

MATERNAL HEMODYNAMIC RESPONSE TO EPIDURAL ANALGESIA IN SPONTANEOUS AND ART-CONCEIVED PREGNANCIES: A PROSPECTIVE USCOM-BASED STUDY DURING LABOR

Alessia Barreca ¹, Francesca Manfredonia ¹, Valeria Maria Savasi ^{1,2}
(1) University of Milan , (2) Vittore Buzzi Hospital



UNIVERSITÀ
DEGLI STUDI
DI MILANO

Sistema Socio Sanitario



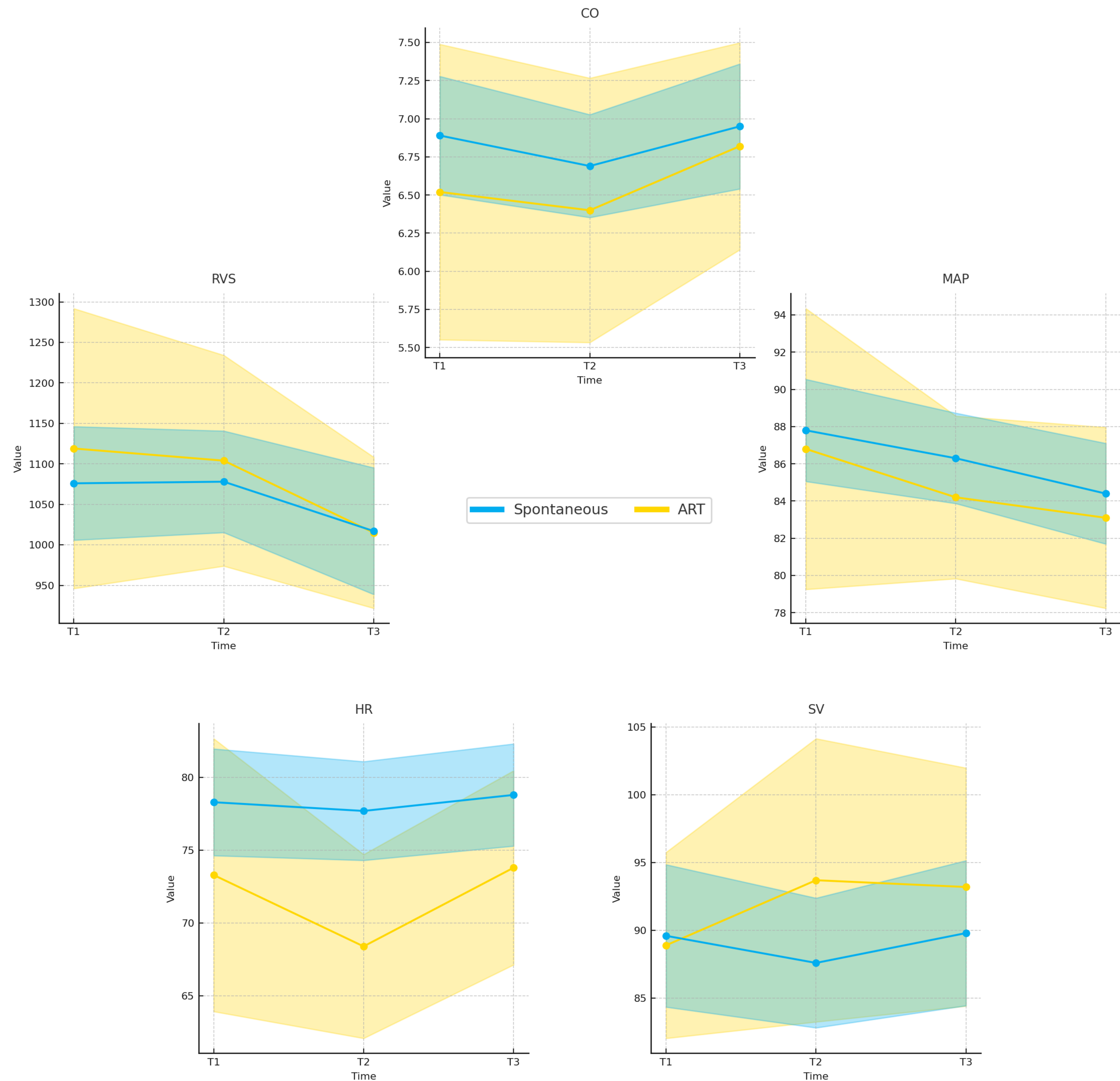
ASST Fatebenefratelli Sacco

Background

- Pregnancy induces a series of complex hemodynamic adaptations that are essential for ensuring adequate uteroplacental perfusion and maintaining maternal cardiovascular homeostasis. Particularly during labor the cardiovascular system undergoes profound adaptations in response to pain, anxiety, physical exertion, and pharmacological interventions, including neuraxial analgesia. Monitoring maternal hemodynamics in real time can provide valuable insights into maternal and fetal well-being, and help prevent peripartum complications.
- In this context, the Ultrasound Cardiac Output Monitor (USCOM) has emerged as a valuable tool. USCOM enables real-time measurement of cardiac output (CO), systemic vascular resistance (SVR), heart rate (HR), stroke volume (SV), and mean arterial pressure (MAP) through Doppler ultrasound technology.
- Although maternal hemodynamic changes during labor are well described in spontaneous pregnancies, there is a paucity of data on how these parameters behave in pregnancies conceived through assisted reproductive technologies (ART).

Objectives

- The aim of this study was to investigate maternal hemodynamic changes in response to epidural analgesia during labor, comparing women with spontaneously conceived pregnancies to those with ART pregnancies.
- This prospective observational study was conducted in the delivery unit of the Buzzi Children's Hospital in Milan, Italy. A total of 65 women in active labor were enrolled and stratified into two groups based on mode of conception: spontaneous pregnancies (n = 56) and ART pregnancies (n = 9), including 8 via homologous ICSI/FIVET and 1 via heterologous ICSI/FIVET.
- All participants underwent continuous maternal and fetal monitoring as per standard clinical protocols. USCOM assessments were performed by trained obstetric gynecologists at three standardized time points relative to the administration of epidural analgesia: before analgesia (T1), 20 minutes post-administration (T2) and 40 minutes post-administration (T3).
- Data were collected cardiac output (L/min), systemic vascular resistance (dynes $\cdot$ cm⁻⁵), heart rate (bpm), stroke volume (mL), and mean arterial pressure (mmHg). All measurements were averaged from at least three high-quality USCOM acquisitions per time point.



Results

Baseline demographic characteristics showed that women in the ART group were significantly older than those in the spontaneous conception group. No significant differences were found in pre-pregnancy BMI or in gestational age at recruitment.

At baseline (T1), the ART group presented a slightly lower mean CO (6.52 ± 1.48) compared to the spontaneous group (6.89 ± 1.48), although the difference was not statistically significant ($p = 0.486$). This trend persisted at 20 minutes (T2) and 40 minutes (T3) post-epidural, with CO values of 6.40 ± 1.32 vs. 6.69 ± 1.29 ($p = 0.535$) and 6.82 ± 1.04 vs. 6.95 ± 1.57 ($p = 0.812$), respectively. Although these differences were small, they reflect a consistent pattern of slightly reduced cardiac output in the ART group at all time points.

SVR showed a mild reduction over time in both groups, with a slightly higher baseline value in the ART group (1119 ± 265) versus spontaneous (1076 ± 268), not significant ($p = 0.657$). At T2, the difference narrowed (1104 ± 199 vs. 1078 ± 240 ; $p = 0.764$) and reversed at T3, with ART slightly lower than spontaneous (1015 ± 143 vs. 1017 ± 299 ; $p = 0.985$). This could suggest a more pronounced vasodilatory effect of epidural analgesia in ART pregnancies, although variability and sample size limit statistical power.

Significant variation occurred in heart rate (HR) at T2, where the ART group exhibited a lower mean HR (68.4 ± 9.7 bpm) compared to the spontaneous group (77.7 ± 12.9 bpm, $p = 0.045$). No group differences were noted at T1 or T3. Stroke volume (SV) and mean arterial pressure (MAP) remained statistically comparable throughout the study period. Repeated measures ANOVA showed no significant time $\times$ group interaction effects for any hemodynamic variable, suggesting that the physiological response to epidural analgesia was similar in both groups over time.

Conclusions

- Epidural analgesia appears to be hemodynamically well tolerated in both spontaneous and ART pregnancies. Although most comparisons did not yield statistical significance, the trends observed — particularly the higher SVR, reduced HR and slightly lower CO in ART pregnancies — may have clinical relevance in certain high-risk scenarios, especially considering the older age and potentially altered cardiovascular reserve in ART patients.
- Given its safety and ease of use, USCOM has the potential to become an integrated monitoring tool not only during labor, but from the earliest stages of pregnancy in women who conceive via ART. This may allow early identification of altered cardiovascular adaptation, offering an opportunity for individualized follow-up and preventive strategies in this growing high-risk obstetric population.

