Spinal Cord Injury Causes Infection of the Spinal Cord, Liver, and Lung in Mice

ABSTRACT

Objective To investigate whether spinal cord injury (SCI) will cause bacteria transfer to other organs and induce these organs infection in mice.

Methods SPF C57BL/6J mice were randomly divided into two groups: SCI group (n = 6) and sham operation group (n = 6). Mice were anesthetized with 1.25% tribromoethanol and performed with a moderate contusion (0.5 mm/0.4 s) injury at the spinal cord T10 with an LSA-Vibraknife. One week after the operation, the spinal cord, liver, and lung tissues in each group of mice were collected for detection of the bacterial DNA using polymerase chain reaction (PCR) to determine

Results It turns out that positive 16s rRNA bands were detected in the spinal cord, the liver, and lungs after spinal cord injury. However, no positive bands were measured in the sham group.

Conclusion The infection of the liver and the lung results suggest that the bacteria of the intestine may enter the blood stream after SCI and cause the infection in these two organs. While spinal cord infection may cause from the injury itself or from translocation of intestinal bacteria.

KEYWORDS spinal cord injury, 16s rRNA, bacterial translocation, liver, lung

INTRODUCTION

External destructive blows that cause spinal fractures and injuries usually cause spinal cord injury (SCI). Endogenous spinal cord injuries can result from inflammation of the spinal cord, tumors, and vascular lesions. It is recognized as one of the world’s most serious health problems, and leads to irreversible injuries, such as feelings, exercise, and autonomic nerves. It is estimated that the annual incidence of SCI worldwide is 250,000–500,000 per year. The spinal cord is part of the central nervous system. SCI damages the microenvironment and makes the spinal cord difficult to repair. The secondary injury plays important role in pathological changes. Infection will worsen the secondary injury. Although many clinical trials have been conducted, the regeneration and functional recovery of the central nervous system after SCI remains a thorny issue. Traumatic SCI causes severe neurological and psychological complications, as well as intestinal dysfunction. Bladder and intestinal dysfunction following SCI may be associated with impaired spinal autonomic circuits. Disorders in the intestinal flora may cause bacterial translocations to induce infections in other organs outside the intestinal tract, thereby aggravating secondary damage. Studies have shown that gut bacteria are associated with diseases of the nervous system including autism, pain, depression, anxiety, and the onset or progression of stroke. The latest research shows that the pathological development and development of SCI related to the intestinal flora. Therefore, it is possible that SCI cause gastrointestinal dysfunction related to intestinal microbiota dybiosis, which leads to the translocation of intestinal bacteria, and finally induces infection of other organs. The purpose of the present study is to investigate whether SCI will cause infection of the liver, lung, and spinal cord.

EXPERIMENTS

C57BL/6J mice were anesthetized with 1.25% tribromoethanol intraperitoneally with 0.2 ml/10 g, and T10 was subjected to moderate SCI using
the LISA-Vibraknife with a depth of 0.5 and a time of 0.4 s. After the surgery, the animals urinate for three times a day until the animals were able to voluntary urination.

On the 7th day, after SCI, spinal cord, lungs, and liver were taken from a clean surgical instrument in a sterile surgical instrument, immediately frozen in liquid nitrogen, and stored at −80°C. The extracted DNA was isolated using the Bioline ISOLATE II Genomic DNA Kit (#BIO-52067) according to the Bioline protocol. PCR was performed using Q5 DNA polymerase (New England Biolabs) using 50 ng of tissue-derived DNA as a template (30 cycles), with the primer set selected to amplify the V3–V4 region of the gene encoding 16S rRNA (forward: ACTCCTACGGGAGGCAGCAG; Reverse: GGACTACHVGGGTWTCTAAT).

RESULTS AND DISCUSSION

The process of moderate spinal cord injury model is shown in Fig. 1. After the operation, the back muscles and skin were sewn together with sterilized suture needles. Water and food supplies were replaced and all the mice returned to breeding cages after sufficient recovery from the surgery. The mice were determined whether the injury succeeded by evaluation of functional defects in two hind limbs of animals one day after contusion. Unsuccessful injured animals were excluded from SCI group. To determine whether the infection of the liver, lung, and spinal cord would occur after SCI, we detected the 16s rRNA level in these tissues using PCR technique. The positive signal of 16s rRNA was detected in the injured spinal cord, lung, and liver, but not in the sham group as the results shown in Fig. 2. These results suggest that SCI will cause infection of the liver, lung, and spinal cord. Infection of the liver and the lung posted SCI relates to the translocation of intestinal microbiota, while infection in the spinal cord seems more complicated. Although we perform SCI of mice under strict sterilized processes, contamination of the injured site may occur because of an open wound. However, it is not excluded the possibility that translation of intestinal bacteria. Recent study has shown that the SCI induce a high permeability of intestine, which may provide the chance for transferring of intestinal flora. Therefore, targeting at post-SCI infection may be one of the treatment strategies for curing the spinal cord injury.

CONFLICT OF INTEREST

No financial conflicts of interest.

REFERENCES

Spinal cord injury causes infection of the spinal cord, liver, and lung in mice