



**HOUGNER**

VOL. 2 | NO. 2 | MAR. 2016

ISSN: 2410-2555

HOUGNER PROTOCOLS IN BIOMEDICAL SCIENCES

霍格納生物醫學方法

HUO GE NA SHENG WU YI XUE FANG FA



出刊頻率： Bimonthly 雙月刊  
2015年1月創刊  
定價： HK\$ 3.00



**HOUGNER**

## **HOUGNER PROTOCOLS IN BIOMEDICAL SCIENCES**

承印人 : Hougnier Publishing Limited

承印人地址：香港灣仔駱克道 301-307 號洛克中心 19 樓 C 室  
Rm. 19C, Lockhart Ctr., 301-307 Lockhart Rd., Wan Chai, Hong Kong.

Tel:00852-31149071

Fax:00852-31149072

Contact us: E-mail: [info@hougnier.com](mailto:info@hougnier.com)

---

---

# HOUGNER PROTOCOLS IN BIOMEDICAL SCIENCES

HPBS | VOL. 2 | NO. 2 | MAR. 2016 | www.hougner.com

---

## Editing

Editorial Board of Hougner Protocols  
in Biomedical Sciences  
E-mail: editing@hougner.com  
Website: www.hougner.com

## Editor-in-Chief

Mohamed M. Ibrahim

## Deputy Editors-in-Chief

Srinivas R Sripathi  
Khue Vu Nguyen  
Haineng Xu

## Statistical Editors

Xi Zhang

## Editorial Board

Ramana Reddy  
Yueli Sun  
Haixia Liu  
Yue Xu  
Hui Shan Ong  
Ahmed Adel Hassan  
Guan Jiang  
Ee Lim Tan  
Yuchen Cai  
Cecilia Yu  
Zilun Li  
Yihong Gong  
Tao Luo  
Xiaohua Li  
Jian Shi  
Jihe Li  
Jingtang Su

## Publishing

Hougner Publishing Limited  
Rm. 19C, Lockhart Ctr., 301-307  
Lockhart Rd., Wan Chai, Hong Kong.  
Tel:00852-31149071  
Fax:00852-31149072  
E-mail: info@hougner.com

## Price

HK\$ 3.00

## ISSN

2410-2555

## CONTENTS IN BRIEF

### **Combined Application of 5-level Pre-examination & Triage System and Green Channel for Safe Transfer of Patients in Pediatric Emergency**

..... 014

*Lihua Chen , Minyi Xie*

### **Potential Safety Risks of High Field Strength Magnetic Resonance Inspection In Hypophysoma Operation and Protection of Patients**

..... 021

*Qiuhua Yu, Shuting Li , Zhi Lin, Xun Zeng*



# Combined Application of 5-level Pre-examination & Triage System and Green Channel for Safe Transfer of Patients in Pediatric Emergency

Lihua Chen<sup>1\*</sup>, Minyi Xie<sup>1</sup>

<sup>1</sup> Department of Paediatrics, Fifth Affiliated Hospital of Sun Yat-Sen University, Zhuhai, Guangdong, 519000, P.R.China

\* Correspondence should be addressed to Lihua Chen (13928031142@163.com)

Received date: November 14, 2015; Accepted date: January 05, 2016; Published date: March 02, 2016

## Abstract

In this research actual combined application effects of 5-level pre-examination & triage and green channels for safe transfer of critical children patients of emergency nature were explored. The analysis was conducted on the application of 5-level pre-examination and triage system for transfer of 600 emergency cases of children patients brought into the hospital from January to November 2014 and from January to November 2015. The current research divided the patients into observation groups and control groups according to whether or not the system is applied; transfer methods; worked out statistical analysis on admission rate, success rate of rescue and satisfaction of the two groups of children patients. Success rate of rescue and satisfaction of observation group were obviously superior to those of control group. Comparative difference of the two groups has statistical meaning ( $p < 0.05$ ). This research reported the application of 5-level pre-examination and triage for rapid judgment of critical patients' situation, timely and effective use of green channel for their safe transfer inside hospital. By following this the rescue time can effectively be shortened and will increase chances of rescue success and satisfaction.

**Keywords** 5-level pre-examination and triage; Green channel; Transfer inside hospital; Critical children patients



## 1. Introduction

Owing to physiological and pathological specialty, big span of age, complicated situation of diseases, fast changes and complications in diseases and poor expression of patients of pediatrics, their parents are usually noticed as much apprehensive in nature<sup>[1]</sup>. The influence of strange hospital environment and widespread terror and anxiety about emergency diseases, it is seen that the satisfaction of family members of patients is low. Considering this situation, higher requirements are proposed for medical nursing, concerning high service quality and fast and effective supply of service. However, traditional step-wise treatment process counts on registration, then measuring body temperature, triage, and then visit the doctor, and admission as per guidance of the doctor, which in turn delays the treatment of diseases. According to analysis on domestic emergency materials, only 20% emergency patients are true emergency cases, but the remaining 80% of the patients are not emergency cases at all. Though transfer inside hospital does not take a long time, more potential safety

risks are existent in the transfer process. For transfer of critical patients inside hospital, dangerous events are existent from 6% to 71.1%<sup>[2]</sup>. Scientific and effective pre-examination and triage can ensure timely entry into the green channel of critical children patients. This realizes safe and effective transfer inside hospital and guarantee reasonable utilization of medical resources. Such practice is an inevitable trend. At present, 5-level pre-examination and triage system has been widely used all over the world. This system has been proved to be reliable through clinical study<sup>[3]</sup>. As there are numerous death cases seen in critical children patients of pediatrics, hence following their safe transfer inside hospital carries a very important meaning to lower the death rates. The hospital started to combine 5-level pre-examination and triage system and use of green channel to realize safe transfer of patients in January 2015. An obvious improved success rate of rescue and service satisfaction was noticed and it lowered misdiagnosis and ultimately decreased death rate of children patients was seen.



## 2. Materials and methods

### 2.1 General materials

Materials of children patients treated by outpatient emergency of the hospital from January 2014 to December 2015 were screened at the hospital, but following circumstances were excluded: 1) When a child patient is older than 14 years of age; 2) When patient was transferred to any other special department; 3) When patient leaves the hospital due to various reasons, 4) When their triage materials are not perfect;

5) When medicine is prescribed or inspection sheet is issued for treatment. Over a span of around two years, 300 cases of critical children patients at outpatient emergency department from January to November 2014 were selected as control group and 300 cases from January to November 2015 as observation group (Table 1). All of the mentioned patients were admitted to receive further treatment of the hospital.

Table 1 Materials of children patients treated by outpatient emergency of the hospital from 2014 to 2015 were screened at the hospital

Control group		Observation group	
Hyperpyretic convulsion	116	Hyperpyretic convulsion	106
Pneomonia and heart failure	230	Pneomonia and heart failure	86
Influenza B	35	Alimentary tract hemorrhage	5
Tracheo-bronchial foreign body	5	Severe hand-foot-mouth disease	45
Carbon monoxide poisoning	2	Neonatal jaundice	10
Drug misuseage	4	Septicemia of newborn	16
Alimentary tract hemorrhage	8	Influenza B	20
Severe hand-foot-mouth disease	40	Transfusion therapy for patients of severe thalassemia	12

## 2.2 Methods

### 2.2.1 Triage criteria and reception methods

Control group:

The traditional process of treatment is as follows

Registration – > measure body temperature – > triage – > visit the doctor – > admission as per doctor's advice.

Observation group:

The children pre-examination and triage guidelines (P ed. CTAS) were formulated by scholars of Canada. Critical degree of children patients was divided into five levels<sup>[5]</sup> varying from very critical (need to be rescued immediately) at very critical stage to non-emergency cases (to be treated in a normal hospital procedure) at an ordinary stage. Patients of level 1 are emergency and need to be rescued immediately, patients of level 2 are critical and need to be rescued within 15 minutes, patients of level 3 are emergency and need to be treated within 60 minutes, patients of level 4 are sub-emergency and need to be treated within 120 minutes and patients of level 5 are ordinary ones, who shall wait for treatment at ordinary outpatient department. In combination with actual situation of children patients of outpatient emergency department of our hospital, criteria of emergency pre-examination and triage system (Table 2) and process chart (Figure 1) were formulated via discussion and practice. These systems

and processes are aiming to ensure timely arrangement of treatment for children patients of level 1 and level 2.

Arrival of children patients at outpatient emergency department and their pre-examination

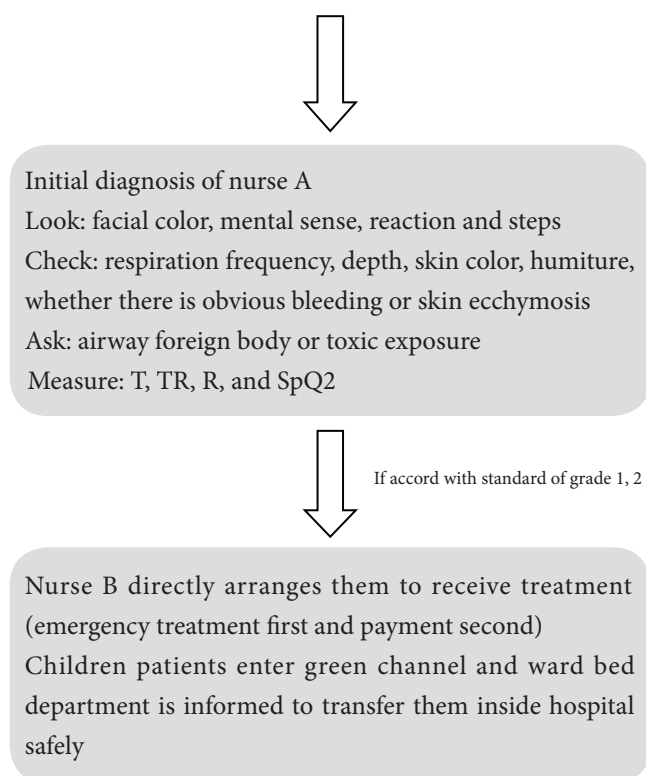


Figure 1 Criteria of emergency pre-examination and triage system and process chart were formulated via discussion and practice.

Table 2 Level-1 and Level-2 Criteria of 5-level Pre-examination and Triage

Level	Level 1 (emergency)	Level 2 (critical)
Body temperature	High fever and seizure	Fever of newborn $\geq 38^{\circ}\text{C}$ and fever of infants $\geq 40^{\circ}\text{C}$
Nerve	Deep coma, convulsion seizure, cramp	Somnolence, severe headache, dysphoria and acute myasthenia
Respiration	Acute respiratory distress, respiratory arrest, Attack of severe asthma, airway foreign body, Acute wheezing rale and laryngeal obstruction at 3rd degree	Difficult breathing, obvious shortness of breath, attack of asthma and obvious wheezing rale
Circulation	Cardiac arrest, severe arrhythmia and shock, Severe dehydration and poor peripheral circulation	Heart failure, severe chest pain and distress, high blood pressure and emesis
Digestive tract	Massive alimentary tract bleeding and severe abdominal distension	Alimentary tract bleeding and obvious abdominal distension
Anaphylactic reaction	Respiratory distress and allergic shock	Swelling of head and face and obvious rash
Blood system	Coagulation disorder and bleeding of whole body	Severe anemia and blood platelet $< 20 \times 10^9/\text{L}$ Active bleeding
Other	Drowning and poisoning with disturbance of consciousness	Drowning and poisoning with clear consciousness

### 2.2.2 Conduct skilled training of medical staff and establish nursing and transfer team for critical patients

Pre-examination and triage of outpatient emergency and safe transfer inside hospital may bring huge pressure for nursing staff, even for experienced nurses. So, related skilled training cannot only improve confidence of nursing staff in transfer, but also enhance their ability of responding to emergency medial events, lowering risks of transfer and avoiding occurrence of unexpected events that may cause trouble<sup>[4]</sup>. Rapid and effective pre-examination and triage will ensure the rescue time of critical children patients. So, it was suggested to ensure selection of nurses of pediatrics diligently. It was advised to

select the nurses with at least 5-year experience of pediatric and strong ability of communication and expression. As far as pre-examination and triage office of outpatient emergency is concerned, it was suggested to ensure nurses of pediatrics to achieve high level of special theoretical and technological knowledge, form fast responding ability and at least 5-year working experience as nursing members of safe transfer team. Training contents included clinical manifestation of critical diseases of pediatrics and treatment of their complication, principles and precautions of using first aid medicine of pediatrics, critical value of inspection



result of pediatric lab, and rescue techniques of pediatrics, including cardio pulmonary resuscitation, and venous puncture etc. Moreover, in combination with processes and standards, simulation of cases was recommended to need to ensure the ones who make consistent evaluation on diseases with doctors to take the positions in these teams was made.

By classifying level-1 or level-2 critical children patients with fast pre-examination and triage, outpatient emergency department should conduct initial first aid treatment and inform critical nursing and transfer team of ward beds to take related instruments and equipped with first aid kit to reach at disposal location within 10 minutes of time. In transfer process, it must be taken into consideration to pay special attention to temperature management of patients and to ensure body temperature of children patients must be stabilized in the transfer process. Also the team must focus on respiration management, maintain their position, fix their head, keep airway open, constantly check and monitor oxyhemoglobin saturation and focus on preventing detachment of trachea cannula. Other important considerations are to conduct circulating management and electro-cardiograph monitoring, get to know heart rate and blood pressure, observe skin color and temperature and adjust infusion speed. Keeping an eye on all the above important operations, it must be ensured to transfer patients to their designated wards and implement rescue measures of next step without any delay.

### 2.2.3 Preparations of medicine and equipment

Some medicine and equipment are important measures to ensure safety of patients, including portable ECG monitor, oxyhemoglobin saturation detector, oxygen bag filled with oxygen, manual respirator, syringe pump and some basic first aid medicine (such as cardiotoxic drug, anti-arrhythmic drug, sedative, anti-allergic agent and normal saline etc.). A small rescue cart needs to be prepared well. Staff shall check them every day to ensure their emergency state at the rate of a maximum possible percentage. This will ensure the effective use of

that cart in emergency situations.

## 2.3 Evaluation method

According to data analysis, admission rate and success rate of rescue of patients in the two groups was compared; questionnaire method to compare satisfaction of patients of the two groups with waiting time was applied, general services of hospital and diagnosis and treatment services of doctors, et al was followed.

## 3. Statistical methods

To see the statistical significance  $\chi^2$  test was performed to conduct inter-group comparison. All statistical analyses were performed using the SPSS (SPSS Inc., Chicago, IL, USA). P value <0.05 was considered statistically significant.

## 4. Result

Compared with control group, safe transfer of patients inside hospital in observation group via combination of 5-level pre-examination and triage was observed through the dataset used for this research. This led to make fast judgment on diseases of critical children patients with timely and effectively utilization of green channel. This results in effectively shorten the rescue time and improve success rate of rescue and satisfaction (Table 3).

## 5. Discussion

It was suggested to conduct standardized training of pre-examination and triage for triage nurses of critical patients of outpatient emergency department, and combine it with uniform training for nurses responsible for safe transfer of patients. Other



Table 3 Comparison of satisfaction with admission rate and success rate of rescue between the two groups n (%)

Group	n	Admission rate	Success rate of rescue	Satisfaction
Control group	300	276(92.00%)	276(92.00%)	263(87.67%)
Observation group	300	296(98.67%)	296(98.67%)	277(92.33%)
$\chi^2$		30.10	30.10	7.22
P		<0.01	<0.01	<0.01

important considerations in such critical patients include stress evaluation on diseases of critical children patients, cultivation of emergency treatment ability, interpersonal communication ability, make full preparations for transfer, strengthen monitoring in transfer process, pay attention to safety and ensure transferred children patients to be nursed just like their nursing in ICU<sup>[5]</sup>. This will ensure the rescue of critical children patients in a timely and effective manner. Also it will improve success rate of rescue and enhance satisfaction of their family members.

The current research result showed 24 cases of 300 children patients of control group who needs to be admitted but were not successfully admitted to the hospital (with reasons unknown) so that their life safety cannot be affirmed. 3 cases of 300 children patients of observation group who need to be admitted were transferred to special hospital due to restrictions of conditions. Another case of level 2 criteria was refused due to special reasons of family, but to be retained in observation zone of emergency department; and leave the hospital when the patient's disease was noticed as stable. Success rate of rescue and satisfaction of observation group were greatly improved when compared with those of control group.

When critical children patients seek medical treatment in hospital, medical staff are recommended to apply standards of pre-examination and triage system to judge treatment sequence of children patients

according to their specific diseases, and make rapid and orderly selection so as to ensure children patients to receive effective treatment within the shortest term, all of which fully present the rescue concept: 'time is life'. Though transfer of patients inside hospital for continuing medial treatment needs several minutes, there are still plenty of potential risks that will endanger life of patients in the transfer process<sup>[6]</sup>. Any carelessness may lead to delay of treatment and missing best rescue opportunity, which will bring immeasurable harm to children patients. In this perspective it was reported in the literature that transfer inside hospital may increase occurrence of critical patients' complication and patients transferred need to face a danger of death rate, 9.6% higher than usual patients<sup>[7]</sup>. From arrival of critical children patients at hospital to their safe rescue, hospitals must shape a strongly responsible nursing team with ability of independent work and emergency disposal. The team members must be trained with rescue techniques and special operation theory and practice so as to make accurate judgment. There are a few domestic reports on combination of pre-examination and triage for safe transfer of patients inside hospital, but the advantages of their respective application have been reported. However, the author thought nursing work needs team cooperation, as team cooperation of nurses is related with safe nursing quality of children patients<sup>[8]</sup>. This will ensure strong communication, connection and cooperation between

outpatient emergency and wards with the ability of disposing problems and communication, identify critical patients rapidly and accurately, and make it to get the diagnosis and treatment in the shortest possible time<sup>[9]</sup>. Nurses are to actively receive patients and timely remove strange and helpless sense and terror of children patients and their family members so as to shorten waiting time. In combination with safe transfer of patients inside hospitals, mental pressure of children patients and family members will be greatly relieved, and treatment effects of children patients can be improved greatly. As a result it will enhance trust of children patients and family members to the hospital

and will result in higher level of satisfaction.

#### Acknowledgement

None.

#### Competing Financial Interests

The authors declare no competing financial interests.

## References

1. Hu Fei, Zhang Yuxia, Zhang Jiayan. Establishment and application of 5-level pre-examination and triage indicator for pediatric emergency. *Chinese Journal of Nursing*. 2015;6(6):707.
2. LowM, Jaschinsk U. Intra hospital transport of critically ill patients. *Anaesthesist*. 2009; 58(1):95-105.
3. Christopher M, Paula T, Nick G, et al. Five level triage: a report from the ACEP/ENA five-level triage task force. *J Emerg NURS*. 2005;(31):39-50.
4. Sun Chi, Wu Jiehua. Progress of research on risks of transfer inside hospital and avoidance measures. *Chinese Journal of Nursing*. 2012;11(11):982.
5. Yang Yongli, Bang Youfeng. Guidelines for safe transfer of critical neonate inside hospitals. *Journal of Clinical Medical Literature*. 2015;2,C(6):1111.
6. Su Shuo, Yu Haiyan. Normalize application of nursing and transfer process inside hospital in transfer of critical patients of emergency department. *China Continuing Medical Education*. 2015;7(8):161-162.
7. Lin Hanzhen, Wei Lihua, Dong Xin. Experience on transfer of critical patients of emergency inside hospital. *Chinese Journal of Disdiagnostics*. 2007;17(7):4027-4028.
8. Song Chunyan, Wu Hongyan, Wang Gaili. Changes and evaluation on cooperation questionnaire of nurse team. *Chinese Journal of Nursing*. 2015;5:620.
9. Fan Ying, Yuan Xiuqun. The application and effect evaluation of emergency triage system. *Chinese Nursing Management*. 2015;15(1): 92-95.

# Potential Safety Risks of High Field Strength Magnetic Resonance Inspection In Hypophysoma Operation and Protection of Patients

Qihua Yu<sup>1\*</sup>, Shuting Li<sup>2</sup>, Zhi Lin<sup>1</sup>, Xun Zeng<sup>3</sup>

<sup>1</sup> Department of Diagnostic Radiology, First Affiliated Hospital of Sun Yat-Sen University, Guangzhou, Guangdong, 510080, P. R. China

<sup>2</sup> Department of Plastic and Reconstructive Surgery, First Affiliated Hospital of Sun Yat-Sen University, Guangzhou, Guangdong, 510080, P. R. China

<sup>3</sup> Outpatient Clinic, First Affiliated Hospital of Sun Yat-Sen University, Guangzhou, Guangdong, 510080, P. R. China

\* Correspondence should be addressed to Qihua Yu (yuqihua85@163.com)

Received date: November 01, 2015; Accepted date: January 25, 2016; Published date: March 02, 2016



## Abstract

In this research existing potential safety risks of high field strength magnetic resonance in hypophysoma operation and effective countermeasures of protecting patients were explored. 68 cases of hypophysoma patients undergone operation in our hospital (First Affiliated Hospital of Sun Yat-Sen University) from December 2014 to November 2015 were collected. The hospital conducted high field strength intraoperative magnetic resonance inspection for them after carrying out comprehensive nurse and safety inspection for them. All patients finished the inspection smoothly and safety of both patients and medical staff were ensured. Via comprehensive and high quality nursing, corresponding protection measures were taken to remove potential safety risks. High field strength intraoperative magnetic resonance inspection for hypophysoma patients is a safe and effective one.

**Keywords:** Magnetic resonance; Hypophysoma; Safety; Protection

## 1. Introduction

Magnetic resonance imaging (MRI) is a kind of new and non-traumatic imaging method. When compared with CT, it has such advantages as clearer image, high-resolution ratio, no ionizing radiation, imaging at any plane and functional imaging etc. For high field strength of intraoperative high field strength magnetic resonance system is used at present, or magnetic field of Siemens 3.0 t (Tesla - unit of magnetic field intensity) superconducting magnet is permanently existent under normal circumstances. In order to ensure safety of patients and medical staff, nursing management of such special operation room becomes more important. Our hospital applies the latest model high definition (HD) MRI and its advanced and comprehensive software support for examining diseases of skeleton, digestion, circulation, nerve, muscular system and soft tissue. Existing potential safety risks in inspection of hypophysoma patients and countermeasures of protection are summarized in the following parts of this research <sup>[1]</sup>.

## 2. Materials and methods

### 2.1 Clinical materials

68 cases of hypophysoma patients who received high field strength intraoperative magnetic resonance inspection in our department from December 2014 to November 2015 were selected. The gender-wise distributions of these cases are 37 and 31 male patients and female patients respectively. The age ranges from 10-68 years, with average age of 48.26 years. Inspection result of hypophysoma were classified as 51 cases of sella routine scan and seller enhanced scan, 12 cases of head routine scan and head enhanced scan, 3 cases of head routine scan and 2 cases of sella routine scan.

### 2.2 Nursing methods

#### (1) Cleaning and maintenance of special articles:

This involves two steps. First avoid collision and contact of wall touch screen and displayer with sharp

instruments and second is to prohibit soaking any part of RF coil and fixed device of head in water.

#### (2) Pre-operative training:

Training is conducted on safety of magnetic resonance for members of magnetic resonance team, make clear specialty of magnetic resonance operation room and understand the necessity of strictly implementing safety norms.

#### (3) Safety interview of magnetic resonance with pre-operative patients:

Through visiting the patients before operation respect their right of patients to know and agree and offer safety publicity, education and interview to them.

#### (4) Intraoperative safety inspection before scanning:

5 steps are involved in intraoperative safety inspecting prior to scanning. The first step is to fix the body position and ensure no contact of skin in large area and prevent forming conductive loop. Second step is to Ensure thermometer of monitor, ECG lines and optical fiber lines not to be crossed or coiled and to seal external auditory canal with bone wax. The third step covers incision with developing-free gauze. Fourth step is to carefully check operative instruments and prevent the risks of their projection. The last step is to cover body of patients with two pieces of 2m-long sterile operational towels before entry of magnet <sup>[2-3]</sup>.

#### (5) Methods of transferring intraoperative patients:

The method of transferring intraoperative patients is split into three main steps. Initially nurses of magnetic field room should carefully check channel of transfer and ensure it not to have any obstacle, and guarantee ground not to have any missing article. This step is



followed by second step in this stage which says that Anesthetist should be responsible for ensuring length of infusion tube; monitoring line and anesthetic incubate to meet the needs of transfer. Lastly must ensure transfer bed to be completely connected with operative bed, fix trundles of transfer bed and slowly pull operative patients to transfer bed. Then, anesthetist should connect magnetic field-compatible anesthesia machine and monitor. Finally after all this process gets completed nurse of magnetic field room sends patients into scanning room to receive magnetic resonance scanning.

### 3. Potential safety risks

#### 3.1 Safety problems caused by strong magnetic field

Strong magnetic field produced by magnet can absorb ferromagnetic substance within magnetic field into the center of magnet, which will not only cause the death of the inspected, but also cause damage to magnet and RF coils. So, it is a must to ensure not to bring ferromagnetic substance into magnetic field. Moreover, set striking sign of strong magnetic field and safety warning outside magnet room. Strong magnetic field also disturbs normal work of electronic lines, especially cardiac pacemaker and operative instruments. In addition, mechanical watches, credit card, mobile phones will be damaged by magnetic field. So, they should not be brought into magnetic field.

#### 3.2 Safety problems caused by radio frequency

Human body is a kind of conductor with certain bio-resistance. So, the power of radio frequency pulse in magnetic resonance scanning will be partially or totally absorbed by human body and its bio-effect mainly

lies on changes of body temperature. When imaging position is different, limit value of SAR will be different. Generally, it is lower than 0.4W/kg for somatic part and 3.2W/kg for head. In addition, increase of temperature caused by any impulse sequence must not exceed 1 °C . The temperature of trunk cannot exceed 39 °C and temperature of limbs cannot exceed 40 °C .

#### 3.3 Safety problems caused by refrigerant

Superconducting magnet is applied for medium and high magnetic resonance imaging device and 77.4k liquid nitrogen and 4.2k liquid nitrogen are applied as two kinds of refrigerant. Usually, it needs to regularly supplement liquid nitrogen to prevent quenching. Hydrogen is a kind of non-toxic and tasteless inert gas, makes people suffocated. Once magnet quenches or realizes de-magnetization for certain reason, plenty of refrigerant will be rapidly volatilized. As a result, the narrow space will be filled with hydrogen and nitrogen and people inside will be short of oxygen. So, under such circumstance, all people should leave immediately. When ventilation is realized well and hydrogen is released, they can go back to dispose it <sup>[4]</sup>.

#### 3.4 Safety problems caused by intraoperative medical staff

(1) Nurses of magnetic field room should remind intraoperative medical staff of making preparations for entering magnetic field room well before entering it.

(2) Iatrogenic infection. In enhanced inspection, remaining needle of venipuncture is demanded; and disinfection, hand sanitation and environment do not conform to requirements. When connecting hose of high pressure injector is not connected solidly, blood will flow back to contaminate connecting hose, thus resulting in iatrogenic infection <sup>[1]</sup>.

(3) As patients are at general anesthesia state, vital signs of patients should be carefully observed by doctors and anesthetist.

## 4. Protection countermeasures

### 4.1 Countermeasures of protecting instruments and device

(1) Routine management of instruments and equipment. Check instruments and equipment routine each day before operation and ensure instruments to be normally used after operation, timely record using situation of instruments and clean them well. After ending operation, anesthetist should check and ensure all instruments and equipment to be closed and nurses of operation room should check operative instruments and place them well. Before entering magnetic field room, it is nurses of magnetic field room that confirm preparations of anesthetist and nurses of operation room to be qualified. Nurses of magnetic field room should connect contrast medium injector with venous tube, position patients and send them into instrument to receive scanning conducted by technician. Inspection and maintenance of instruments and equipment of magnetic field room should be registered well, aiming to ensure safe and effective work of instruments and equipment.

(2) Cleaning and maintenance of special articles: Nurses of magnetic field room should be held responsible for post-operative cleaning of fixed device of head and RF coils and ensure their cleaning quality to be high and their safety. Fixed device of head should be scrubbed with special wet tissue of operation room and soft cloth after being used and nurses should check whether its parts are complete. Outside package of RF foil should be replaced after being used in operation. In its storage and movement process, nurses should prevent dropping coil and connector.

### 4.2 Countermeasures of protecting patients

(1) Safety publicity and education of patients. One day before operation, medical staff should visit patients and specifically introduce precautions of MRI inspection and specialty of operation; understand somatic situation of patients, ask patients whether they have implant inside

their body, confirm whether implant inside body is compatible with magnetic resonance and fill in consent to safety of magnetic resonance scanning carefully.

(2) Pre-operative safety preparations: At the morning of operation, patients are to be sent into operation room, confirm whether patients have metal things on their body or not and remove the ones found timely. Patients should lie on their back on operation bed and their upper limbs should be covered with medium towel and fixed at two sides of body, gasket should be placed between lower limbs to ensure them not to be crossed, all of which aim to prevent contact of skin in large area and formation of conducting loop. Special earplugs or cleaning cotton ball should be inserted into external auditory canal to protect their audition.

(3) Intraoperative safety inspection before scanning: All monitoring lines and optical fiber lines for body of patients should not be coiled or crossed or contact skin of patients directly, aiming to prevent burning skin due to back flow of current. Lines and tubes of instruments around operation bed should be cleaned to ensure transfer to be safe and smooth. Responsible nurses of instruments and devices and tour nurses should carefully check operative instruments and devices and nurses of magnetic field room should confirm no magnetic resonance-compatible instruments left on the body of patients.

### 4.3 Countermeasures of protecting medical staff

(1) Safety training: Before operation, it is the professional that conducts safety education and training of magnetic resonance for all participating workers of intraoperative magnetic resonance inspection. Through theoretical instructions, electrified education and consent to safety of magnetic resonance and practice, and safety training of other forms, the workers who obtain approval of department directors and are confirmed to be qualified via evaluation can enter iMRI integrated operation room to participate in operation and magnetic field work.

(2) Safety supervision: All workers who enter iMRI integrated operation room must consciously observe



related management regulations of magnetic field room, conduct self check on their carried articles, and place non-compatible articles of magnetic resonances into special basket prepared well inside magnetic field room and not take any metal article into magnetic resonance inspection room. Nurses of magnetic field room should strictly implement management regulations and check and remind related workers again before their entry to inspection room to ensure their personal safety.

(3) Management of cleaning workers: It is important to designate special personnel to finish cleaning work of magnetic resonance inspection room. Cleaning workers must receive safety training of magnetic resonance and start their work when they are assessed to be qualified. In doing cleaning work of inspection room each time, it is a must to have nurses on site to conduct safety interview and site supervision and guidance to avoid random movement of instruments and articles inside <sup>[5]</sup>.

## 5. Discussion

Formulating management regulations of magnetic field room of operation room is the precondition to ensure safe use of instruments and device and smooth implementation of operation. All participants and observing staff of operation must follow it. Meanwhile, set related warning signs inside magnetic field room of operation room, mark precautions clearly, and remind workers of observing them consciously. Moreover, improve management system constantly in its using process and ensure operations to be safe.

For safety of personnel and smooth operation of magnetic resonance scanning inside operation room, higher requirements are proposed for nursing management of magnetic field room of operation room. Carefully check them and perform the ones as specified. Nursing work of magnetic field room of operation room should be precise and orderly, and various regulations should be strictly implemented and magnetic resonance operation room should be managed well, so as to ensure safety of personnel and smooth operation of magnetic resonance scanning

of operation room. In addition to setting of striking warning board, it is better to make a partition to avoid entry of irrelevant personnel or companions to magnetic field room <sup>[4]</sup>.

By safety training, ensure workers to improve their safety awareness, have clear understanding on their own responsibilities and shape a cultural atmosphere on safety. Through video and field display, ensure them to recognize the necessity of high field strength intraoperative resonance's safety ideologically and avoid occurrence of injuries.

Before scanning, nurses are required to do their work precisely according to 'list of safety inspection' and check related items together with nurses of magnetic field room. Strict working attitude will avoid causing any harm to operation participants and patients. Due to permanent existence of 3.0T high magnetic field, we should strictly conduct safety interview of magnetic resonance, and carefully perform list of safety inspection of magnetic resonance to ensure safety of patients and medical staff of operation and ensure magnetic resonance scanning inside the room to be smooth <sup>[6]</sup>.

By formulating and gradually improving corresponding management systems of operation room and magnetic field room, setting specialist to manage them, carefully finishing preoperative safety preparations of patients, strictly implementing safety inspection of magnetic resonance, normalizing operation and maintenance of instruments and equipment and conducting safety training, workers are required to improve their safety awareness, and strengthen self management so as to constantly strengthen safety management of magnetic field room of operation room and ensure operation participants and patients to be safe <sup>[7]</sup>.

## Acknowledgements

None.

## Competing Financial Interests

The authors declare no competing financial interests.



## References

1. Zhao Pinxian Zhao, Ruilin Chen. Potential safety risks of patients in MRI inspection and their protection countermeasures. *Traffic Medicine*. 2010;24(1): 96-97.
2. Peterfy C G. Recent advances in magnetic resonance imaging of the musculoskeletal system. *Radiol Clin North Am*. 1994;32(2):291-311.
3. Yang Zhenhan. *Guidelines of MRI technique*. Beijing. People's Military Medical Press. 2007;PP:400-455.
4. Rosenberg Z S, Bencardino J, Astion D, et al. MRI features of Chronic injuries of the superior peroneal retinaculum. *Am J Radiol*. 2003;181(6):1551-1557.
5. Hua Xiao, Ningning Cui, Cuifang Yang. Safety management of integrated operation room of intraoperative MRI. *Tianjin Journal of Nursing*. 2013;21(6):511-512.
6. Miao Liu, Li He, Xiaolei Chen. Safety management in high field strength intraoperative magnetic resonance system. *Journal of Nursing Administration*. 2009;9(10):47-48.
7. Shujuan Xu, Yucui Li. Research on nursing management model based on 1200 cases of intraoperative magnetic resonance operations. *Journal of Logistics University of People's Armed Police Force (medical version)*. 2013;22 (9):818-819.



**HOUGNER**

## **HOUGNER PROTOCOLS IN BIOMEDICAL SCIENCES**

承印人：Hougner Publishing Limited

承印人地址：香港灣仔駱克道 301-307 號洛克中心 19 樓 C 室  
Rm. 19C, Lockhart Ctr., 301-307 Lockhart Rd., Wan Chai, Hong Kong.

Tel:00852-31149071

Fax:00852-31149072

Contact us: E-mail: [info@hougner.com](mailto:info@hougner.com)