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Intravenous Access in Distressed Children: Effects of midazolam and nitrous oxide on success rate, hormone and metabolic stress responses

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Abstract

Background and Aims:
Intravenous (IV) access has demonstrated high levels of pain and distress in children. A stress full IV access should be avoided, primarily by the children, but also for the parents and staff. When testing children with suspected endocrine and metabolic disorders there is a substantial risk that a stressful IV access influences the hormone releases and metabolic response.
The aims of this thesis were to facilitate painful procedures and IV access in children at a paediatric outpatient clinic. To study the feasibility, effects and stress response of Nitrous Oxide (N_2O) compared to Midazolam and EMLA alone in children with endocrine disorders and obesity
Material and Methods:
Children with anxiety or previous difficulties establishing IV access were included (n=140).
50 children were openly randomised to EMLA (n=25) or EMLA+ N_2O (n=25).
90 children (60 obese and 30 growth retarded) were double blinded randomised to; midazolam, 0.3mg/kg, max 15 mg, (n=30), 50% N_2O (n=30), and to 10% N_2O (n=30).
A subgroup of 20 anxious children undergoing repeatedly painful procedures was also included. These children underwent two procedures with EMLA and EMLA+N_2O, the order of priority being randomised.
Measurments: Number of attempts; defined both as the number required to succeed in setting up double IV lines, and as a successful IV line procedure with 2 attempts for two iv lines vs >2 attempts, *IV access time*; defined as time from start of setting up the IV lines until two IV lines were established. *Recovery time*; defined as the time from establishment of the IV lines until regained alertness. *Total procedure time;* defined as IV access time plus recovery time. *Evaluations;* children's, parents' and nurses' satisfaction of the IV line procedure, *Pain*; evaluated by the child. *Sedation levels;* assessed using the Observer's Assessment of Alertness/Sedation Score.
Blood samples were obtained during 30 minutes at four time points after achieving venous access and, if possible, after 24 hours. 1; 0–1 min, 2; 5–6 min, 3; 14–15 min, and 4; 29–30 min. Analyses were compared between treatments and treatments over time.
60 children (40 obese and 20 growth retarded), served as controls.
Results:
Comparing all study children together with IV access problems, a significant difference in number of attempts between the treatments groups were seen ($P<0.001$) with differences between midazolam compared with 50% N_2O and EMLA compared with midazoalm, 10%, 50% N_2O. The percentage of successfully IV line procedures were 70% using 50% N_2O.
The children's evaluations were significantly more positive for 50% N_2O during IV access and painful procedures.
50% N_2O was more efficient measured as total procedure time ($P<0.001$) and especially in obese children an unfavourable long procedure time was observed after midazolam.
Significantly lower cortisol levels were detected when midazolam was used compared to both 50% and 10% N_2O and to unstressed controls. Glucose levels among growth retarded children increased from 0 to 30 min, whereas the opposite was found in obese children regardless of treatment. The growth hormone levels decreased with time in the midazolam group compared to 50% and 10% N_2O, where the effect of time was reversed.
Conclusion:
50% N_2O in combination with EMLA, was in all aspects superior to midazolam for facilitation of IV access for distressed children. The IV access procedure was more efficient, with a shorter total procedure time and an increased number of successful IV lines.
Midazolam should only be used exceptionally in obese children due to the long recovery time.
Treatment with N_2O and midazolam influence the results of hormone analyses in the form of different levels and trends in glucose and stress hormones.

Keywords: children, adolescents, intravenous access, pain, distress, stress response, hormone, metabolic

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