

Monitoring cerebral oxygenation in orthopedic shoulder surgery in the beach chair position

With the INVOS™ regional oximeter

The beach chair position (BCP) is commonly used in orthopedic shoulder surgery procedures. This position allows easier intra-articular visualization due to the elevation of the patient's head above the horizontal plane. However, elevation of the patient's head may contribute to gravitational effects on cerebral perfusion and rotation of the patient's head may contribute to obstruction of cerebral vessels.^{1,2} These gravitational effects should be tolerated if the patient's blood pressure remains within the auto-regulation range.¹

Unilateral decrease in cerebral oxygenation may indicate an intraoperative neurological event in the beach chair position

Early recognition of a transient ischemic attack utilizing cerebral oxygenation monitoring during shoulder surgery in the beach chair position: a case report

AGUIRRE JA, MOHAJERI MS, RUPNIK B, ET AL. (Switzerland)

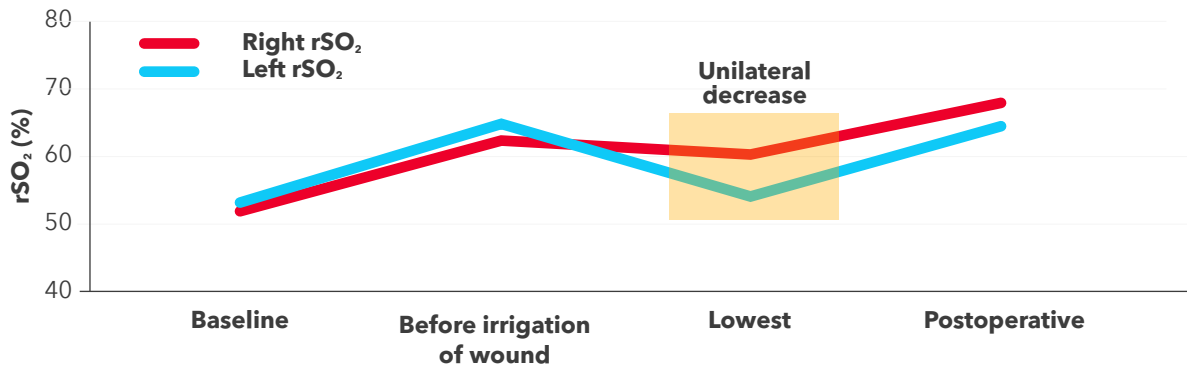


Figure: Case report of an elderly female patient – cerebral oxygenation as measured by INVOS™ monitoring technology throughout shoulder surgery in beach chair position

Elderly female with multiple cardiovascular risk factors undergoing surgery in BCP:

14%
Drop in left-side regional cerebral oxygenation (rSO₂)



2 mins
Spent with rSO₂ at 55%



Weakness, drooping, speech issues observed three hours postoperatively

Case study of 76-year-old woman undergoing shoulder surgery in beach chair position

The study observed an overweight elderly woman with ASA class III, history of smoking, hypertension, coronary artery disease, COPD, tachycardia, and dyslipidemia. The patient's perioperative cerebral oxygenation was continuously measured with INVOS™ monitoring technology.

The findings

- Patient's baseline rSO₂ was low and reflective of severe cardiopulmonary dysfunction, increasing the risk of postoperative complications.
- Following irrigation of the surgical site with a known vasodilating solution, the patient's blood pressure dropped suddenly, and her left regional cerebral oxygenation decreased by 14 percent.
- Patient was treated with ephedrine and supplemental volume, which increased the blood pressure and rSO₂ to adequate levels for the rest of the surgery.
- Within three hours of surgery, patient developed right side weakness, drooping, and speech issues. Clinicians detected moderate to severe narrowing of internal carotid arteries.
- After receipt of antiplatelet therapy, the patient recovered all neurological function within 24 hours.
- The patient's low preoperative cerebral oxygenation levels indicated she was of higher risk and even the slight drop of rSO₂ could be representative of severe damage and complications.

Blood pressure alone may not be an accurate predictor of cerebral desaturation

Cerebral desaturation events in the beach chair position: correlation of noninvasive blood pressure and estimated temporal mean arterial pressure

TRIPLET JJ, LONETTA CM, LEVY JC, ET AL. (U.S.)

Table: Descriptive characteristics of noninvasive blood pressure (NIBP), temporal mean arterial pressure (eTMAP), and rSO₂ at baseline and during a cerebral desaturation event (CDE)

Variables	Baseline median	CDE median	Correlation with rSO ₂ <i>r</i> (sig)
NIBP (mmHg)	108	57	0.064 (<i>P</i> = 0.675)
eTMAP (mmHg)	101	25	0.121 (<i>P</i> = 0.430)
rSO ₂ (%)	77	48	NA

No significant association was found between rSO₂ and NIBP and/or eTMAP at baseline and during a cerebral desaturation event



Single center prospective trial of 57 adult patients undergoing elective shoulder surgery in beach chair position

The study sought to examine the relationship between cerebral rSO₂, estimated temporal mean arterial pressure (eTMAP) and noninvasive brachial blood pressure (NIBP) during cerebral desaturation events (rSO₂ drop of ≥ 20 percent from baseline) (CDE).

The findings

- Almost half of patients (n = 26) experienced at least one cerebral desaturation event.
- No significant association was found between the decrease in rSO₂ and the decrease in NIBP and/or eTMAP from baseline to CDE.
- NIBP and eTMAP alone may not be accurate in estimating cerebral perfusion and predicting cerebral desaturation events.
- NIBP, eTMAP, and rSO₂ should all be considered for the most accurate estimate of cerebral perfusion.

The beach chair position and induced hypotension significantly decreases cerebral oxygen saturation during shoulder surgery

Effects of beach chair position and induced hypotension on cerebral oxygen saturation in patients undergoing arthroscopic shoulder surgery

LEE JH, MIN KT, CHUN YM, ET AL. (SOUTH KOREA)

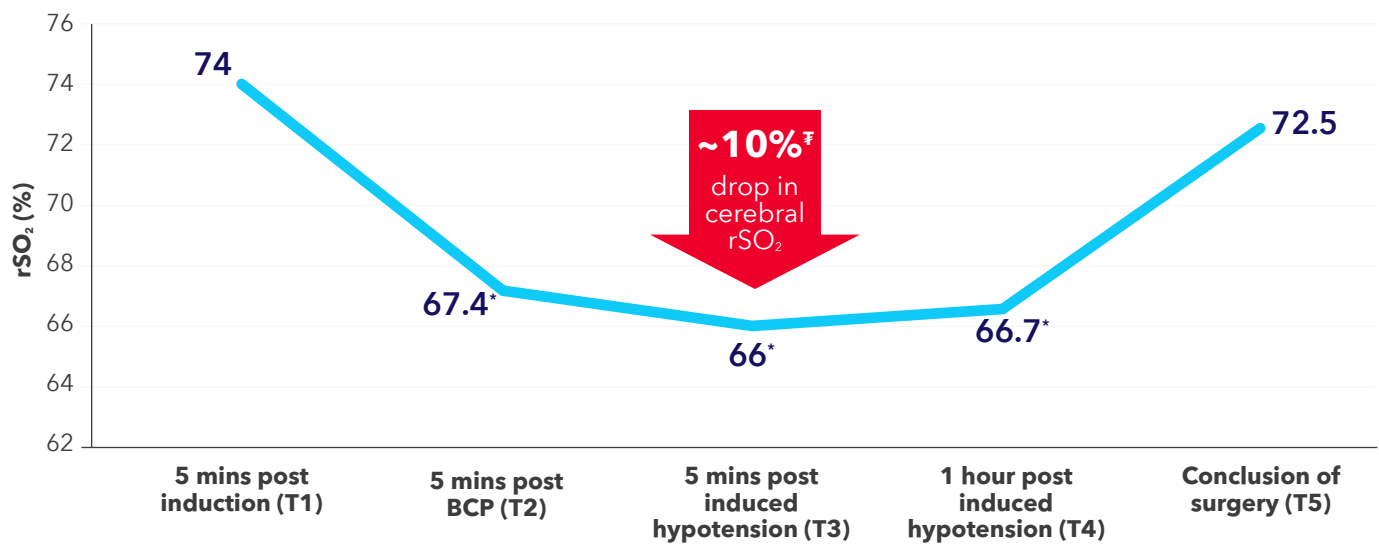


Figure: Change in regional cerebral oxygen saturation during arthroscopic shoulder surgery. * $P < 0.05$ vs. T₁ & T₅
‡Calculation

7%

Of patients experienced a cerebral desaturation event (CDE)



There was a significant decrease in MAP and rSO₂ in the beach chair position

Single center prospective study of 27 adult patients undergoing elective arthroscopic shoulder surgery in beach chair position (BCP)

The study investigated the effects of the beach chair position and induced hypotension on cerebral saturation (rSO₂) and what effect this change had on postoperative cognitive function. Mean arterial pressure (MAP) and INVOS™ monitoring were utilized. Recordings were taken before induction, after induction (baseline), after BCP initiated, after induced hypotension, and at supine at the end of surgery. Intervention was taken if rSO₂ values dropped below 80 percent of the baseline value for 15 seconds or greater.

The findings

- rSO₂ values decreased after induction and initiation of the beach chair position.
- There was a significant decrease in MAP and rSO₂ in the beach chair position compared to the supine position.
- Induced hypotension decreased MAP values but did not impact rSO₂ significantly.
- Cognitive dysfunction did not occur in any of the patients following surgery.

Controlled hypotension in beach chair position decreases cerebral oxygenation impacting neurobehavioral functioning

The beach chair position for shoulder surgery in intravenous general anesthesia and controlled hypotension: Impact on cerebral oxygenation, cerebral blood flow, and neurobehavioral outcome

AGUIRRE JA, ETZENSPERGER F, BRADA M, ET AL. (SWITZERLAND)

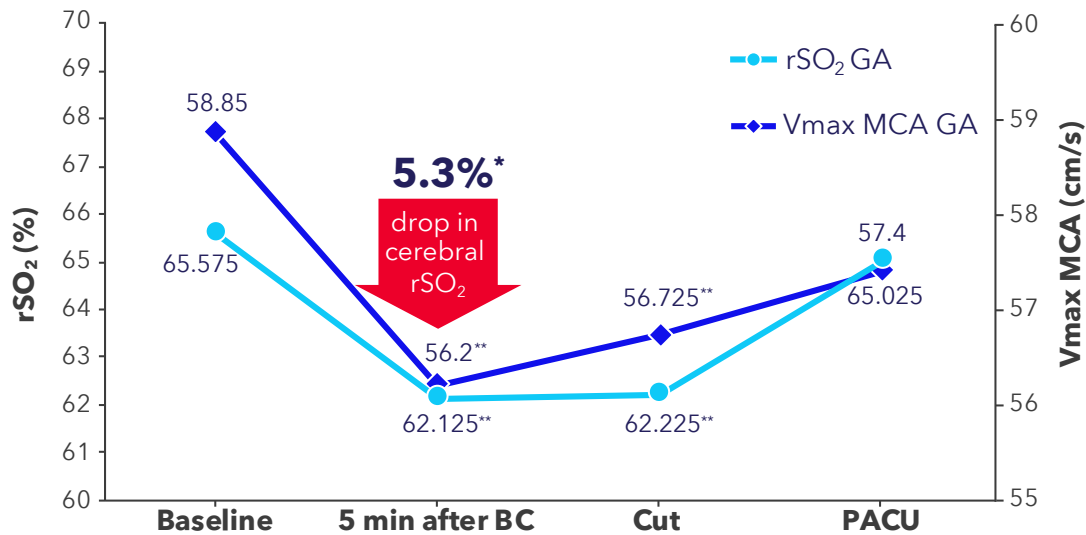


Figure: Cerebral oxygenation (rSO₂) and maximal cerebral artery blood flow (Vmax MCA) throughout shoulder surgery in beach chair position

*Calculation

** statistically different from baseline values ($P < 0.01$)

25%

Of patients experienced a drop in rSO₂ ≥ 20 percent from baseline

12.5%

Of patients desaturated below 55% for more than 15s

Patients experiencing a CDE scored worse on neurobehavioral tests 1 day after surgery

Prospective single-blinded observational study of 40 adult patients undergoing shoulder surgery in beach chair position with controlled hypotension (systolic ≤100 mm Hg)

Patients underwent neurobehavioral tests preoperatively and 24 hours postoperatively. They were monitored for cerebral oxygen saturation (INVOS™ technology), maximal cerebral artery blood flow (Vmax MCA), invasive blood pressure, and depth of anesthesia (BIS™ technology).

The findings

- There was a significant decrease in rSO₂ values five minutes into BCP compared to baseline, with only a weak correlation between rSO₂ and invasive blood pressure values.
- Cerebral artery blood flow was highly correlated with rSO₂.
- One in four patients experienced a cerebral desaturation event (rSO₂ drop of ≥ 20 percent from baseline).
- Patients who experienced a CDE scored significantly worse on neurobehavioral tests 24 hours after surgery ($P < 0.01$).
- History of smoking, arterial hypertension, and coronary artery disease increased the risk of a CDE.

One third of patients experienced cerebral desaturation in beach chair position

Evaluation of cerebral oxygen perfusion during shoulder arthroplasty performed in the semi-beach chair position

CHAN JH, PEREZ H, LEE H, ET AL. (US)

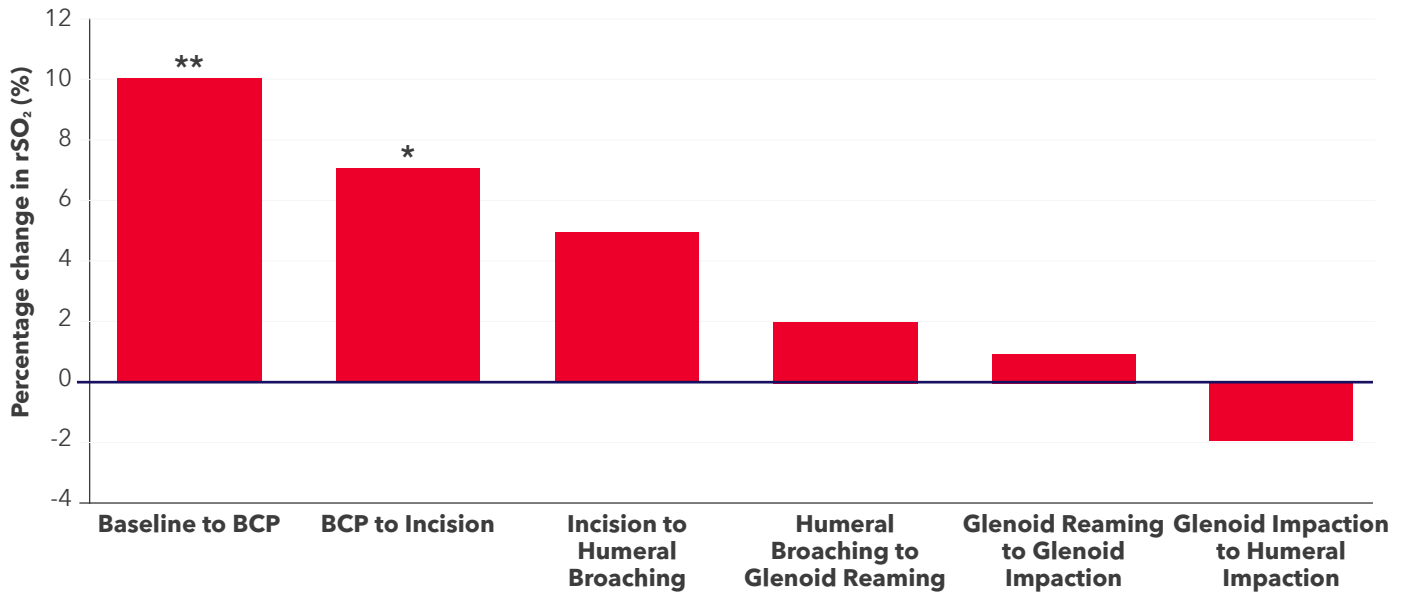


Figure: Percentage change in cerebral oxygenation during each interval. Positive change values represent a decrease in oxygen saturation.

* $P < 0.01$, ** $P < 0.001$

76%
Of patients experienced a CDE throughout the course of the surgery

25%
Mean maximal drop in rSO₂

Single-blinded case series of 25 adult patients undergoing shoulder surgery in beach chair position

The study sought to evaluate the risk of cerebral desaturation events (CDEs) and how time and positioning during surgery could relate to these events. Regional O₂ saturation (rSO₂) was monitored continuously using INVOS™ technology and retrospectively matched to the seven timepoints throughout the surgery.

The findings

- The transition from baseline to beach chair position showed the only significant decrease in rSO₂ (8 percent, $P = 0.01$).
- The steepest slopes of percentage change in oxygen saturation were seen in the time period between baseline and beach chair position and beach chair to incision (10 percent & 7 percent, $P < 0.01$).

This is a case study shown for illustrative purposes only. Individual results and experiences vary.

The INVOS™ monitoring system should not be used as the sole basis for diagnosis or therapy and is intended only as an adjunct in patient assessment. Reliance on the INVOS™ system alone for detecting cerebral desaturation events is not recommended.

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