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Comparison of near-infrared spectroscopic measured liver tissue oxygenation with hepatic vein oxygen saturation in children undergoing cardiac catheterization

M. Weiss[1,2], G. Schulz[1,3], M. Fasnacht[4], A. C. Gerber[2], J. Fischer[1], H. U. Bucher[3], O. Baenziger[1]. Departments of [1]Intensive Care and Neonatology, [2]Anaesthesia and [4]Cardiology, University Children's Hospital Zurich and [3]Clinic of Neonatology, University Hospital Zurich

Background: Liver tissue oxygenation measured by hepatic surface near-infrared spectroscopy (NIRS) has been shown to correlate with hepatic vein oxygenation [1] The aim of the study was to compare transcutaneously measured near-infrared spectroscopic liver tissue oxygenation with hepatic vein oxygen saturation in anaesthetised children undergoing cardiac catheterization.
Methods: 30 children were enrolled into the study. On each patient a NIRS optode (containing an emitter and a receiver of near-infrared light) was placed directly below the right costal arch. Spatially resolved spectroscopic measured liver tissue oxygenation index (TOI_L) was recorded using the NIRO-300‰ (Hamamatsu, Japan). Paired blood samples from the hepatic vein were taken by the cardiologist under radiological control and hepatic vein oxygen saturation was analysed in the oxymeter. Simultaneous arterial SpO_2, subsequent oximetrically measured oxygen saturation from the inferior vena cava (IVC) as well as haemoglobin concentration were noted. TOI_L values were compared with the aforementioned parameters using simple linear and multi-regression analysis. Data are presented as range (mean±SD).
Results: The patients' age ranged from 0.03 to 5.94 yr (2.09 ± 1.92 yr). TOI_L ranged from 39 to 71% (59.9 ± 6.9%), hepatic vein SO_2 from 32 to 80% (55.8 ± 15.0%), arterial SpO_2 from 65 to 100% (88.8 ± 9.9%), IVC SO_2 from 38 to 90% (66.1 ± 13.0%) and haemoglobin concentrations from 96 to 171 g/l (122.6 ± 20.6 g/l). No correlation was found between TOI_L and hepatic vein oxygen saturation (all patients R^2 = 0.0034; cyanotic cardiac patients [n = 17] R^2 = 0.0133; non-cyanotic cardiac patients [n = 13] R^2 = 0.103). The multivariable regression model containing three additional variables explained 79% of the observed variance in TOI_L. In this model, hepatic vein oxygen saturation explained 9.0% of the variance, haemoglobin concentration 37.7%, arterial SpO_2 24.3% and inferior vena cava SO_2 16.1%.
Conclusion: Transcutaneously near-infrared spectroscopic measured liver tissue oxygenation does not reflect hepatic vein oxygen saturation. The value is mainly determined by non-hepatic measures such as the haemoglobin concentration and arterial oxygen saturation.

1 El-Desoky AEH. et al. Eur Surg Res 2000;32:207-14.

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29

Non-invasive haemodynamic monitoring using liver-NIRS and gastric intramucosal pH in children at risk for intraoperative hypovolaemia

G. Schulz[1,2], M. Weiss[1,3], J. Teller[1], A. C. Gerber[3], H. F. Sailer[4], H. U. Bucher[2], O. Baenziger[1]. [1]Departments of Intensive Care and Neonatology and [3]Anaesthesia, University Children's Hospital and [2]Clinics of Neonatology and [4]Craniofacial Surgery, University Hospital Zurich

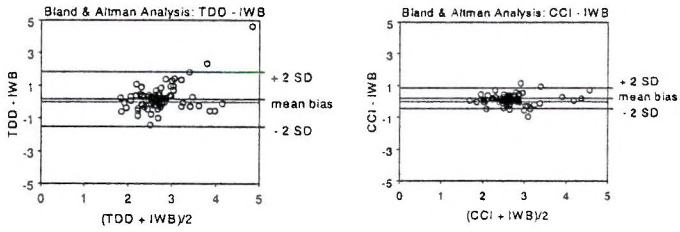
Aim of the study: To compare near-infrared spectroscopic (NIRS) measured liver tissue oxygenation[4] and gastric intramucosal pH[2] with global oxygen delivery as measured by central venous oxygen saturation (SvO_2) in anaesthetised children during craniofacial surgery with expected massive intraoperative haemorrhage.
Methods: We studied 19 anaesthetised children undergoing craniofacial surgery with massive intraoperative blood loss. Spatially resolved spectroscopic measured liver tissue oxygenation index (TOI_L) and air tonometric measured gastric pH_i values were recorded at least every hour. Simultaneously arterial blood gas analysis and oxymetrically measured SvO_2 were assessed from arterial and central venous blood samples. Data were compared using linear regression analysis.
Results: Patients' age ranged from 1.0 to 8.2 yr (median 2.03 yr) and weight from 8.1 to 23.0 kg (median 12.5 kg). Intraoperative blood loss ranged from 36 to 282 ml/kg (median 115 ml/kg). Values for TOI_L ranged from 42 to 77 % (median 62%), for pHi from 7.13 to 7.60 (median 7.38) and for SvO_2 from 51 to 86 % (median 75 %). Among subjects only weak correlation was found between TOI_L and SvO_2 (R^2=0.4) and between gastric pH_i and SvO_2 (R^2=0.21). Intra-individual measured SvO_2 values demonstrated good correlation to TOI_L (R^2: 0.56 to 0.95; median 0.68) but showed varying correlations with gastric pH_i (R^2: 0.003 to 0.94; median 0.29). TOI_L undulated simultaneously with fall and rise of SvO_2 values. Gastric pHi decreased later and only with very low SvO_2 values (<60 %) and recovery was delayed compared to SvO_2.
Conclusion: Continuous measurement of liver tissue oxygenation by NIRS represents a non-invasive trend monitor of SvO_2. In contrast, gastric intramucosal pH represents a metabolic monitor of tissue oxygen reacting only to critical fall of global oxygen delivery.

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Measurement of cardiac output by a new transoesophageal Doppler device after cardiac surgery. A comparison with the thermodilution technique

C. Hofer, Ph. Jaeggi, M. Genoni[1], P. Fodor, A. Zollinger. Institute of Anaesthesiology, Division of Cardiac surgery[1]; Triemli City Hospital, Zurich

Background: Assessment of hemodynamics by transoesophageal Doppler devices (TDD) may be a non-invasive alternative to the pulmonary artery catheter (PAC) [1]. In contrast to the TDD evaluated so far [2], the new TDD (HemoSonic100®, Arrow, Reading, PA, USA) measures both blood flow velocity and the diameter of the descending aorta. The aim of this study was to determine the accuracy and reliability of the new TDD as compared to the thermodilution technique by PAC.
Methods: With Ethical Committee approval, 22 patients following hemodynamic stabilization in the ICU after routine cardiac surgery were studied. Cardiac output was determined by iced water bolus (IWB), continuous cardiac index (CCI) and the TDD. Repeated measurements were made with each patient at intervals of minimal 30 min (T1–T4). Routine therapy and monitoring was not influenced by the study, and weaning from the respirator was begun after the last measurement. Statistical analysis was done using linear correlation, Bland & Altman analysis and ANOVA (post hoc Bonferroni/Dunn correction). A p-value < 0.05 was considered to be statistically significant.
Results: 88 matched sets of data were obtained from 22 patients (age 65 ±7.6 years, body mass index 29±3.4 $kg \cdot m^{-2}$ [mean±SD], ASA III) for statistical analysis. 5 sets (6%) were incomplete due to failed signal detection by the TDD. The correlation between TDD and IWB (r = 0.3) was found to be inferior to the correlation between CCI and IWB (r = 0.8). Bland and Altman analysis (Figure) revealed a mean bias of 0.23 $lit \cdot min^{-1} \cdot m^{-2}$, whereas mean bias for CCI and IWB was 0.11 $lit \cdot min^{-1} \cdot m^{-2}$.



Conclusion: TDD was found to be less reliable and less accurate than CCI in comparison with IWB. The transoesophageal Doppler device HemoSonic100 cannot be recommended as a sole device for monitoring cardiac index in patients after cardiac surgery.

1 J Trauma 1999;46(4):607-12.
2 Crit Care Med 2000;28(6):2045-50.

1

Retrograde embolisation of flush solution into the central arterial circulation: Safety of pressurised bag pump and syringe pump flush systems

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Background: Retrograde embolisation of flush solution into the central arterial circulation with the risk of cerebral damage are likely to occur in neonates, when arterial flush boluses of ≥ 0.5 ml are applied within 1 sec [1]. The aim of the study was to compare bolus volumes and flow velocities delivered from bag pump and syringe pump flush systems.
Methods: In an *in vitro* experiment, bolus volumes and flow velocities delivered through a 24 GA intravenous cannula at a simulated mean arterial pressure of 40 mmHg were gravimetrically measured. Flush boluses from the bag pump system (Pressure Bag 500 ml; ERKA) were initiated at 100, 200 and 300 mmHg bag pressure by opening the Intraflow (Monitoring Set; Baxter) for 1 or 2 sec. In the syringe pump flush system (Fresenius Injectomat cp-IS) bolus volumes of 0.5, 1.0, 1.5 and 2.0 ml as well as occlusion alarm volume were preloaded from the syringe pump and then released by opening the Intraflow (Monitoring Set; Baxter) for 1 or 2 sec. Additionally, pressures generated proximal to the Intraflow before bolus release were recorded using an industrial pressure transducer system. Experiments were repeated twice in two models of each flush system. Data are presented as mean±SD.

Results	Pressures recorded	Bolus Volume	Peak Flow	Bolus Volume	Peak Flow
		Intraflow 1 sec opened		Intraflow 2 sec opened	
Bag Pump	mmHg	ml	ml/sec	ml	ml/sec
300 mmHg	315 ± 6.8	0.55 ± 0.06	0.29 ± 0.03	1.07 ± 0.09	0.42 ± 0.03
200 mm Hg	233 ± 14.7	0.37 ± 0.01	0.24 ± 0.02	0.70 ± 0.02	0.34 ± 0.03
100 mmHg	133 ± 3.0	0.21 ± 0.02	0.12 ± 0.02	0.41 ± 0.05	0.19 ± 0.01
Syringe Pump					
0.5 ml	262 ± 19.9	0.24 ± 0.01	0.13 ± 0.01	0.37 ± 0.03	0.16 ± 0.01
1.0 ml	488 ± 58.8	0.47 ± 0.01	0.25 ± 0.06	0.69 ± 0.01	0.32 ± 0.03
1.5 ml	1022 ± 124.0	0.76 ± 0.10	0.41 ± 0.03	0.92 ± 0.03	0.43 ± 0.03
2.0 ml	1523 + 196.6	1.01 ± 0.04	0.50 ± 0.03	1.35 ± 0.06	0.60 ± 0.04
Occlusion Alarm	2052 ± 230.1	1.32 ± 0.08	0.67 ± 0.04	1.71 ± 0.09	0.75 ± 0.07

Conclusion: The tested syringe pump flush system is more likely to deliver unacceptable flow velocities than bag pump flush systems. Clinical implications and necessary pressure limitations for both flush systems require further investigations.

1 Butt WW et al. Pediatrics 1985;76:250-4.

2

Pain on Injection with Propofol 1% vs Propofol-Lipuro 1%

D. Cristina[1], M. Bissig[2], M.R. Spoto[1], E. Alon[1]. Dipartimento di Anestesiologia[1] e Servizio di Farmacia[2],Ospedale Regionale di Lugano

Aims: Intravenous (IV) injection of pure propofol (P) is known to cause local pain during induction of general anesthesia [1]. Propofol-Lipuro (PL) is a new formulation of lipid-in-water emulsion which is assumed to cause less pain on injection [2]. We performed a randomized, double blind, prospective trial comparing P with PL, to discover whether there was any significant difference of pain during IV injection.
Methods: Pain scores (assessed by visual analogue scale [VAS] 0–10) were obtained from 100 patients undergoing general anesthesia for various surgical procedures during IV injection of 2 mg/Kg P (50 patients) or PL (50 patients). The studied solutions were prepared every trial day in randomized syringes by the hospital pharmacist. The anesthesiologist who administered the solutions was blinded to the content of the syringes. All patients gave their informed consent before surgery. All injections were performed via 18G IV cannula. Postoperatively patients were asked whether they recall any pain during IV induction of anesthesia.
Results: In group P the intensity of pain on injection was greater (VAS 6.06 vs 4.81) and the number of patients having pain was higher (35 of 50 vs 26 of 50) than in group PL. Postoperative recall of pain was similar in both groups, respectively 88% and 85%.
Discussion: PL compared with P reduces the intensity of pain and also the number of patients having pain during IV injection. However, PL does not guarantee a pain-free IV induction of anesthesia.

1 Picard P, Tramèr MR: Prevention of Pain on Injection with Propofol: A Quantitative Systematic Review. Anesth Analg 90:963-9,2000
2 Rau J, Doenicke AW, Roizen M et al: Propofol in an MCT/LCT Emulsion: Effects on Pain. Anesthesiology 91(3A), 1999

3

Is the follow-up in outpatient surgery efficient and useful?

A. Wolff, C. Aurilio, A. Forster. Division of Anaesthesiology, University Hospitals, Geneva

Introduction: In order to obtain the same quality of care in outpatient anaesthesia as for inpatients, it is widely accepted that all outpatients should be contacted at least once after they have left the ambulatory center. This follow-up represents a challenge, which requires energy and motivation which are difficult to maintain. The purpose of this study was to evaluate the usefulness and the efficiency of such a follow-up.
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Results: Among the 805 patients included, data were missing for 349, (239 patients could not be contacted after two attempts, and 110 files were missing). Thus, the analysis is on the effective follow up of 456 patients. Regional anaesthesia (spinal, axillary, and Bier's bloc) was performed on 383 patients (84%), and general anaesthesia on 73 (16%). Moderate to intense pain (VAS>3) was noted for 25% of the patients, nausea was for 4% and debilitating sides effects for 5%. In addition, 16% of patients complained about difficulty of sleep.
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