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Recovery of Brain in Chick Embryos by Growing Second Heart and Brain

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Abstract

To recover chick embryos damaged the brain, two methods are presented. In both of them, somatic cells of an embryo introduced into an egg cell and an embryo have emerged. In one method, injured a part of the brain in the head of an embryo is replaced with a healthy part of the brain. In the second method, the heart of brain embryo dead is transplanted with the embryo heart. In this mechanism, new blood cells are emerged in the bone marrow and transmit information of transplantation to subventricular zone (SVZ) of the brain through the circulatory system. Then, SVZ produces new neural stem cells by a subsequent dividing into neurons. These neurons produce new neural circuits within the brain and recover the injured brain. To examine the model, two hearts of two embryos are connected, and their effects on neural circuits are observed.

Introduction

Several years ago, some investigators proved the existence a little brain on the heart which acts like a real brain in the head [1]. This 'little brain' on the heart is comprised of spatially distributed sensory (afferent), interconnecting (local circuit) and motor (adrenergic and cholinergic efferent) neurones that communicate with others in intrathoracic extracardiac ganglia, all under the tonic influence of central neuronal command and circulating catecholamines. Neurones residing from the level of the heart to the insular cortex form temporally dependent reflexes that control overlapping, spatially determined cardiac indices [2]. Until now, fewer discussions have been done on this subject. For example, some researchers have argued that cardiac function is under the control of the autonomic nervous system, composed by the parasympathetic and sympathetic divisions, which are finely tuned at different hierarchical levels. They have shown that while a complex regulation occurs in the central nervous system involving the insular cortex, the amygdala and the hypothalamus, a local cardiac regulation also takes place within the heart, driven by an intracardiac nervous system. This complex system consists of a network of ganglionic plexuses and interconnecting ganglions and axons [3].

Now, the question arises that what happens for this little brain during heart transplantation? Recent investigations show that patients who gave hearts from donors, obtain some characteristics of them. One of them was Sylvia who declared that soon after her operation, she felt like drinking beer, something she hadn't particularly been fond of before. Later, she observed an uncontrollable urge to eat chicken nuggets and found herself drawn to visiting the popular chicken restaurant chain, et al., [4]. This means that the little brain could be transformed from one body to another during heart transplantation.

On the other hand, the existence of the little brain on the heart could help to head transplantation and make it possible. In fact, during cutting heads, this little brain plays the main role in decisions and does all activities of a real brain. Until now, some scientists have reported the head transplantation in animals. For example, in 1908, some scientists have tried to graft the head of one dog on an intact second dog; the grafted head showed some reflexes early on but deteriorated quickly, and the animal was killed after a few hours [5]. There were few animal experiments on head transplantation for many years after this [6], [7]. In 2016 some investigators published a review of attempted as well as possible neuroprotection strategies that they said should be researched for potential use in a head transplantation procedure; they discussed various protocols for connecting the vasculature, the use of various levels of hypothermia, the use of blood substitutes, and the possibility of using hydrogen sulfide as a neuroprotective agent [8]. Besides these considerations, one of the interesting claims in head transplantation has been made by Sergio Canavero. He published a protocol and said would make human head transplantation possible [9]. This transplantation is possible if there be a second brain for doing activities of the brain in the absence of the head. This second brain could be a little brain in the heart.

On the other hand, using cells transplantation may save some brain-damaged patients. However, the new head or brain should be formed from cells of the patient his / her self. This may be possible through the reprogramming of cells. During reprogramming, cells can convert to induced pluripotent stems and then these cells produce new specialised cells [9], [10], [11], [12]. In one of the methods, an oocyte can reprogram an adult nucleus into an embryonic state after somatic cell nuclear transfer, so that a new organism can be developed from such cell [13]. In some other methods, some factors (Oct4, Sox2, Klf4, and c-Myc) are used to generate induced pluripotent stem cells (iPSCs) [14]. Using these methods, we can produce new neural stem cells that could produce new neurons and form new neural circuits within the injured or dead brain.

In this paper, we propose two methods for recovering chick embryos dead brains. In both methods, we injected a cell of the patient into an egg cell (for women, we use their egg cell) and put it in a uterus. After a period of time, neural networks and blood circulatory systems are produced. For a dead brain, we could transplant initial circuits of the initial brain with circuits of the second brain. For an injured brain, we can transplant the initial heart with the second one. This causes the formation of new blood cells in bone marrows and new neural stem cells in the subventricular zone (SVZ) of the brain. New neurons which are emerged in this process, produce new neural circuits and cure injured brain.

The outline of this paper is as follows: In section II, we make a review of connections between the neural network and the circulatory system. In section III, we propose two methods for recovering injured brains. In section IV, we test one of the methods on chick embryos.

A review of connections between nervous and circulatory systems

Previously, it has been shown that there is a little brain in the heart that can control some activities of the body [1], [2]. In Figure 1, the location and distribution of intrinsic cardiac ganglia are shown [15]. A ganglion is a nerve cell cluster or a group of nerve cell bodies located in the autonomic nervous system and sensory system, mostly outside the central nervous system except for certain nuclei [16]. This system is a bridge between the nervous system and neural network. The origin of these systems is genetic circuits of initial DNAs. These genetic circuits act as the receiver or sender of radio eaves [17].

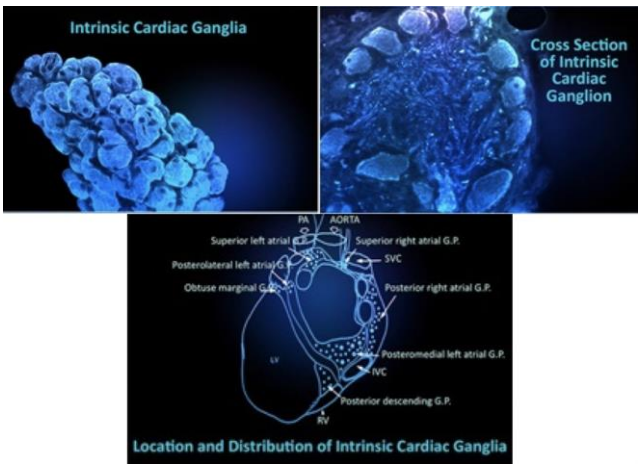

Figure 1: Distributions of neurons in a heart [1], [15]

To transfer information of these genetic circuits, two types of circuits have emerged. First circuits are built of neurons and form a neural network within the brain. Second circuits are formed from vessels of blood cells and form the circulatory system.

There are some connections between the nervous system and the heart which are known as cardiac ganglia. Also, there are some connections between the circulatory system and the neural network in the brain (see Figure 2).

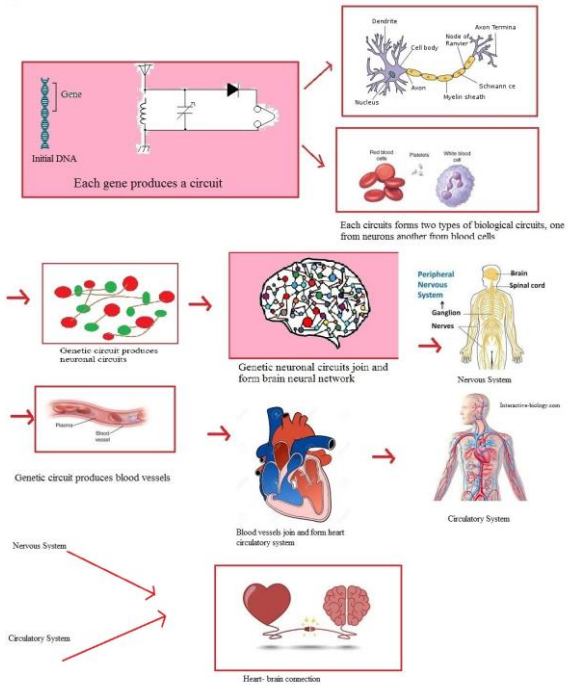

Figure 2: Connections between neural and circulatory systems

Two methods for recovering injured and dead brains

To recover injured or dead brains, we should replace some hurt circuits with healthy ones. To produce these circuits, we can use of reprogramming. The best way for reprogramming is by removing the nucleus of an egg cell and replacing it by the nucleus of a body cell of a patient. If we put this system under normal conditions like conditions of a uterus, this cell divides into more cells, and an embryo emerges. This embryo has a brain and a heart which are like the initial brain and heart (See Figure 3).

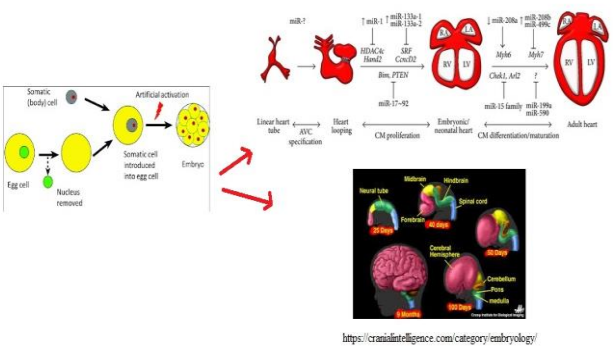

Figure 3: Formation of second heart and brain by introducing a somatic cell into an egg cell

During the formation of the brain in an embryo, first, neural plate and neural tube are emerged [18] (See Figure 4) which can be transplanted with the nervous system of the related patient and pass other stages inside his/her body.

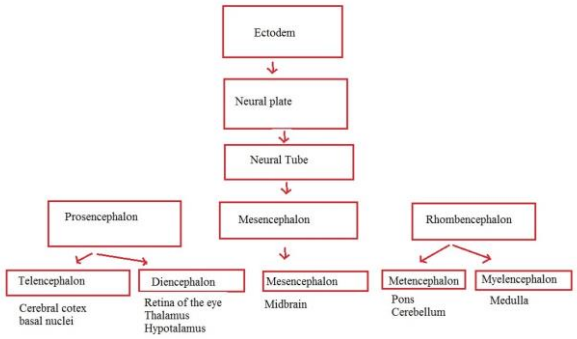

Figure 4: Stages of developments of a brain in a chick embryo [18]

For some brain-dead patients, some parts of initial brain should be replaced by normal and healthy parts of the second brain (See Figure 5).

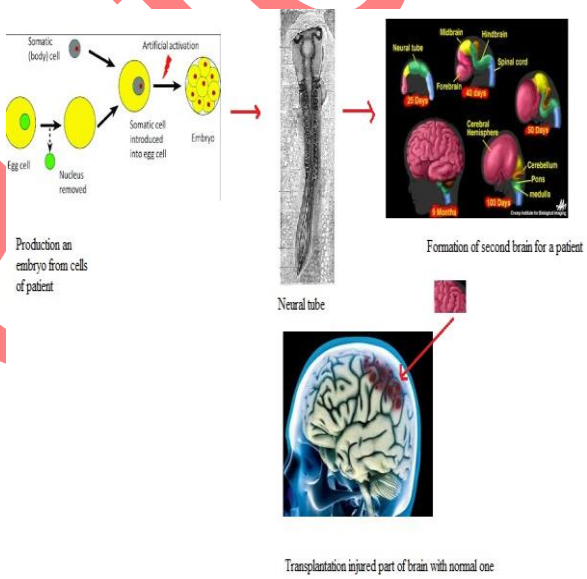

Figure 5: Formation and Transplantation of normal part of the second brain into the injured part of the first brain

Maybe this question arises that what is the fate of memory and personality during this replacement. We can hope that some information is exchanged between circuits of brain and heart, and thus, the initial heart has a copy of memory in its neural system. After replacing neural circuits of the dead brain with new ones, this memory can be transformed into the brain. For patients who their SVZ part of the brain isn't hurt and is healthy, one can transplant initial heart with the heart of related embryo. In these conditions, some new blood cells have emerged in bone marrows. These new cells reach the SVZ and communicate with neural stem cells. Consequently, some new neurons have

emerged which produce neural circuits and recover brain (See Figure 6).

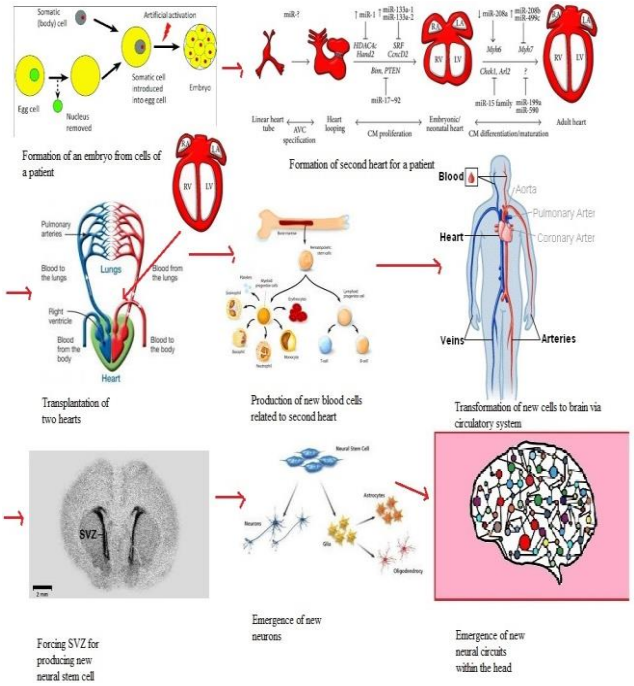

Figure 6: Emergence of new neural circuits after transplantation of second heart into an initial one

Testing the model for chick embryos

To observe the effects of transplantation of two hearts on neural systems, we can use of chick embryos. First, we incubate fertilised eggs for 58 h. Then, we break them and pour them in a tube or vessel of a shell-less culture system. In this system, similar to [19], we apply a 450 ml polystyrene plastic cup as the pod for the culture vessel. We also make a 1-1.5 cm diameter hole in the side of the cup approximately 2 cm from the bottom and plug the hole with a cotton pledget as a filter.

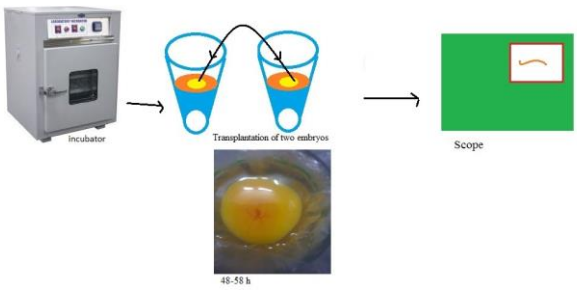

Figure 7: Transplantation of two embryos

We insert a 2 mm diameter plastic tube through the space between the pledget and the hole to provide an oxygen supply. We add an aqueous solution (40 ml) of benzalkonium chloride to the cup. We form a polymethylpentene film into a concave shape, carefully avoiding wrinkles and installed as an artificial culture vessel in the pod. Finally, we place a polystyrene plastic cover on top of the culture vessel [19]. In one of the vessels, we put normal embryo, and in another, we try to connect two embryos from their hearts. We put two types of vessels in an incubator (see Figure 7).

We connect two systems to the scope and measure related currents. We observe that there is a significant difference between radiated waves of neurons within a normal vessel and vessel, including two connected embryos (See Figure 8). This shows that transplantation of two hearts has a direct effect on the formation of neural circuits.

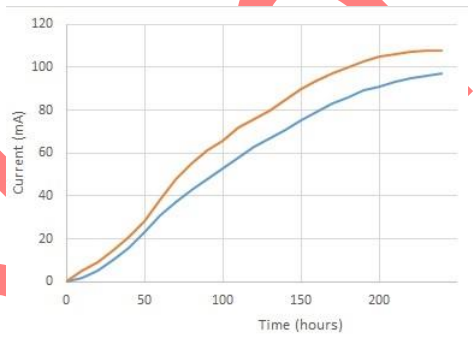

Figure 8: Comparing currents which are emerged by the neural system of a chick embryo (blue colour) with currents of two interacting embryos (red colour)

Conclusion

In this paper, we have shown that there is a direct relation between the neural network and the blood circulatory system. Both of them are emerged to transfer information of initial genes in an initial stem cell. In fact, each gene acts as the receiver or sender of waves and produce two types of circuits, one related to the neural circuit and another related to the blood circuit. These circuits exchange information with each other through some connections. These connections are some neurons within the heart and some vessels with the head. This may help us to introduce some methods for recovering dead and injured brains. In these methods, we inject a cell of a patient into a bare egg cell and put this system in a uterus. After some time, two new neural and circulatory systems emerge. Then, we have two ways. In one way, we can transplant injured parts of the initial brain with some neural circuits of the second brain. In the second way, we can transplant the initial heart of a patient with a second heart of embryo. In these conditions, bone marrows produce new stem blood cells and cause to produce new blood cells. These blood cells move along the circulatory system and reach to SVZ part of brain. Then, SVZ produce some new neurons related to the second heart and

create new neural circuits. These circuits are replaced with ruined circuits and recover dead brain. We have tested the model in chick embryos and shown that transplantation has a direct effect on neural circuits.

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