



Clinical Nursing Practice for Fracture Healing Vs. Fracture Merge Cerebral Injury

Hongxia Wang¹, Xiaoying Bao^{2*}

ABSTRACT

This paper aims to observe fracture healing quality in rabbits after cerebral injury and compare it with the subcutaneous fracture healing. Purebred New Zealand white rabbits are randomly chosen as two groups, i.e. fracture merge brain injury group and simple fracture group. For the latter group: under the anesthesia, saw the right ulnar midpiece off rabbit, build a standard right ulnar fracture model. For the former group, repeat the above procedure for right ulnar fracture model, a linear acceleration brain injury model is also built. After anesthesia, place a stainless-steel gasket between the coronal and lambdoidal sutures, wait until the rabbit fully awakens, let it lie prostrate on a sponge mat, and then fall down from a height. The results show that bone mineral density of the fracture merge brain injury group is higher than that of simple fracture group. It is concluded that the healing quality of the fracture merge brain injury group is significantly better than that of simple fracture group. Hence one can see that the high-quality nursing service model can effectively facilitate fracture healing of patients and accelerate the recovery of the function of the ill limb.

Key Words: Brain Injury, Fracture Healing, Nursing

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Introduction

The fracture healing is defined as the physiologic repair for injured bone tissue, structure and function. In orthopedic clinical practices, we often encounter patients with fracture merge brain injury, who are manifested by rapidly growing and spate calluses, and even heterotopic ossification. Well, it seems that brain injury can accelerate fracture healing (Spencer, 1987). In clinical practices, it is found by experiments that when fractures occur with brain injury, there are some signs, for example, callus grows excessively, hypertrophic callus appears, the healing of bone fractures noticeably accelerates, and even the complications occur in the later stages of healing, i.e. heterotopic ossification (Garl, 1990).

Severe skull fractures are typical fractures merge brain injury. Skull fracture refers to such a

disease that one or more of the head bones partially or completely rupture, mostly caused by blunt impact. Skull structure change does not require special treatment, but if there is tissue injury with it near the force bearing point in the skull, for example, blood angiorrhesis, brain or cranial nerve injury, meningeal tear, etc., it must be treated in time. Otherwise it can cause intracranial hematoma, neurological function impairment, intracranial infections, cerebrospinal fluid leakage and other serious complications that will affect prognosis (Spencer, 1989). Skull fractures occur as the consequence of the reaction produced against the violence on the skull. If the skull moves with the direction of violence such that no reaction is formed, it will not cause a fracture. Since the skull's tensile strength is constantly less than the compression strength,

Corresponding author: Xiaoying Bao

Address: ¹Operating Room, Affiliated Hospital of Gansu University of Chinese Medicine, Lanzhou 730020, China; ²Outpatient Service, Affiliated Hospital of Gansu University of Chinese Medicine, Lanzhou 730020, China
e-mail ✉ 1246364870@qq.com

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the part always subjected to stretch stress ruptures first from violence (Walter *et al.*, 1997). If the force bearing area is small, skull bones mostly deform locally; otherwise, the whole skull deformation will occur, and is often accompanied with extensive brain damage. The skull can be simplified into a hemisphere model with braincap as surface and basis cranii as subface. The whole skull can deform after it suffers from stress, while the lateral violence against it often causes fracture perpendicular to the sagittal line, and folding over the tempora and basis cranii; the violence against anterior-posterior parts often leads to the fracture parallel to the sagittal line, forward to the anterior cranial fossa, and rearward to the occipital bone, even causes sagittal suture separation fracture in severe cases (McCabe *et al.*, 1994). Besides, when violence acts perpendicularly on the axis of the body, it can be transmitted along the spine to the basis cranii, and cause linear fractures of basis cranii in light cases. In severe cases, it can lead to ring fractures of cranial base sinking into the intracranial part that may endanger lives (Chen *et al.*, 2008). Injury factors such as the violence direction, speed, and impact area, etc., have a greater effect on skull fractures, here's a quick summary as follows: the mechanical axis against violence and its main components mostly align with the fracture extension direction, but the thickened skull arch forces it to fold over the parts with weak sclerotin. When the impact area from violence is small and fast, a hole shape fracture often forms and the sclerite sinks into the cranial cavity. If the impact acts on a large area and is fast, locally comminuted and depressed fractures are mostly caused; or otherwise, linear fractures through the stress points will be caused; if the impact acts on a large but is slow, it is possible that the comminuted fractures or multiple linear fractures will occur. Blows perpendicular to the calvaria can cause local depression or comminuted fractures; diagonal blows mostly cause linear fractures which may extend to the axis of action force; tend to fold toward the basis cranii; occipital subjected to impact often appears occipital fractures or fractures that extend to tempora and fossa cranii media (Li *et al.*, 2009).

This paper explores pathology and mechanism about how to expedite the fracture healing after cerebral injuries and why the incidence of heterotopic ossification heaves by wrapping up the opening of the blood-brain barrier after cerebral injury, the expression and

release of certain osteogenic factors in brain tissue, the changes in the expression levels of such factors in serum, and their effects on fracture healing, based on analysis on how the heterotopic ossification complication is caused.

Methods

Take 20 purebred adult New Zealand white rabbits, male, weighing 2500 ± 100 g, which should be raised with free diet, water at room temperature. They are randomly divided into two groups: fracture merge brain injury group and simple fracture group, 10 each group. The experiment is conducted by several authors, all of whom are trained. Establishment of Rabbit brain injury model: the fracture merge brain injury group builds a rabbit brain injury model: First, as per the dosage of 0.12 mL/kg, intramuscular compound ketamine (1.0 mL*10) new veterinary drug-41, after anesthesia, the skin preparation should be made on the parietal region, and the iodophors disinfect it. Second, along the midline sagittal line cut the skin on the parietal region with about 3cm long incision, peel off the periosteum, and expose the parietal bone. 3. Place a stainless steel gasket (1cm in diameter and 0.3cm in thickness) between the coronal suture and lambdoidal suture and secure it with a dental cement. Stitch the skin intermittently. 4. After the rabbit fully awakens, let it lie prone on a sponge mat. Use an improved injuring mold, a copper cylinder, weighed 450g, falls freely from a height of 1.5m down on the steel gasket at the top of the skull of the animal, and the injuring impact is 0.675 (kg·m). The establishment of a right ulnar fracture model: All rabbits have been built a right ulnar fracture model: First, after the anesthesia, the skin preparation is made on the lateral right forelimb, and disinfected with the iodophor. Second, cut apart the skin along the right ulna approximately 2.5cm. The muscles should be bluntly dissociated so that the mid ulna is exposed and sawn (Scheven *et al.*, 1991). Third, stop bleeding, interruptedly suture the skin.

Measure one mineral density of affected limb callus: Animals are killed in 6 weeks after the injury. The soft tissue and periosteum of the affected limbs should be stripped. A dual energy X-ray absorptiometry can measure the bone mineral density at the fracture of the affected limb. Biomechanical measurement of limbs: Animals are killed in 6 weeks after injury, strip the soft tissue and periosteum. A electronic universal test machine conducts the three-point

bend test on the affected limb, measure the bending strength limit and plot a curve.

X-ray plain film examination and gross measurement on callus diameter: Two animals are randomly sampled from each group at 2, 4 and 6 weeks after injury, take X-ray films to observe fracture healing. After 6 weeks of injury, the X-ray examination should be performed on all affected limbs from which the soft tissues have be stripped at anteroposterior and lateral side under the agreed exposure conditions: 45W, 2MA. On the X-ray plain film, the widest diameter of the callus should be measured with a vernier caliper.

Results and discussion

Analysis of lab animal brain injury in relation to fracture

The bone mineral density and callus diameter are compared between the two groups at 6 weeks after injury. The fractures of the two groups all have bony joint in the form of the second healing within the expected time. The comparison of BMD and callus diameter at 4 weeks after injury is shown in Table 1.

Table 1. Comparison of bone mineral density and bone callus diameter after injury in the two groups of rabbits

Groups	N	Bone density	Bones	
			Positive film	Lateral film
Brain injury group	9	0.112±0.024	1.264±0.120	1.164±0.114
Simple fracture group	10	0.086±0.024	1.086±0.126	0.961±0.012

As shown in Table 2, a sample size is 8 in the fracture merge brain injury and 6 in the simple fracture group. The limits of flexure strength of the affected limbs of the two groups are (161.67±10.060) KN/cm² and (135.400±12.540) KN/cm², respectively, at 6 weeks after injury. There was a significant difference between the two groups. (P<0.05).

Table 2. A sample size is 8 in the fracture merge brain injury and 6 in the simple fracture group

Groups	N	Bone density
Brain injury group	8	161.67±10.060
Simple fracture group	6	135.400±12.540
P		0.001

Some studies show that cerebral injuries can cause the nervous system to be dysfunction, especially pituitary function impairment (see Fig. 1), and lead the levels of various hormones in the whole body to change by the neuroendocrine system. Growth hormone plays an important role in bone growth and fracture healing because it

can promote bone growth by stimulating cell division and proliferation at the epiphyseal plate. As the blood-brain barrier is impaired due to cerebral injury, a large number of osteogenic factors are released into the blood, thereby enhancing the osteogenic effect of serum in patients with brain injury.



Figure 1. Pituitary test results

High-quality nursing for fracture merge brain injury

Choose 50 cases with fractures, 34 males, 16 females, aged 12~72, disease courses of 7 d-40 d, who were treated in our hospital in May 2011, as the control group, and 50 cases fractures, 33 males, 17 females, aged 10~70, the disease course of 6 d-38 d, who were treated in our hospital in June 2011, as intervention group. Fracture sites of control group: 16 cases with tibial fractures, 8 cases with femoral neck fractures, 7 cases with rib fractures, 6 cases with humeral fractures, 5 cases with radius fractures, 4 cases with hand bone fractures, and 4 cases with other fractures. There are 28 cases with stable fractures and 22 cases with unstable fractures. Fracture sites in the intervention group: 16 cases with tibial fractures, 9 cases with femoral neck fractures, 8 cases with rib fractures, 5 cases with humeral fractures, 4 cases with radius fractures, 5 cases with hand bone fractures, and 3 cases with other fractures. There are 26 cases with stable fractures and 24 cases with unstable fractures. There is no statistical significance of difference in age, gender, fracture classification and severity between the two groups (P>0.05) so that they are comparable. Both groups of patients are given the voluntary principles, sign informed consent form, and ruled out severe organ disease, mental illness, and cognitive impairment. The control group should



be given routine nursing care, i.e., basic nursing on the patient's body position, diet, treatment, etc., including relevant knowledge propaganda according to the patient's fracture site to inform the patients of precautions for preventing complications. The intervention group is provided with high-quality nursing services: cling to the "patient-centered" service concept; "all beds are cared, and everyone has responsibility". Statistical approaches are as described above. Fracture healing of the two groups of patients (see Table 3).

Table 3. Fracture healing of the two groups of patients

	N	Cure %	Effective %	Invalid %	Total efficiency%
Control group	50	74.0	14.0	12.0	88.0
Intervention group	50	94.0	6.0	0.0	100.0

Recovery of joint function in both groups (see Table 4).

Table 4. Recovery of joint function in both groups

	N	Completely normal %	good %	Poor %	Excellent rate%
Control group	50	0.0	84.0	16.0	84.0
Intervention group	50	0.0	96.0	4.0	98.0

Conclusions and outlook

Earlier studies are mostly case reports or unsystematic observations with different results that have never been worthy heeding. The hypothesis that brain injury can facilitate fracture healing was once considered a "myth" in the field of orthopedics. The part of reason why the clinical trials have obtained greatly different results is that the bias factors in clinical trials are more and difficult to be controlled. The experimental results show that the ulnar fractures merge brain injury are superior to the simple ulnar fracture in terms of the callus width, BMD, and the limits of the flexure strength of the affected limb at 6 weeks after injury. The difference has statistical significance. During the dissection of the affected limbs and X-ray plain film observation on the fracture healing, there is no heterotopic ossification.

In regard to nursing care for fracture merge brain injury, the quality care service should be implemented. The recovery of joint function in the intervention group performs better than that in the control group, which suggests that nurses can actively guide patients to carry on functional exercises in the service process, observe the patient's functional recovery whenever possible,

and timely make adjustment on poor conditions. At last, the patient should be informed of the exercise procedures after discharge and encouraged to exercise in accordance with local conditions until their functions are fully restored. The high-quality nursing services can enable the nurses to intensify the intervention in functional exercises while concerning the reduction, fixation, and healing of fractures of the patients. A reasonable functional exercise not only correct the residual displacement of the fracture but also accelerate the fracture healing. Most importantly, functional exercise can improve and increase local blood circulation, build up muscle strength, spur on the recovery of limb function, and enable patients to return to society and resume normal life and work at an early date.

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