [6]. In March 2000, Professor Kwang-Sup Soh led a research group, which was called the Laboratory of Biomedical Physics for Korean Medicine, in the Department of Physics, Seoul National University, and began to represent the experimental results of the BK group from 2002. After obtaining meaningful data and observation techniques, the Professor Soh's group actively carried out demonstrations by visiting laboratories inside and outside the country, and formed international research networking [7]. In 2010, the group decided to call the Bonghan system as the PVS to promote more scientific meaning in the academic fields, and officially suggested to use that term during the first International Symposium on PVS, which was held with the government's support as a part of the activities at the Oriental Medicine Expo in Jaechon, South Korea [8]. In this paper, the term "PVS

group” encompasses all domestic and foreign researchers, who have been studying on the claims of the BK group after leading reports and transmission of the Professor Soh’s group.

Over the past twenty years, more than one hundred papers have been published in international academic journals, including ones registered with SCI (E) and SCOPUS, by the PVS group. For example, the group reported that they had succeeded in identifying the structures, which the BK group claimed to have found, in the lymphatic system [9-24] and the blood system [25-28], on the surfaces of internal organs [29-45], and inside the nervous system [46-55]. In addition, they hypothesized that the structures might be new cancer metastasis channels and showed some related experimental evidence [56-65]. One of the PVS sub-groups, which started to study the PVS after visiting and demonstration of the Professor Soh’s group and renamed the PVS to the HARNDS (hyaluronic-acid-rich node and duct system), even reported that there were many immune cells and stem cells in the structures of several body parts [66-69]. Furthermore, during this period, there were several turning points showing the quantitative and qualitative growth of the research. For example, the first International Symposium on PVS was successfully held in 2010 in South Korea, and its outcomes were published in a book by Springer in 2012 [70]. Additionally, themes centered on the PVS were dealt with as special issues in the journal *Evidenced-Based Complementary and Alternative Medicine* in 2013 and in 2015.

If the discoveries of the PVS group were true, the existence of a new circulatory system corresponding to the *Kyungrak* system in the body would be first proven in the world, and the PVS group would cast crucial implications for investigating the origin of stem cells as well as cancer metastasis mechanisms in the current biomedical field. However, until recently, the outcomes of the PVS group did not seem to have been widely accepted and expanded upon in the modern scientific community.

One reason for this may be found in the external dimension, such as the indifference and prejudice of the majority of the Western biomedical community against the studies on the *Kyungrak* system [7]. However, it is also necessary to examine another reason, one in the internal dimension, the scientific achievements themselves. As a large number of research papers does not guarantee the authenticity of their outcomes, the qualitative aspects of the papers by the PVS group should be validated, including whether they provided sufficient evidence to be accepted by the scientific community, what kinds of journals the papers were published in, and, basically, how accurately they represented the outcomes of the BK group. In fact, several review articles written by the PVS group [6,71-73] mainly showed evidence corresponding to the findings of BK group, as well as technical suggestions to

identify the new system, but few studies have examined to what extent the outcomes of the BK group have been (un) successfully confirmed as a whole in those achieved by the PVS group. Moreover, little information has been provided concerning the formative process of the BK group’s research. As the PVS group was attempting to represent the BK group’s experiments, it is necessary to examine first how the BK group’s discovery process was conducted.

The purpose of this paper is to examine historically the achievements of the PVS group compared with those accomplished by the BK group. On the one hand, I looked through five papers, four of which [1-4] were English versions containing colorful illustrations and microscopic photos, published by the BK group, as well as articles in the *Rodong Sinmun*, a newspaper published by the Worker’s Party in North Korea, relating background stories not presented formally in the five papers. Stefanov [74] pointed out that there were insufficient explanations and inaccuracies with the current biological knowledge on the important points in five papers, and suggested hypotheses for the morphological architecture and the function of the PVS. In this paper, I indicate that the research process of the BK group was ongoing at that time, and that, as a result, some unclear and inconsistent statements had been described among the texts and visual materials. In fact, the BK group and many of their papers had suddenly disappeared before the research was finished. On the other hand, I selected about sixty papers published by the PVS group to determine how much of the characteristics of the new system argued by the BK group had been confirmed. Since one of the intentions in this paper is to compare the basic anatomical/histological characteristics presented by the two groups, I chose the papers of the PVS group with relatively well-defined basic characteristics through visual data. I also check on the kinds of journals in which the PVS group had published papers. As a result, I point out that, despite the PVS group’s meaningful findings so far, there were aspects that did not fully prove the claims of the BK group, a potential factor in not so many papers being published in major Western biomedical journals. Finally, I suggest that it is necessary to demonstrate the existence of the PVS with more evidence from one animal and to report the outcomes in more influential journals.

DEVELOPMENTS AND DISAPPEARANCE OF THE EXPERIMENTS BY THE BK GROUP

1. Rapid growth and downfall of the group size and findings

The paper in which the BK group first reported that they had discovered the material substance of *Kyungrak* was presented at a conference of the Pyongyang Medical

College on August 8, 1961, and was published in Korean and in English in 1962 [1]. The author of the paper was Bong-Han Kim, but the BK group comprised six members from the Pyongyang Medical College. According to the *Rodong Sinmun* dated December 5, 1961, the group, which was first organized in October 1959, began researching the bioelectrical phenomenon through the *Kyungrak* and observed changes in the voltage at the *Kyunghul* (acupoints) on the skins of their bodies and those of rabbits using a self-made instrument. After obtaining consistent results, i.e., the same constant regular repetitive curves at the *Kyunghul* that differed from the curves for other biological parts of the skin, through more than one hundred experiments conducted until February the following year, the group, now confident of the material substance's existence, started seeking it in earnest. It was said that, at first, the group found the oval-shaped tissues corresponding to the *Kyunghul* and, on August 18, finally succeeded in discovering the material pathway connections between the *Kyunghul*.

The BK group continued to study the physical distribution of the *Kyungrak* throughout the body, as well as the chemical composition inside them, and reported the results in their second paper in 1964 [2], which was authored by Bong-Han Kim and published by the Kyungrak Research Institute. The number of the group was the same as for the first paper, but their discoveries, particularly concerning the distribution inside the vessels, were surprisingly new. They reported, "We have also discovered the existence of structures inside the vessel, a fact which no one has ever conceived of...they are found in the blood and lymph in all vessels in a state of isolation, not adhering to the vessel wall" [2]. The *Kyunghul* and the connecting tubular structures between them were named Bonghan corpuscles and Bonghan ducts, respectively, in the second paper.

By the time the second paper was published, the size of the BK group had expanded greatly. According to the 1965 North Korean national central almanac, *Chosun-Jungang-Yeonkam*, the Academy of Kyungrak, established in February 1964, consisted of about forty laboratories, and its president was Bong-Han Kim. In 1965, the third and fourth papers, which described the overall framework for the structures and functions of the Bonghan system, were published in the same journal [3,4], with authorship ascribed to the Academy of Kyungrak, led by Bong-Han Kim, in the table and end part of Korean and English version.

The fifth paper, published in Korean in 1965, reported on the renewal cycling process of the blood cells as one specific example of the fourth paper's theory of *sanal*. The paper was not the last one written, nor did it signal the end of the research, but is it the last remaining one. According to the *Rodong Sinmun* on October 9, 1965, the fifth paper was only

one of over sixty papers presented at the conference of the Academy of Kyungrak, which was held from October 4 to 8. The newspaper article described the main points at the conference:

The newly published papers were more than sixty covering broad areas of biology and medicine, including theoretical biology, genetics, cytology, developmental biology, physiology, biochemistry, microbiology, anatomy, histology, pathology and experimental therapy. What drew particular attention from the papers presented at this academic presentation was that new theories on pathology and experimental therapeutic achievements have been established based on the theory of *sanal*...Among the papers presented at the conference, we first published a summary on the <Bonghan Sanal-Cell Cycle> of blood cells.

However, the experimental results presented at the conference as well as any remarks about the BK group in the *Rodong Sinmun* and *Chosun-Jungang-Yeonkam* disappeared abruptly in North Korea around 1966. There has been much speculation about the study's downfall, but the cause does not seem to have been a matter of scientific performance.

2. Undisclosed research methods for discovery

The BK group did not explain in the five papers the specific methods for discovering the structures. According to the *Rodong Sinmun* dated December 5, 1961, the experiments were conducted in an enclosed, dark room with low air circulation. After the group discovered the structures, it was said that they also succeeded in staining them, allowing them to be clearly identified. However, it is hard to guess what the dye was, or how the structures had been found in the darkroom without first dyeing them. In the first paper, it was only reported that they "succeeded in correctly discovering *Kyunghul* by the method we ourselves initiated and found out that its distribution tallies in the main with the distribution of *Kyunghul* indicated in the classics" [1]. A similarly vague description was used in the second paper: "by the vivi-staining method and by the unique external appearance of the *Kyunghul* position we could unmistakably single out the Bonghan corpuscles" [2].

The BK group did not seem to have informed foreign visiting scientists of how to discover the new structures. For example, in May 1965, the Ministry of Health of Russia sent two scientists to the Academy of Kyungrak [75]. After returning to Russia, they proposed that it was necessary to send young scientists to the Academy of Kyungrak for training, as well as to establish two laboratories for studying the meridian system in Moscow. However, this attempt was ideologically thwarted by fierce opposition from a cytologist,

Vladimir Yakovlevich Alexandrov, a powerful leader in the Russian scientific community at that time. In the case of China, several institutes, including the Institute of Meridian-Collaterals in Beijing, tried to prove the claims of the BK group on human bodies, rabbits, mice, pigs, and monkeys, but they had considerable difficulties because the BK group's papers provided no specific methods [76]. In 1963, a group of leading Chinese anatomists, histologists, physiologists, and pathologists twice visited the laboratory of the BK group, but they did not learn how the experiments were conducted. Because the methods were not disclosed, associated studies could not be easily attempted, and several cases have assessed the outcomes of the BK group as fake without any experimental trials [77].

Instead, the BK group suggested many ways to identify the characteristics of the new structures. They determined that the new structures were spread like a net over the body

during exploration processes following the discovery of the superficial structures, i.e., the profound structures were discovered in the process of investigating what the superficial structures were connected to. According to an article written by one of the BK group scientists in the *Rodong Sinmun* dated July 30, 1965, the external and the internal Bonghan corpuscles were found in the process of studying the distribution of the ducts connected to the superficial Bonghan corpuscles. In the same way, the intra-external and neural Bonghan corpuscles were found while following the respective ducts. Furthermore, the intra-organic and terminal Bonghan corpuscles were discovered while determining where the Bonghan ducts ended. Every time a new discovery was made, the BK group identified the anatomical and histological characteristics of the structures. Beginning with the second paper, the BK group actively applied contemporary cutting-edge research methods of Western science and

Fig. 1. Uncommon visual materials of the Bonghan structures. There were some uncommon visual materials about the Bonghan structures in the papers. For example, the photo of the internal Bonghan corpuscle (A) in the third paper would not be the typical one. Rather, it looked like the superficial one (B) as shown in the illustration and photo of the second paper. Also, the photo of the intra-external Bonghan corpuscle (C) in the third paper did not seem to be the common one because it looked like that one duct was penetrated into some unknown tissues. In the case of the photo of the intra-external duct (D) in the third paper, it seemed to be the corpuscle rather than the typical duct. All visual materials were from the ISPVS website (www.ispvs.org) accessed in July, 2020.

technology. The structures and functions of the Bonghan system were investigated in detail using various dyes, advanced microscopes, such as phase-contrast, stereoscope, and electron microscopes, radioactive isotope tracking devices, and many biochemical test techniques.

For example, the BK group applied Chargaff's rules (1905-2002), which provided an important inspiration to James Watson and Francis Crick, who published a famous paper suggesting the form of DNA as a double helix in *Nature* in 1953, to estimate the ratios of DNA and RNA in the *sanals*. The group found that the amount of purine bases and that of pyrimidine were equal to that of normal nucleic acids, and they proposed that one *sanal* would correspond to one chromosome in a cell [4]. Another example was their use of a radioisotope (P^{32}) in their second paper to show that the Bonghan system was a circulatory system. They injected the radioisotope into the Bonghan corpuscles in the skin of the abdominal wall and could observe a nearly straight line with high radioactivity without any sideways dispersion. In addition, most of the staining methods they employed are still widely used in modern science and technology communities [72].

3. Inconsistent expressions

The five papers included more than one hundred and fifty photos and illustrations that showed the structures and functions of the Bonghan system. Whenever a new paper was

published, it included more accurate visual data. However, there were some inconsistent expressions among the texts and visual materials in the five papers.

First, some structures in the photos seemed not to match the descriptions in the texts and other visual materials. For example, the internal Bonghan corpuscle reported in the third paper, as shown in Fig. 1A, looked more like a superficial Bonghan corpuscle, as shown in Fig. 1B in the second paper, because the ducts were connected to one side of it. Also, according to the text in the second paper, the profound Bonghan corpuscle "is a long fusiform one (cucumber shape) with blunt ends or an oval form" and "Both ends of the Bonghan corpuscle are connected with the Bonghan duct" [2]. Additionally, one duct of the internal Bonghan corpuscle was thicker than the other, which was not described in the text. Another example was found in the case of the intra-external Bonghan corpuscle of the third paper, as shown in Fig. 1C. The duct appears to penetrate a corpuscle, as if some tissues had attached around the duct rather than the common corpuscle. In addition, the middle part of the intra-external Bonghan duct in the third paper, as shown in Fig. 1D, which was found on the surface of the internal organ, was somewhat convex, so that it looked more like a corpuscle than a typical duct.

Second, the state of connection between the Bonghan structures and the cells was depicted inconsistently. For example, an illustration of the terminal Bonghan corpuscles

Fig. 2. The connection between the Bonghan system and cells. There was some inconsistent depiction about location of the cells from the *sanals* in the third paper. The illustration about the total cycle of the Bonghan liquor (A) showed that the terminal Bonghan ductules were connected to two sides of a cell, but, in the photos of them (B), there was only one ductle joined to a cell. Throughout the papers, it was generally described that the *sanals* went out through the ductles, and the cells grown from them inside the Bonghan system became to locate at some related tissues outside the Bonghan system, for example, in the lymphatic vessel (C). All visual materials were from the ISPVS website (www.ispvs.org) accessed in July, 2020.

and ductles in the third paper, as shown in Fig. 2A, showed that they were connected to two sides of the nucleus of a cell; one was in the nucleus, and the other was out of the nucleus. However, in the photos of the same paper, as shown in Fig. 2B, the terminal Bonghan ductles seem to be connected to only one side of the nucleus. According to the conclusion of the fourth paper, the *sanals* “grow mature and come out of the cell, breaking the cell membrane” and “while moving through them (Bonghan ducts), grow into nucleus-like structures, which become cells in the relevant tissues” [4]. If this is correct, the terminal Bonghan ductles would perform the role of the first gateway for the *sanals* to grow into cells and should be connected to one side of the cells. Moreover, the cells would be located in the tissues outside the Bonghan system, as depicted in Fig. 2C of the third paper, which showed that the *sanals* of the internal Bonghan corpuscle in the lymphatic vessel grew into cells and went out “through the holes of the destroyed outer membrane” [3].

OUTCOMES OF THE PVS GROUP COMPARED WITH THOSE OF THE BK GROUP

1. Incomplete confirmation and reports

There have been many meaningful discoveries about Bonghan corpuscles and ducts reported in the papers of the PVS group. However, as a whole, it was not easy to find cases that showed most of the major characteristics at the same time in one paper (Table 1). The biological tissues where the findings about the Bonghan system had been reported were the surface of the internal organs (17), the lymphatic vessels (16), the nervous system (10), the blood vessels (4) and several parts (4). However, none of these fifty-one papers identified all the major anatomical and histological characteristics, nor all the components of the internal materials. Furthermore, several cases did not report the basic characteristics of the Bonghan system. For example, only twenty-two papers (internal organs, 11; blood vessels, 4; lymphatic vessels, 3; nervous system, 2; and several parts, 2) showed the presence of the Bonghan ductles, and thirty-five papers (internal organs, 11; lymphatic vessels, 10; nervous system, 7; several parts, 4; and blood vessels, 3) reported the connection among the ducts and the corpuscles. Thirty-one papers (lymphatic vessels, 12; nervous system, 9; internal organs, 6; and blood vessels, 4) presented the rod-shaped nuclei of the endothelial cells. In addition, there were fewer reports of internal substances implying the function of the system. For example, in the cases of the internal materials, seven papers (internal organs, 5; nervous system, 2) reported the existence of DNA granules inside the Bonghan ductles, and five papers (internal organs, 4;

Table 1. Achievements of the PVS group in comparison with those of the BK group

Found parts (No. of papers)	No. of papers reporting anatomical characteristics of the Bonghan duct		No. of papers reporting histological characteristics of the Bonghan duct		No. of papers reporting substance inside the Bonghan duct		No. of papers reporting substance inside the Bonghan corpuscle				No. of papers comparing before and after dyeing	No. of papers comparing with blood clots
	Presence of ductles/width	Connection to the corpuscle/size of the corpuscle	Rod-shaped nucleus of endothelial cells	Length of rod-shaped nucleus	DNA granules (Sanals)	Adrenalin granules	DNA granules (Sanals)	Adrenalin granules	Cells			
Lymphatic vessels (16)	3/2	10/3	12	9	0	0	0	0	0	9	0	0
Blood vessels (4)	4/0	3/3	4	3	0	0	0	0	0	0	0	2
Internal organs (17)	11/6	11/9	6	2	5	0	4	0	7	1	0	0
Nervous system (10)	2/1	7/3	9	2	2	1	1	0	0	0	0	1
Several parts (4)	2/0	4/1	0	0	0	0	0	0	4	0	0	0
Total (51)	22/9	35/19	31	16	7	1	5	0	11	10	0	3

The PVS group did not show sufficiently the anatomical/histological characteristics of the Bonghan system and the functional substances inside it in each paper. However, they developed advanced identifying methods such as the comparison of before and after dyeing, and comparison with blood clots.

nervous system, 1) showed the DNA granules in the Bonghan corpuscles. By comparison, the existence of the cells in the corpuscles has been reported relatively more. For example, seven papers presented various types of the cells, including cells with adrenalin granules, in the internal organs, and four papers studying several parts reported the presence of immune cells and stem cells. This situation of not meeting the basic requirements of the Bonghan structures suggested by the BK group did not improve significantly over time.

Not many structures were clearly reported in one laboratory animal, too. According to the claims of the BK group, there were a great many structures all over the body, but, except in a few cases [15,18,28,39], about three or less structures per animal were reported in their papers. In addition, there were cases that the number of animals and structures was not reported at all, or unclear statements such as “over 100 animals” or “many structures” were used.

2. New approaches for visualization and medical applications

Since the BK group did not provide information on the research methods to discover the new structures, the PVS group had to undertake numerous trials and errors to observe their existence. In the process, they developed their own definite methods to discover the structures, and suggested new medical applications for them.

First, the PVS group developed several ways to clearly show that the new structures they found were different from blood vessels, lymphatic vessels, and nerve tissues. For example, ten papers showed the comparison of these tissues before and after staining, and three papers presented the differences between the new structures and the blood clots treating specific dyes they developed (Table 1). They even suggested

an optical method to find the structures floating in a lymph vessel without any staining [13].

Second, the PVS group sought to determine the structures in cancer tissues and suggested that the structures could be new cancer metastasis channels in addition to blood and lymphatic vessels [56-65]. One sub-group of the PVS group reported that, through investigating the new structures in several body parts, they found not only various immune cells but also pluripotent adult stem cells able to repair some injured tissues, the location of which had not been well known [66-69]. The group filed a patent for the relevant research (HAR-NDS-derived stem cells, method for separating same, and use thereof, US2020/0138859 A1) in the U.S. in 2020.

3. Publishing trends of the papers

Some characteristic trends were revealed in regard to the kinds of academic journals in which the PVS group published its papers. As a whole, not many of their papers were published in major biomedical journals. For example, of their sixty-seven papers which were published until recently [9-69,78-83], twenty-one were published in Western biology and medicine journals (Table 2). In addition, eight papers were published in Western scientific journals dealing with physics and observation techniques. On the other hand, thirty-eight papers were reported in alternative or Oriental medicine journals. This trend was similar in terms of time, as the number of papers published in Western biomedical journals did not increase relatively as time passed.

Regardless of the fields the journals represented, the number of papers published in a year did not continuously increase. From 2007 to 2015, about four to ten papers were published annually, but the number decreased beginning in 2016. Although several review papers on the experimental

Table 2. Trends of the journals published by the PVS group

Found parts (No. of papers)	Published year/No. of papers (No. of total papers)		
	Western biology/medicine	Other sciences including physics, observation methods	Alternative medicine/oriental medicine
Lymphatic vessels (16)	2005/1, 2006/1, 2008/1 (3)	2007/1 (1)	2007/1, 2012/2, 2013/3, 2014/2, 2015/4 (12)
Blood vessels (5)	2004/1, 2008/2, 2011/1 (4)	-/0 (0)	2019/1 (1)
Internal organs (22)	2005/1, 2016/1, 2019/2 (4)	2007/2, 2008/1, 2010/1, 2016/1, 2021/1 (6)	2008/2, 2009/3, 2013/3, 2015/2, 2020/2 (12)
Nervous system (10)	2011/1, 2012/1, 2015/1 (3)	-/0 (0)	2008/1, 2010/3, 2012/2, 2013/1 (7)
Cancer tissues (10)	2010/1, 2013/1, 2014/1 (3)	2010/1 (1)	2009/1, 2011/2, 2013/2, 2015/1 (6)
Several parts (4)	2012/1, 2014/2, 2018/1 (4)	-/0 (0)	-/0 (0)
Total (67)	21	8	38

The papers of the PVS group were more published in the journals of alternative or Oriental Medicine than ones of Western biomedicine. Also, the number of the papers did not increase while several review papers dealing with research methodology had been published.

methodologies for representing the new structures had been steadily published, the number of papers was not affected much. For example, in the case of the lymphatic vessels, from 2012 to 2015 four of sixteen papers [14,17,19,24] presented experimental protocols, which mainly pointed out the rod-shaped nuclei as characteristics of the Bonghan structures using alcian blue in rabbits, rats, and mice. Review papers were also published on the areas of cancer tissues [64] and several body parts [69] exploring functional aspects of the Bonghan system.

DISCUSSION AND SUGGESTIONS

Although the BK group claimed that they first discovered the material substance of the *Kyungrak* system, there were different aspects between the characteristics of the *Kyungrak* system and what they observed. For example, as the BK group mentioned in the second paper, the Bonghan corpuscles and ducts were located all over the body, even in the blood and lymphatic vessels, as well as under the epidermis where the *Kyunghul*, in Oriental medicine, were generally known to be distributed. In addition, they identified this new system as a “multi-circulation system,” which had independent circulatory passages complexly linked to each other, unlike the meridian system in Oriental medicine [3]. Therefore, the scientific significance would be that the BK group strongly suggested the possibility of discovering a new fundamental circulatory system, rather than first discovering the material substance corresponding to the *Kyungrak* system.

Of course, there were several unclear and inconsistent statements throughout the five papers. However, it is necessary to remember that the BK group’s research abruptly stopped while it was moving toward completion. If their research had continued, the outcomes would potentially have been reported more consistently, and their methods for identifying the new structures could have been reported.

Although the PVS group actively attempted to prove experimentally the claims of the BK group, until recently, insufficient scientific evidence appears to have been presented in their papers. Nevertheless, the importance of the new research methods and biomedical knowledge achieved by the PVS group cannot be denied. As was the case with the BK group, it was very significant for the PVS group to have successfully discovered new structures in the body that were different from what had been known.

Until recently, the discoveries about the new biological structures were still being reported in the West. For example, in 2015, one research group claimed that they found lymphatic vessels in the membrane of a mouse’s brain, contrary to established academic orthodoxy [84]. In 2017, a paper confirming the existence of lymphatic vessels in

the human brain was published [85]. These discoveries of anatomical structures in new sites have led to the development of new treatments for incurable illnesses, such as Alzheimer’s disease [86]. In 2018, another research group suggested the interstitium, which is a contiguous fluid-filled space existing between structural barriers, as a new organ [87]. Recently, this group proposed the role of the interstitium as a channel of cancer metastasis [88].

The achievements of the PVS group do not seem to lag behind compared to those mentioned above. Even if the existence of the Bonghan system was not fully represented, it would be worthy of notice from Western biological journals to report that there is a new biological system that consists of unique tissues interconnected and spread throughout the body, one that is clearly distinguished from the blood, lymphatic, and nervous systems without any artifacts. To do so, it would be necessary to develop experimental methods for subsequent researchers showing much more structural and functional evidence per laboratory animal in one paper.

ACKNOWLEDGEMENTS

I express my special thanks to the committee of ISPS2021, held from May 27 to 29 in 2021, for giving me a chance to present the draft of this paper, which included some contents of my recently published book.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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