TITLE: OHMEDA(R) FLUOTEC-4 VAPORIZER OUTPUT NEAR MRI MAGNET

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INTRODUCTION: Ohmeda (R) Fluotec-4 vaporizer is an integral component of the new Ohmeda(R) XL 210 non-magnetic anesthesia machine for use in the Magnetic Resonance Imaging (MRI) unit.[1] In our MRI unit (1.5 tesla magnet) the vaporizer when held close to the magnet was pulled toward the magnet. This implied that the vaporizer may contain some magnetic components which in turn may influence the vaporizer output near the MRI unit. The purpose of this investigation was to evaluate the accuracy of vaporizer output near the MRI magnet.

METHODS: The outputs of four Fluotec-4 vaporizers at dial settings of 0.5, 1.0, 1.50 and 2.0 percent with 5L/min oxygen flow were analyzed under two conditions: (a) Outside the MRI unit 30' from the magnet (control) and (b) Inside the MRI unit two feet from the magnet. The vaporizer output was analyzed with a calibrated Ohmeda(R) MGM 6000 mass spectrometer which was always kept outside the MRI suite 35' from the magnet. A 30' long teflon tubing was attached to the vaporizer outlet. The vaporizer output was assessed by inserting the mass spectrometer sampling tube into the teflon tubing. At each vaporizer dial setting a 10 min equilibration period was allowed prior to output analysis.

RESULTS: The results are shown in the table. At the four dial settings of 0.5, 1.0, 1.5 and 2.0 percent there was no statistically significant (Paired Student's t-test P>0.05) difference in the vaporizer output between the control (vaporizer outside the MRI unit) and the study conditions (vaporizer closer to the magnet).

We conclude that the anesthetic output of Fluotec-4 vaporizer is accurate in the proximity of a 1.5 tesla magnet.

Ref: 1. Anesthesiology 71:A365,1989

TABLE

Vaporizer settings (vol %)	Halothane Output (M±SD) Outside MRI unit (control)	Near the MRI magnet (study)
0.5	0.485±0.066	0.468±0.051 *
1.0	0.963±0.050	0.940±0.057 *
1.5	1.500±0.074	1.483±0.082 *
2.0	2.040±0.168	2.020±0.187 *

* not significant (P>0.05)

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Title: Improved MR Imaging by ECG-Triggered High-Frequency Ventilation

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Introduction: Radiologic diagnostic modalities have been significantly improved by the development of magnetic resonance imaging (MRI). MRI of the thorax and upper abdomen still poses specific problems because of respiration and heart contraction [1,2,3] degrading image quality by ghosting artifacts and reduced edge sharpness. Effects of cardiac action can be reduced by ECG triggered MR data acquisition (TMR). The aim of our study was to develop a method for elimination of respiratory and cardiac motion artifacts to improve image quality.

Patients and Methods: A system of ECG triggered high-frequency-positive-pressure ventilation (HFPPV) and MR data acquisition (TMRHFV) was developed. In 9 children undergoing MR investigation under general anesthesia, image quality and parameters of gas exchange were compared using TMRHFV and TMR. During TMR ventilator settings (CMV, pressure controled) were choosen according to patient age. Peak inspiratory pressure (PIP) during TMRHFV was set 0,75xPIP during TMR. Up to a heart rate of 105/min ventilation and MR excitation were synchronized to every heart beat (R-wave of ECG). For higher frequencies only every second heart beat was used.

Results: In all children MR image quality was markedly improved using TMRHFV compared to TMR. Especially delineation of lung anatomy, corticomedullary differentiation of the kidneys, sharpness of the diaphragm and vascular anatomy of parenchymal organs in the upper abdomen was improved due to an increase in edge sharpness and almost complete absence of ghosting artifacts. Parameters of gas exchange (Tab. 1) did not change significantly.

	TMR	TMRHFV
Parameter	mean±SD	mean±SD
pH	7,43±0,052	7,37±0,077
pO_2 (mmHg)	147,7±44,5	144,1±73,2
pCO_2 (mmHg)	34,2±5,9	40,8±9,9
HCO_3^- (mmol/l)	23,7±1,3	23,4±0,9
BE (mmol/l)	-1,0±1,4	-1,2±1,2

Tab. 1: Blood gas parameters during TMR and TMRHFV (n=9, Age=0,3-4,3 years)

Discussion: Because of the small size and the close anatomic relations of the organs, high resolution imaging is especially required in small children. Due to long data acquisition time as well as low noise tolerance and unsatisfactory respiratory monitoring of spontaneously breathing sedated children general anesthesia with controlled mechanical ventilation (CMV) is currently by far the best method for MRI investigation in these little patients. Hence TMRHFV is an obvious additional technique for optimizing image quality in pediatric patients. TMRHFV further is a promising technique for MR imaging in intensive care patients requiring CMV.

Conclusion: TMRHFV is a new and efficient method improving thoracic and upper abdominal MR image quality. The present study indicates that it can be used in anesthetized patients with a high margin of patient safety.

Literature: 1. Kim WS, Magn Reson Med 13:25 (1990); 2. Lanzer P, Magn Reson Med 13:407 (1990); 3. Tarver RD, J Thorac Imag 4:1 (1989)