

Anaesthesia management of a patient in MRT (Magnetic Resonance Tomography). Save working environment – it must be achieved

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Magnetic resonance imaging (MRI) provides specific diagnostic information that cannot be obtained by other methods: computed tomography, ultrasound and others. Movements during the MRI examination cause artifacts, therefore patients must remain motionless during the entire study period. Anaesthesia during the MRI examination is a way to ensure the quality of investigations. Some patients, children and adults with movement and learning disorders or claustrophobia, are unable to lie still during the MRI scan and consequently sedation or general anaesthesia is required. The continuous presence of a strong magnetic field and restricted access to the patient means that the provision of anaesthesia within MR units presents unique problems. General anaesthesia for paediatric patients undergoing MRI is a safe and effective method in the MRI room with special anaesthesia equipment. Therefore, general anaesthesia is often indicated to increase safety, to improve the quality of imaging, to increase the comfort of patients and for the improvement of logistics of the MRI suite. The safety of the procedure is defined by the possibility of having equipment, monitoring and qualified staff.

Key words: magnetic resonance imaging (MRI), general anaesthesia, safety, special anaesthesia equipment, comfort, qualified staff

Magnetic resonance imaging (MRI) is now routine investigation for many conditions. MRI study provides specific diagnostic information that cannot be obtained by other methods: computed tomography, ultrasound and others. Movements dur-

ing the MRI examination cause artifacts, therefore patients must remain motionless during the entire study period. Some patients, children and adults with movement and learning disorders or claustrophobia, are unable to lie still during the MRI scan and consequently sedation or general anaesthesia is required. Anaesthesia during the MRI examination is a way to ensure the quality of investigations. The continuous presence of a strong magnetic field and restricted access to the patient means that the

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provision of anaesthesia within MR units presents unique problems.

The level of assistance for the anaesthetist must be equal to that expected in the operating theatre environment. Anaesthetic equipment that is used in the scanning room should be MR compatible. The monitoring of patients in MR units during anaesthesia, sedation and recovery must comply with minimum monitoring standards. Monitoring during the MRI examination is indicated whenever a patient requires observations of vital physiologic parameters due to an underlying health problems or is unable to respond or alert the MRI technologist or other healthcare worker regarding pain, respiratory problems, cardiac distress, or difficulty that might arise during the examination. A MRI compatible anaesthetic machine should be located within the scanning room.

Significant levels of acoustic noise are produced during the MR imaging due to the vibration of the switched gradient coils. So why all patients, anaesthetised or non-anaesthetised, should be given ear protectors. Patients requiring general anaesthesia are often difficult to manage, e. g. rare paediatric syndromes and critical care patients. The early detection and treatment of complications that may occur in high-risk, critically-ill, sedated, or anaesthetized patients undergoing MRI procedures can prevent relatively minor problems from life-threatening situations. Because of the widespread use of MRI contrast agents and the potential for adverse effects or idiosyncratic reactions to occur, it is prudent to have appropriate monitoring equipment and accessories readily available for the proper management and support of patients who may experience side-effects.

The practice of anaesthetizing patients for MRI is poorly standardized. The technique (depth of sedation/anaesthesia) and the drugs and monitoring used vary greatly from one institution to another. General anaesthesia with tracheal intubation or a laryngeal mask and mechanical ventilation probably provide the best prevention of the patient motion.

The aim of the study was to assess and to compare the anaesthesia methods management during the MRI examination. The tasks of the study were to compare anaesthesia methods management and duration of anaesthesia for patients undergoing the MRI examination when the airway is ensured through the tracheal intubation or laryngeal mask.

METHODS

A retrospective analysis was carried out in the Lithuanian University of Health Sciences Hospital Anaesthesiology Department. There were analyzed 378 patients younger than 18 years, who underwent the MRT examination with anaesthesia during the period 2008–2011. Informed consent for MRI under general anaesthesia was obtained from the patient's parent or guardian. All scans were diagnostically adequate and none of the monitoring techniques described interfered with MR function or produced image artifacts. We describe our anaesthetic management of paediatric patients with a MRI-compatible anaesthesia machine, a ventilator, and monitoring devices. Satisfactory monitoring of ECG, percutaneous O₂ saturation (SpO₂), end-tidal CO₂ pressure (P_{ET}CO₂) and the concentrations of the anaesthetic gases was obtained. No premedication was given.

Patients underwent intravenous (with thiopental or propofol) or inhalation (sevoflurane) induction and with or without muscle relaxants. Anaesthesia was maintained with air, oxygen and sevoflurane, and a muscle relaxant was given when necessary. Patients were divided into two groups: the first group (Group 1) – the patients' airway secured by introducing a laryngeal mask (138 patients), the second group (Group 2) – the airway secured by tracheal intubation (240 patients). We analyzed the demographic data of the test groups, rated ASA class (according to the American Society of Anesthesiologists' (ASA) classification), MRT examination area, the duration of anaesthesia, anaesthesia techniques and workflow features, anaesthesia complications. When the MRI was completed, the patient was awakened / or not and transferred to the department or ICU. Data were analyzed using the Microsoft Excell and SPSS 17.0 software. P value <0.05 was considered statistically significant.

RESULTS

56% male children and 44% female children received general anaesthesia during MRI examination. The mean age and body weight were 3.2 years (range from 1 month to 17 years) and 28.4 kg (range 3.4 – 65 kg), respectively. 14% were classified as ASA I, 70% as ASA II, 15% as ASA III and 1% as ASA IV. Majority of the patients had MRI of brain or head because of neurological and neurosurgical

pathology. There were no significant differences between the groups with respect to demographic characteristics (age, sex, weight, height, etc.) and variables during the MRT examination.

Duration of anesthesia when the patients' airway was secured by introducing a laryngeal mask was 72.1 ± 3.2 minutes and anaesthesia with tracheal intubation lasted 76.9 ± 2.5 minutes ($p = 0.018$). At the discretion of the responsible anaesthesiologist, general anaesthesia was induced via the inhaled route using Sevoflurane or intravenously using Propofol or Thiopental and maintained with Sevoflurane. Patients were allowed to breathe spontaneously via a laryngeal mask (i-gel) or endotracheal tube, or were placed on a ventilator depending on their medical history. Patients underwent general anaesthesia with a laryngeal mask (Group 1) using Thiopental – 33 (24.8%), Propofol – 73 (52.6%), Sevoflurane – 31 (22.6%), and patients underwent general anaesthesia with tracheal intubation (Group 2) using Thiopental – 173 (72.4%), Propofol – 5 (2.1%), Sevoflurane – 61 (25.5%) ($r = 0.620$; $p < 0.001$). For airway maintenance with a laryngeal mask there were used the following muscle relaxants: in 3 cases (2.2%) – Rocuronium, in 134 cases (97.8%) – without relaxant. During tracheal intubation there were used Rocuronium – in 6 (2.5%) cases, Mivacurium – 168 (70%), Pipercuronium – 4 (1.7%), Cisatracurium – 6 (2.5%), no relaxants – 56 (23.3%) ($r = 0.716$, $p < 0.001$). As we might expect, more patients used muscle relaxants during tracheal intubation than a laryngeal mask.

The procedure was successful in all of the pediatric patients who received general anaesthesia during the MRI examination, with two incidents (0.5%) of laryngospasm. In all patients, adverse events were promptly recognized and managed appropriately, resulting in no long-term sequelae. The low incidence of respiratory events in our sample may be explained by the fact that patients' airway was secured by tracheal intubation or a laryngeal mask.

CONCLUSIONS

Anaesthesia during the MRI examination remains a challenge for anaesthesiologists with regard to the selection of the proper anaesthesia method as well as the selection of the place for patients management after anaesthesia. Safety of patients and medical staff using the MRI facility is of utmost import-

ance. General anaesthesia for paediatric patients undergoing MRI is a safe and effective method in the MRI room with special anaesthesia equipment. Therefore, general anaesthesia is often indicated to increase safety, to improve the quality of imaging, to increase the comfort of patients and for the improvement of logistics of the MRI suite. The future development of anaesthesia for MRI must provide for improving the training of staff and safety of the procedure. Pulse oximetry, noninvasive blood pressure (NIBP) and capnography should be the standards for safe anaesthesia during MRI. The safety of the procedure is defined by the possibility of having equipment, monitoring and a qualified staff.

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ANESTEZIJOS YPATUMAI MRT (MAGNETINIO REZONANSO TOMOGRAFIJOS) TYRIMO METU. PRIVALOMA SAUGI DARBO APLINKA

Santrauka

Magnetinio rezonanso tomografijos (MRT) tyrimas suteikia specifinės diagnostinės informacijos, kurios negalima gauti kitais tyrimo metodais – kompiuterine tomografija, ultragarsu ir kt. Judesiai MRT tyrimo metu trikdo gaunamą vaizdą, todėl tiriami pacientai turi gulėti nejudėdami. Anestezija – būdas užtikrinti kokybišką MRT tyrimą. MRT su anestezija gali būti atliekama įvairaus amžiaus pacientams, tačiau dažniausiai anestezija reikalinga vaikams, kuriems dėl jauno amžiaus ar psichologinių niuansų sunku ilgai gulėti nejudant uždaroje patalpoje. Dėl MRT aplinkos anestezijos metu kyla tam tikrų sunkumų: negalima naudoti feromagnetinių objektų, tarp paciento ir anesteziologo yra didelis atstumas, sąlyginai ilga tyrimo trukmė, galimos įvairios su pacientu susijusios pavojingos būklės. Bendroji anestezija, vykdant saugios anestezijos reikalavimus, ir paciento gyvybinių funkcijų pastovus stebėjimas garantuoja paciento saugumą, pagerina darbo kokybę ir padidina pacientų komfortą MRT metu. MRT tyrimo su anestezija saugumą apibrėžia turima anesteziologinė įranga ir personalo kvalifikacija.

Raktažodžiai: magnetinio rezonanso tomografija (MRT), bendroji anestezija, saugumas, speciali anesteziloginė įranga, komfortas, personalo kvalifikacija