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Abstract

Background / Aim. The concept of utilizing central venous oxygen saturation (ScvO$_2$) to calculate cardiac index (CI) remains controversial and neither precise nor generally applicable conclusion has been reached yet. We evaluated the relationship between ScvO$_2$ and mixed venous (SvO$_2$) oxygen saturation in elective surgery of the abdominal aorta. The adequacy of their interchangeability was tested by comparing cardiac indices (CI) calculated by two methods in patients that underwent major vascular surgery. The aim of this study was to test the correlation between ScvO$_2$ and SvO$_2$ in different time frames, in patients undergoing elective abdominal aortic aneurysm (AAA) surgery. Additionally, we wanted to determine if the use of ScvO$_2$ for calculating CI, by modified Fick equation, could be feasible and accurate surrogate for the values obtained by pulmonary artery catheter (PAC).

Methods. Prospective observational study included 125 consecutive patients that underwent elective AAA surgery. The ScvO$_2$ and SvO$_2$ data, as well as CI values, were obtained and compared from samples taken in three different time frames: immediately after induction of general anesthesia (T$_0$), immediately after admission in the intensive care unit (ICU; T$_1$), and 8h after admission in the ICU (T$_2$). Fick equation, used for CI estimation from ScvO$_2$ (CI-F), for the purpose of this study, was simplified according to Walley.

Results. There was good linear correlation between ScvO$_2$ and SvO$_2$ in all time frames and linear regression study revealed strongest coefficient of determination (R$^2$=0.661) in T$_2$ time-frame. There was no correlation between CI-F (i.e. CI calculated from ScvO$_2$ by modified Fick equation) and CI (measured by PAC from SvO$_2$) in any time-frame.

Conclusions. The results of our study confirm that ScvO$_2$ is a reliable substitute for SvO$_2$ among patients undergoing elective surgery of the AAA. However, ScvO$_2$ cannot be used as a surrogate to true SvO$_2$ in the calculation of CI.

Key words: mixed venous saturation, central venous saturation, surgery, abdominal aorta.

Apstrakt

Uvod. Koncept korišćenja saturacije centralne venske krvi (ScvO$_2$), umesto saturacije mešane venske krvi (SvO$_2$), za izračunavanje srčanog indeksa (CI), ostaje kontroverzan s obzirom da još uvek nema pouzdanih podataka koji bi ukazivali da jedna saturacija može biti adekvatna zamena drugoj. Odnos između ova dva parametra testirali smo upoređivanjem vrednosti srčanih indeksa izračunatih na dva načina, kod elektivno operisanih bolesnika zbog aneurizme abdominalne aorte (AAA). Cilj ove studije bio je testiranje korelacije između ScvO$_2$ i SvO$_2$ u različitim vremenima merenja kod bolesnika podvrgnutih eliktivnim operacijama AAA. Pored toga, želeli smo da utvrdimo da li bi upotreba ScvO$_2$ za izračunavanje CI, modifikovanoj Fickovom jednačinom, mogla biti izvodljiva kao adekvatna zamena vrednosti CI dobijenih merenjem putem plućnog arterijskog katetera (PAC). Metode. Prospektivnom observacionom studijom obuhvatili smo 125 konsekutivnih bolesnika podvrgnutih eliktivnim operacijama AAA. Podaci ScvO$_2$, i SvO$_2$, kao i vrednosti CI, dobijeni su uzimanjem uzoraka krvi i merenjem u tri različita vremena: nakon uvoda u opštu anesteziju (T0), odmah nakon prijema u jedinicu
intenzivnog lečenja (JIL) (T1), i 8h nakon dolaska u JIL (T2). Za izračunavanje CI upotrebljena je pojednostavljena Fick-ovu jednačinu po Walley-u, u kojoj smo koristili ScvO₂ (CI-F). Rezultati. Pronašli smo dobri linearni korelacioni između vrednosti ScvO₂ i SvO₂ u svim vremenima merenja, a linearna regresiono studija pokazala je najjači koeficijent determinacije (R² = 0.661) u T2 vremenskom okviru. Nije bilo korelacije između CI-F (CI izračunat iz ScvO₂ modificovanom Fickovom jednačinom) i CI (meren PAC-om) u bilo kom vremenskom okviru.

Zaključak. Rezultati studije potvrđuju da ScvO₂ može biti pouzdana zamena za SvO₂ kod bolesnika podvrgnutih elektivnim operacijama AAA. Međutim, ScvO₂ se ne može koristiti kao surrogat za pravu SvO₂ u izračunavanju CI-a.

Ključne reči: mešana venska saturacija, centralna venska saturacija, hirurgija, abdominalna aorta.

Introduction

Measurement of mixed venous oxygen saturation (SvO₂) is useful indirect index of the entire body tissue oxygenation. However, risk/benefit of the pulmonary artery catheter (PAC) placement remains controversial, and thus, its use has become somewhat unpopular. Routine use of the PAC in critically ill patients does not improve mortality and is associated with higher costs and complication rates. Insertion of a central venous catheter (CVC) in the superior vena cava (SVC), via the right internal jugular or subclavian vein, on the other side, remains standard of care in critically ill patients. Monitoring of central venous oxygen saturation (ScvO₂) may be, therefore, the safer alternative to SvO₂. Despite recent renewed interest in clinical applicability of serial ScvO₂ measurements, there are no published data in the available literature describing the pattern of ScvO₂ changes during major vascular surgery or possible relationships with outcome.

Principle objective of our study was to test the correlation between ScvO₂ and SvO₂ in different time frames, in patients undergoing elective abdominal aortic aneurysm (AAA) surgery. Additionally, we wanted to determine if calculating cardiac index (CI) using ScvO₂, by modified Fick equation, could be feasible and accurate surrogate for the values obtained by PAC.

Methods

Prospective observational study included 125 consecutive patients, scheduled for the elective AAA surgery, between July 2015 and April 2016, at Clinic for Vascular and Endovascular Surgery, Clinical Center of Serbia. Patients with aortoiliac occlusive disease (Leriche’s syndrome), cardiac or dialysis access shunt (fistula or graft) and emergent cases (ruptured AAA) were excluded from the study. Study protocol has been approved by the Ethical Committee of the Clinical Center of Serbia. Written informed consent was obtained from all patients before enrollment. All operations were performed with combined (peridural and general endotracheal) anesthesia. Patients were premedicated with 5mg i.m. midazolam (Dormicum, Roche) 45 minutes prior to anesthesia. Peridural catheter (Perifix, B.Braun Melsungen AG) was inserted under local anesthesia at Th₁₀-L₁, or L₁-L₂, or L₂-L₃ level, with patient in left recumbent position. Induction proceeded with 0.2 mg/kg midazolam and 0,6mg/kg
rocuronium bromide (Esmeron, Merck Sharp & Dohme). Patients were connected to anesthesia apparatus (Primus, Dräger) and anesthesia was maintained with gas mixture O2/N2O (FiO2=0.5) and sevoflurane (Sevoran, AbbVie) in concentration of 0.8-1.5 Vol%, along with rocuronium bromide in total dose of 100mg. For analgesia, 6-8ml of 0.5% levobupivacain was given every 1.5h-2h via the peridural catheter. Operations were completed without any use of intravenous analgetics.

Median laparotomy and transperitoneal approach to the abdominal aorta and classical inguinal approach to the femoral arteries were utilized. Abdominal aortic cross clamping was done below or above the origin of renal arteries, and occasionally above the origin of truncus coeliacus. Reconstruction of the abdominal aorta (AA) included interposition of either tubular (Ao graft interposition - GI) or Y Dacron graft (Ao-biiliac - AII, Ao-bifemoral - AFF).

Postoperative analgesia was maintained with a bolus dose 6-8ml of 0.25%, levobupivacain, every 8h, via the peridural catheter. Lungs were mechanically ventilated (Evita, Dräger).

Invasive monitoring included radial artery cannulation (Becton Dickinson off-on), for the measurement of systemic blood pressure and serial blood sampling for gas analyses (Radiometar ABL 90 flex).

Insertion of the CVC (Arrow) was performed via the right internal jugular or subclavian vein and position of its tip in SVC, for ScvO2 measurements, subsequently verified by chest radiograph. In addition, the PAC (Swan-Ganz catheter, Arrow, 7F) was also inserted for SvO2, CO (cardiac output), CI measurements. Thermodilution CO and CI were obtained in triplicate and averaged. Samples from CVC and PAC were taken simultaneously in following time-frames: immediately after induction of general anesthesia (T0), immediately after admission in the ICU (T1), and 8h after admission in the ICU (T2).

Fick equation, used for CI estimation from ScvO2 (CI-F), for the purpose of this study, was simplified according to Walley:

\[
CI \approx \frac{100}{Hgb} \times \frac{1}{(SaO_2-SvO2)}
\]

where: CI = cardiac index (L/min/m²); Hgb = hemoglobin (gram/L); SaO2 = arterial oxygen saturation (%) and ScvO2 = central venous oxygen saturation (%).

Statistical analyses were performed using SPSS software v.23.0 (SPSS Inc., Chicago, IL, USA). Descriptive data for all groups and variables were expressed as mean ± SD for continuous measures, or percent of a group for discrete measures.

A normal distribution was tested using the Koglomorov-Smirnov test. If the data were normally distributed, RM-ANOVA was used. Non-parametric data were analyzed using Fridman test. Post hoc analysis was performed using Bonferroni test (parametric data) and Wilcoxon test (non parametric data).

Correlation of the CVC and PAC parameters was tested with Pearson (parametric data) and Spearman correlation coefficient (non parametric data).

All reported p values were two-sided; differences were considered significant when p value was <0.05.

Results

Preoperative and intraoperative patient characteristics are summarized in Table 1. It is noteworthy emphasizing that majority of patients were in the seventh decade of life, with significant male predominance. Almost 95% were hypertensive and more than a half had
some form of coronary artery disease. Intraabdominal reconstruction (i.e. GI and AII) with infrarenal clamp was possible in more than 90% cases.

**TABLE 1.**
Values of observed parameters (ScvO₂, SVO₂, CI, CI-F), obtained in three different time frames, are summarized in Table 2. Significant changes were registered for all of them, but intergroup significance was present only for ScvO₂ and SVO₂.

**TABLE 2.**
Correlation between ScvO₂ and SVO₂ in different time frames is shown on Table 3. Since we established statistically significant correlation between observed parameters, a linear regression study was performed and the strongest coefficient of determination (R²=0.661) was found in T2 time-frame (Table 3, Figure 1C). These results have confirmed that ScvO₂ could be reliable surrogate for SVO₂, particularly 8 hours after admission in the ICU.

**TABLE 3.**
**FIGURE 1.**
Unlike expected, there was no correlation between CI-F (i.e. CI calculated from ScvO₂ by modified Fick equation) and CI (measured by PAC from SVO₂) in any time-frame (Table 4).

**TABLE 4.**

**Discussion**

Interchangeability of ScvO₂ and SVO₂ values has been a matter of debate, primarily because of different sampling points and venous blood pools they represent (i.e. entire body for SVO₂ and upper part of the body for ScvO₂). Complex relationship of these two parameters is different in healthy and diseased persons. Thus, ScvO₂ is slightly lower (76% vs. 78%) than SVO₂ in healthy individuals, but in persons with cardiovascular instability, this relationship changes⁹.

The most valuable information is trend of either ScvO₂ or SVO₂ changes upon applied treatment. Renewed interest in ScvO₂ monitoring came from the fact that lots of complications related to PAC insertion have been documented in the literature.¹¹ Intravascular pressure could not provide an adequate insight in intravascular volume, which is, in turn, the only cardiac preload equivalent of CVP. Sandham et al. found no correlation between PAC guided therapy and outcome in non-cardiac surgical patients.² Scheinman and co-workers compared ScvO₂ and SVO₂ levels in different hemodynamic states.¹¹ They found no significant difference in stable patients and patients with heart failure (54.7% vs. 56.9%, p>0.1 and 61.8% vs. 58.2%, p<0.1 respectively). In patients with circulatory shock, this difference was significant (58.0% vs. 47.5%, p<0.001), due to poor left ventricular function and renal impairment.¹³,¹⁴ The degree of correlation between ScvO₂ and SVO₂ was tested by numerous studies, regardless of patient’s hemodynamic status. By doing so, they were unable to find the reasons for poor correlation observed. This main shortcoming comes from the fact that CO distribution changes in critically ill patients, thus affecting ScvO₂ and SVO₂ relationships.¹⁵-¹⁷ Unlike previous, studies performed under experimentally controlled conditions found good correlation between ScvO₂ and SVO₂, regardless of their absolute values.¹⁸,¹⁹ Also, some studies emphasized the importance of similarity of trends between two parameters, while others deny the reliability of ScvO₂.²⁰,²¹,²²
If we keep in mind that ScvO depends on: hemoglobin levels, SaO, CO, VO (oxygen consumption), body temperature, analgesic level and metabolic state, keeping all, except selected one constant, than ScvO value reflects the changes of the remaining. The relationship between ScvO and SvO is not simple. In healthy persons, absolute values of these parameters are similar, which is not necessarily true in critically ill patients. Absolute values of ScvO may be pathological even when it is high or low.

Attempts to calculate CI from ScvO is not a new concept. In experimental studies, with dogs in different cardio-respiratory conditions, Reinhart et al. found a good correlation (r=0.97) between CI calculated using two different methods. Goldman et al. 1968, performed similar study in human subjects. Since then, a lot of studies on human subjects in different medical conditions were designed to correlate ScvO and SvO.

During hypovolemic circulatory disturbances, CI and ScvO showed better correlation with the extent of blood loss, than CVP, PCWP (pulmonary capillary wedge pressure), arterial pressure and heart rate. Interestingly, in spite of different absolute values, the trends of ScvO and SvO changes paralleled observed hemodynamic changes: Orthostatic hypotension is commonly used, as a model of the cardiovascular disturbances associated with hypovolemia in humans. Median ScvO fell from 75% to 60%, paralleling CO decrease from 4.3 to 2.7 L/min, at the onset of pre-syncpe symptoms. However, unlike in experiments, in series of major trauma victims, there was no strong correlation of ScvO and SvO with the extent of blood loss.

In septic patients, different trials could not find firm correlation between absolute values of ScvO and SvO, probably due to modified blood flow distribution and oxygen extraction (O2 ER) by brain and splanchnic tissues. In spite of this, variations in these two parameters usually occurred in a parallel manner.

Maybe the most extensively studied were the patterns of SvO and ScvO changes in cardiac failure and myocardial infarction. Goldman correlated derangements ScvO with severity of myocardial dysfunction and subsequent response to treatment, finding that levels below 45% usually indicate the onset of cardiogenic shock. While decrease of ScvO levels depicts the severity of disease, trends are associated with CO and response to treatment.

There are few papers describing SvO monitoring during the aortic surgery. Application and removal of aortic and femoral clamps produces complex SvO changes. Clamp removal and lower body reperfusion produce significant SvO decrease, not necessarily reflecting a need to change cardiovascular management. However, there are very few or no data, regarding ScvO monitoring during the abdominal aortic surgery.

Kopterides and coworkers investigated the significance of CVC tip position. When positioned 15cm away from the inlet of the right atrium, ScvO overestimated SvO by 8%. However, when the tip of the CVC was advanced deeper in the right atrium, ScvO becomes an excellent surrogate, overestimating SvO by only 1%.

Our study enrolled patients without PA and SVC (superior vena cava) catheterization under fluoroscopic guidance. So, both measurements, neither ScvO nor SvO, were obtained under direct visualization of the catheter tips. Our subsequent analyses of the central line tip positions, in the ICU, showed that most of them were located in SVC or proximal right atrium (RA) or SVC-RA junction. This implies that blood samples were actually obtained from different places. We used the X-ray confirmation of the CVC tip position in the ICU, to exclude the patients in whom CVC was accidentally placed in the innominate vein. Thus, we intended to test the correlation between ScvO and SvO within more limited
variations of ScvO₂ values. It should be emphasized that it was our intention to adapt on “real-life” situation, without changing established perioperative protocols for the purposes of this study. On the other hand, PAC parameters (SvO₂ and thermodilution CI) were obtained in triplicate and then averaged. Although our results have confirmed statistically significant linear correlation between ScvO₂ and SvO₂, almost paradoxically, the same was not true with CI-F and CI. The most logical explanation is that, in fact, we have used “different mathematics”. Walley’s simplification of Fick formula, using ScvO₂ values to calculate CI-F, could not meet correlation criteria with thermodilution CI values obtained by PAC, using SvO₂. The ability of ScvO₂, measurement to estimate SvO₂, is useful but still imperfect, depending on CVC catheter placement, patient anatomy and physiologic state. Importantly, ScvO₂ is an increasingly less reliable substitute for SvO₂ as the cardiac performance is worsened. This should always be kept in mind when interpreting ScvO₂ measurements. When true SvO₂ is essential, PAC placement remains the gold standard, since it provides more data than just a calculation of CI and many patients may still benefit from it. In that sense, significant linear correlation between ScvO₂ and SvO₂ in our study could be seen as a result of standardized and reliable team work, resulting in absence of significant perioperative hemodynamic disturbances and mayor blood loss, allowing early detubation (within 2 postoperative hours) and stable spontaneous breathing in all patients.

**Limitations of the study**

Accuracy of ScvO₂ measurement depends on CVC catheter placement, patient anatomy and physiologic state. Positioning of PAC and measurements was not always done by the same physician.

**Conclusion**

The results of our study confirm that ScvO₂ is a reliable substitute for SvO₂ among patients undergoing elective surgery of the abdominal aorta. It seems, when applied appropriately, measurement of either ScvO₂ or SvO₂ may provide a valuable guide to circulatory management in the early postoperative period. However, this is not always true. In our study ScvO₂ cannot be used as a surrogate to true SvO₂ in the calculation of CI. Further studies are needed to confirm our findings. In practice, ScvO₂ seems especially useful in combination with vital signs and other relevant parameters.
REFERENCES:

32. Rivers E. Mixed versus central venous oxygen saturation may be not numerically equal, but both are still clinically useful. Chest 2006;129(3):507-8.
## Table 1.

### Patient characteristics

<table>
<thead>
<tr>
<th>Demography and anthropometry</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>125</td>
</tr>
<tr>
<td>Gender n (%)</td>
<td>Male: 108 (86.4%); Female: 17 (13.6%)</td>
</tr>
<tr>
<td>Age</td>
<td>66.39±6.49 (66.0; 49-86)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.36±3.85 (26.10; 14.70-36.50)</td>
</tr>
<tr>
<td>BSA</td>
<td>2.00±0.21 (2.03; 1.28-2.51)</td>
</tr>
</tbody>
</table>

### Comorbidities

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>118 (94.4%)</td>
</tr>
<tr>
<td>DM</td>
<td>16 (12.8%)</td>
</tr>
<tr>
<td>COPD</td>
<td>29 (23.2%)</td>
</tr>
<tr>
<td>Carotid surgery</td>
<td>14 (11.4%)</td>
</tr>
<tr>
<td>CVI</td>
<td>17 (13.6%)</td>
</tr>
<tr>
<td>CRF</td>
<td>14 (11.2%)</td>
</tr>
<tr>
<td>CABG</td>
<td>11 (8.8%)</td>
</tr>
<tr>
<td>Valvular surgery</td>
<td>2 (1.6%)</td>
</tr>
<tr>
<td>AP</td>
<td>46 (36.8%)</td>
</tr>
<tr>
<td>PCI</td>
<td>14 (11.3%)</td>
</tr>
</tbody>
</table>

### Surgery

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ao Reconstruction</td>
<td>Ao-II: 51 (40.8%); Ao-FF: 10 (8.0%); Ao GI: 64 (51.2%)</td>
</tr>
<tr>
<td>Infrarenal cross clamp</td>
<td>114 (91.2%)</td>
</tr>
<tr>
<td>Proximal clamp time (min.)</td>
<td>21.94±8.09 (21.09-53)</td>
</tr>
<tr>
<td>Total clamp time (min.)</td>
<td>49.73±20.21 (45.0; 17-118)</td>
</tr>
</tbody>
</table>

*Table legend: BMI - Body mass index; BSA - Body surface area; DM - Diabetes mellitus; COPD - Chronic obstructive pulmonary disease; CVI - Cerebro-vascular insult; CRF - Chronic renal failure; CABG - Coronary artery bypass grafting; AP - Angina pectoris; PCI - Percutaneous coronary intervention; Ao-II - Aortobiiliac bypass; Ao-FF - Aortobifemoral bypass; Ao-GI - Abdominal aortic graft interposition.*
Table 2.
Analysis of selected parameters measured by CVC and PAC in different time frames.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Time Frames</th>
<th>Values</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ScvO₂</td>
<td>T0</td>
<td>73.79±10.12 (74.5; 45-94)</td>
<td><em>p=0.000</em></td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td>66.82±12.24 (68; 37-92)</td>
<td><em>p=0.000</em></td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>63.94±10.35 (64; 34-87)</td>
<td><em>p=0.044</em></td>
</tr>
<tr>
<td>SvO₂</td>
<td>T0</td>
<td>75.31±8.76 (77; 44-91)</td>
<td><em>p=0.000</em></td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td>69.52±9.59 (70;40-94)</td>
<td><em>p=0.000</em></td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>66.33±9.30 (66; 45-86)</td>
<td><em>p=0.000</em></td>
</tr>
<tr>
<td>CI</td>
<td>T0</td>
<td>3.31±1.09 (3.01; 1.50-7.0)</td>
<td>*p=0.097</td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td>3.34±0.97 (3.20; 1.70-6.8)</td>
<td><em>p=0.001</em></td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>3.62±0.79 (3.60; 1.30-5.90)</td>
<td><em>p=0.000</em></td>
</tr>
<tr>
<td>CI-F</td>
<td>T0</td>
<td>3.03±1.05 (2.81; 1.27-5.93)</td>
<td>*p=0.118</td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td>2.83±1.02 (2.62; 1.21-6.12)</td>
<td><em>p=0.001</em></td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>2.64±0.88 (2.49; 1.3-5.45)</td>
<td><em>p=0.041</em></td>
</tr>
</tbody>
</table>

Table legend: *statistical significance; RM ANOVA; Fridman-s test; Bonferroni test; Wilcoxon-s test; p=To and T1 comparison; p= To and T2 comparison; p= T1 and T2 comparison.
Table 3.

Correlation of the CVC and PAC parameters: $\text{ScvO}_2$ and $\text{SvO}_2$.

<table>
<thead>
<tr>
<th>Time</th>
<th>Linear correlation</th>
<th>$R^2$</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>$r=0.779$</td>
<td>0.60</td>
<td>$p=0.000^*$</td>
</tr>
<tr>
<td>T2</td>
<td>$r=0.702$</td>
<td>0.49</td>
<td>$p=0.000^*$</td>
</tr>
<tr>
<td>T3</td>
<td>$r=0.814$</td>
<td>0.66</td>
<td>$p=0.000^*$</td>
</tr>
</tbody>
</table>

*Table legend: *statistical significance.*

Table 4.

Correlation of the CVC and PAC parameters: CI and CI-F

<table>
<thead>
<tr>
<th>Time</th>
<th>Spearman correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>$\rho=0.085$</td>
<td>$p=0.346$</td>
</tr>
<tr>
<td>T1</td>
<td>$\rho=0.148$</td>
<td>$p=0.100$</td>
</tr>
<tr>
<td>T2</td>
<td>$\rho=0.069$</td>
<td>$p=0.444$</td>
</tr>
</tbody>
</table>
Fig. 1 – Linear regression ScvO$_2$-SvO$_2$ in different time frames.
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