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INVOS™ 7100 regional oximetry system

Clinical evidence guide



This clinical evidence guide references key studies that discuss the importance of near-infrared spectroscopy (NIRS) monitoring* for critical patients in the NICU, PICU, and ICU.

***NIRS monitoring with the INVOS™ 7100 regional oximetry system should not be used as the sole basis for diagnosis or therapy and is intended only as an adjunct in patient assessment.**

Bailey et al

Splanchnic-cerebral oxygenation ratio as a marker of preterm infant blood transfusion needs

Transfusion. 2012 Feb;52(2):252-60.

About the study

A prospective observational pilot study utilizing NIRS to analyze the SCOR in symptomatic anemic premature neonates receiving RBC transfusions and nontransfused asymptomatic premature neonates with similarly low hemoglobin (Hb) levels. The study included 52 subjects (34 transfused, 18 asymptomatic).

Key results

- The splanchnic-cerebral oxygenation ratio (SCOR) may help identify premature infants who may benefit from RBC transfusion.
- Supports the use of cerebral and somatic NIRS in a transfusion protocol.
- The ratio of difference between cerebral and somatic NIRS was a marker for patients requiring blood transfusion.
- The larger discrepancy between cerebral and somatic NIRS was noted in the symptomatic patients.

Bronicki et al

Cerebral and somatic oxygen saturations after repair of tetralogy of fallot: Effects of extubation on regional blood flow

Ann Thorac Surg. 2013 Feb;95(2):682-6.

About the study

This study examines extubation and low NIRS correlation. 23 patients were monitored for 30 minutes before and after extubation following repair of tetralogy of Fallot to determine the effects of extubation and loading of respiratory muscles on the distribution of cardiac output.

Key results

- With extubation, central venous oxygen saturation increased from 65% to 70% ($p=0.003$) and cerebral rSO_2 increased from 67% to 72% ($p=0.0001$)
- Before extubation, 4 patients were below or near the critical cerebral rSO_2 value of 50%
- rSO_2 data suggest that the brain was in or approaching an oxygen supply-dependent state with a subgroup of patients near or below critical rSO_2 values

Chakravarti et al

Near infrared spectroscopy (NIRS) in children

Cardiothorac Vasc Anesth. 2008 Mar;12(1):70-9.

About the study

This review provides a comprehensive description of NIRS in children.

Key results

- NIRS reflects the delicate balance between oxygen delivery and consumption in more than one organ system.

Chock et al

Cerebral oxygenation during different treatment strategies for a patent ductus arteriosus

Neonatology. 2011;100(3):233-40.

About the study

Compared regional cerebral oxygen saturation (rSO₂) as measured by near-infrared spectroscopy (NIRS) in very low birth weight (VLBW) infants with a hsPDA treated with conservative management, indomethacin, or surgical ligation. The study enrolled 33 VLBW infants with a hsPDA diagnosed by echocardiogram and 12 control VLBW infants without a hsPDA.

Key results

- NIRS monitoring during PDA management may be beneficial.
- Findings suggest that infants requiring surgical ligation for hsPDA have a higher risk for significant changes in cerebral oxygenation.
- Infants receiving indomethacin (medical closure) or conservative management maintain more stable cerebral oxygen levels.

Chock et al

NIRS improves hemodynamic monitoring and detection of risk of cerebral injury: cases in the neonatal intensive care nursery

J Matern Fetal Neonatal Med. 2020 May;33(10):1802-1810.

About the study

Presenting six clinical scenarios illustrating the value of NIRS monitoring for the diagnosis and management of critically ill newborns.

Key results

- Discusses common areas of use for NIRS monitoring in the NICU
- Includes overviews in care utilizing NIRS monitoring in the diagnosis and management of critically ill newborns

Near-infrared spectroscopy as a hemodynamic monitor in critical illness

Pediatr Crit Care Med. 2011 Jul;12(4 Suppl):S27-32.

About the study

A review of validation studies, controlled trials, and other reports of near-infrared spectroscopy use in children and adults, including a review of guidelines published by the American Heart Association, the American Academy of Pediatrics, and the International Liaison Committee on Resuscitation.

Key results

- Class II level B evidence supports the use of NIRS monitoring that it can be effective and beneficial as a hemodynamic monitor for critically ill patients. NIRS provides:
 - Early indication of changes in regional circulation that occur early in developing shock state
 - Early recognition and treatment with growing evidence for improved outcomes
 - Validated accuracy in neonates, infants, and small patients
- Conventional hemodynamic monitoring (blood pressure, heart rate, acid-base balance, serum lactate development) often show late signs of shock – resulting in delayed recognition of serious illness and potential sub-optimal outcomes

A decline in intraoperative renal near-infrared spectroscopy is associated with adverse outcomes in children following cardiac surgery

Pediatr Crit Care Med. 2016 Apr;17(4):342-9.

About the study

This study was performed to determine if a greater than or equal to 20% reduction in renal near-infrared spectroscopy for 20 consecutive minutes intraoperatively or within the first 24 postoperative hours is associated with 1) acute kidney injury, 2) increased acute kidney injury biomarkers, or 3) other adverse clinical outcomes in children following cardiac surgery.

Key results

- A greater than or equal to 20% reduction in renal near-infrared spectroscopy was significantly associated with adverse outcomes in children following cardiac surgery.
- Real-time evaluation of renal near-infrared spectroscopy may be useful in predicting prolonged mechanical ventilation and other adverse outcomes in children undergoing cardiac surgery.

Hoffman et al

Postoperative cerebral and somatic near-infrared spectroscopy saturations and outcome in hypoplastic left heart syndrome

Ann Thorac Surg. 2017 May;103(5):1527-1535.

About the study

Testing the hypothesis that near-infrared spectroscopy (NIRS)-derived cerebral and somatic/renal regional saturations can predict survival. Patient data was studied with the primary outcome measure survival through hospital discharge and 30 days.

Key results

- Perioperative cerebral rSO₂ monitoring can detect hypoxic-ischemic conditions associated with neurological injury and reduced neurodevelopmental performance.
- Continuous non-invasive measurement of regional cerebral and somatic NIRS saturations in the early postoperative period can predict outcomes of early mortality and extracorporeal membrane oxygenation use in hypoplastic left heart syndrome. Because outcomes were strongly determined by NIRS measures at six hours, early postoperative NIRS measures may be rational targets for goal-directed interventions.

Johnson et al

Near-infrared spectroscopy in neonates before palliation of hypoplastic left heart syndrome

Ann Thorac Surg. 2009 Feb;87(2):571-7; discussion 577-9.

About the study

Studied 92 patients with hypoplastic left heart syndrome (HLHS) – 47 without and 45 with preoperative NIRS.

Key results

- NIRS monitoring provides a non-invasive continuous estimate of venous saturation and detected changes in organ perfusion
- Arterial oxygen saturation is a poor predictor of oxygen delivery
- Findings include:

	Control (no NIRS) n=47	NIRS monitored n=45
Intubation	39	27
Median hours of ventilation	67.3	36
Inotropic score 1st hr	2.0 (±4.2)	0.7 (±1.8)

Loomba et al

Acute effects of vasopressin arginine infusion in children with congenital heart disease: Higher blood pressure does not equal improved systemic oxygen delivery

Pediatr Cardiology. 2021 Dec;42(8):1792-1798.

About the study

The purpose of this study was to characterize the effects of vasopressin infusions on hemodynamics and systemic oxygen delivery in children with congenital heart disease. This was a retrospective, single-center study of patients with congenital heart disease who received vasopressin infusions in a pediatric cardiac intensive care unit between January 2019 and May 2020.

Key results

- Vasopressin infusions appear to statistically significantly increase systolic blood pressure in children with congenital heart disease who have a biventricular but not functionally univentricular circulation. Even when an increase in systolic blood pressure is present, systemic oxygen delivery did not improve.
- Correlation analyses further reinforced that blood pressure was not correlated with markers of systemic oxygen delivery. So, while blood pressure may have increased with vasopressin infusion, oxygen delivery did not significantly change.
- This highlights that blood pressure and systemic oxygen delivery should not be considered interchangeable. A deficit in systemic oxygen delivery may not be improved by augmenting blood pressure, in fact it may be worsened. Moreover, other effects of interventions to increase blood pressure, particularly vasoactive medications, may lead to a decrease in systemic oxygen delivery.

Ortmann et al

Use of near-infrared spectroscopy for estimation of renal oxygenation in children with heart disease

Pediatr Cardiol. 2011 Aug;32(6):748-53.

About the study

Evaluated whether near-infrared spectroscopy (NIRS) measurement from the flank correlates with renal vein saturation in children undergoing cardiac catheterization.

37 patients <18 years of age were studied. A NIRS sensor was placed on the flank, and venous oxygen saturations were measured from the renal vein and the inferior vena cava (IVC).

Key results

- NIRS flank monitoring provides accurate early non-invasive real time measure of renal oxygenation
- Widely used to monitor renal perfusion
- Especially children with congenital heart disease who are at risk of acute renal failure secondary to decreased perfusion
- Decreased values associated with regional ischemia
- Correlates closely with IVS saturations
- Children undergoing CHD repair are at high risk of developing acute renal failure
- Incidence of postoperative dialysis from 2.3 to >30%

Low renal oximetry correlates with acute kidney injury after infant cardiac surgery

Pediatr Cardiol. 2011 Feb;32(2):183-8.

About the study

This prospective observational study enrolled 40 infants (age, <12 months) undergoing biventricular repair. Continuous renal oximetry data were collected for the first 48 postoperative hours and correlated with postoperative course, standard laboratory data, and the occurrence of acute renal injury.

Key results

- Infants undergoing biventricular repair with flank NIRS <50% for >two hours postoperatively was predictive
 - Increased creatinine
 - Greater incidence of acute kidney injury by 48 hours
- Low flank NIRS patients had worse clinical outcomes including
 - Increase lactate values
 - More ventilation days
 - Greater vasoactive medication needed

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