The Use of Epinephrine in Caudal Anesthesia Increases Stroke Volume and Cardiac Output in Children
Chang Amber Liu MD MSc, Jinghui Sui PhD, Charles Cote MD, Thomas Anthony Anderson MD PhD
Department of Anesthesiology, Critical Care and Pain Medicine
Massachusetts General Hospital, Boston, Massachusetts

Introduction
- Caudal anesthesia is a common and effective regional anesthesia technique in pediatric patients.
- The addition of epinephrine to local anesthetics in caudal anesthesia is a frequent practice; however, changes in hemodynamic and cardiac parameters produced by epinephrine in caudal anesthesia are not well studied.
- A noninvasive cardiac output monitor which measures changes in thoracic bioimpedance during the cardiac cycle was used to study the hemodynamic consequences of epinephrine combined with local anesthetic for caudal anesthesia in children.

Materials and Methods
- We performed a retrospective analysis of 40 patients who received caudal anesthesia among 402 patients from whom we prospectively collected noninvasive cardiac output monitor data.
- Twenty-three patients received epinephrine with local anesthetic (ELA) and 17 patients received only local anesthetic (OLA) in their caudal block.
- We compared heart rate (HR), stroke volume (SV), cardiac output (CO) and cardiac index (CI) changes from baseline before caudal injection to 1 minute intervals over 15 minutes after caudal injection for both ELA and OLA groups.
- We also performed subgroup analysis of the same parameters comparing both ELA and OLA groups in patients <6 months of age and in patients ≥6 months of age.
- Statistical significance was determined using ANOVA between ELA and OLA groups at each time point with Bonferroni correction. A P value < 0.05 was considered to be statistically significant.

Results
- In the ELA group, significant increases were noted at 7 and 10-15 minutes after caudal injection time for SV (Figure 1d), 7-10 minutes after caudal injection time for CI (Figure 2f), and 6-7 and 10-12 minutes after caudal injection time for CO (Figure 1h). Conversely, there was no statistically significant difference for the ELA group in terms of changes in HR after caudal injection (Figure 1b).
- In the OLA group, there were no statistically significant changes in SV, CO, CI, and HR compared to baseline within the 15 minute interval after caudal injection (Figure 1a, c, e, g).
- In the ELA group, SV was noted to be increased at 7 and 9-15 minutes post-injection compared to the OLA group at the same time points (Figure 2c). CO was noted to be increased at 10-15 minutes post injection in the ELA group compared to the OLA group (Figure 2d).
- No statistically significant differences were noted when comparing systolic (Figure 3a), diastolic (Figure 3b), and mean arterial blood pressure (Figure 3c) between patients in the ELA and patients in the OLA group up to 15 minutes after caudal injection.
- In infants <6 months of age, no significant differences were found in HR (Figure 4a, SV (Figure 4c), and CI (Figure 4e) in patients in the ELA group compared to patients in the OLA group up to 15 minutes after caudal injection.
- In patients ≥6 months of age, SV increased significantly in the ELA group compared to the OLA group at 12-14 minutes after caudal injection (Figure 4d); CI also increased significantly in the ELA group compared to the OLA group at 12-13 minutes after caudal injection (Figure 4f). No significant differences were noted in HR between patients ≥6 months in the ELA group compared to the OLA group (Figure 4b).

Conclusions
- Epinephrine added to local anesthetic injected for caudal anesthesia produces significant increases in SV, CO, and CI in children.
- Stroke volume and CI changes from epinephrine injected to local anesthetic for caudal anesthesia appear to take place only in patients ≥6 months of age.
- This study elucidates the hemodynamic consequences of local anesthetic with and without epinephrine injected into the caudal space in pediatric patients.

References

Table 1. Patient demographics

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<tr>
<th>Parameter</th>
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<td></td>
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Figure 1. Percent change in HR (a), SV (b), CI (f), and CO (g) compared to baseline in OLA (a,c,e) and ELA (b,d,f,g) patients. * Denotes P < 0.05, ** Denotes P < 0.01.

Figure 2. Percent change in HR (a), SV (b), CI (f), and CO (g) in ELA and OLA patients. * Denotes P < 0.05, ** Denotes P < 0.01.

Figure 3. Percent change in HR (a), SV (b), CI (f), and CO (g) in ELA and OLA patients. * Denotes P < 0.05, ** Denotes P < 0.01.

Figure 4. Percent change in HR (a), SV (b), CI (f), and CO (g) in ELA and OLA patients. * Denotes P < 0.05, ** Denotes P < 0.01.