evidence that epinephrine injected into the cerebrospinal fluid has any deleterious effects, its use in this type of block is unnecessary as it does little to extend the duration of block with bupivacaine, nor does it significantly lower bupivacaine blood levels, especially when total dosage is submaximal.

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Postoperative Pain Relief after Hypospadias Repair in Pediatric Patients: Regional Analgesia *versus* Systemic Analgesics

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Hypospadias repair is generally associated with severe postoperative discomfort, agitation, and restlessness.[1] Restlessness may lead to manipulation of the site of surgery resulting in postoperative hemorrhage, infections, or other surgical complications.[2] Various techniques, including regional anesthesia and parenteral narcotics, are available to provide postoperative analgesia. A caudal approach to peridural blockade is effective after circumcision and hypospadias repair.[3–9] Blockade of the dorsal nerve of the penis provides effective analgesia for patients undergoing circumcision,[7,10–15] but only Soliman *et al.* have evaluated its efficacy in patients undergoing hypospadias repair.[1] To determine which technique provides the best postoperative analgesia with the fewest complications and shortest recovery period, we compared these two techniques with parenteral narcotics.

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Materials and Methods

After informed consent from the parents, 45 pediatric patients (mean age 4.5 yr, range 8 months to 17 yr) were

randomized in three groups of 15 patients each. There was no statistical age difference between groups. All patients had the same general anesthesia. Anesthesia was induced with thiopental 5 mg/kg, atropine 0.02 mg/kg, and succinylcholine 1.5 mg/kg iv; their tracheas were intubated and ventilation controlled; anesthesia was maintained with N_2O/O_2 70%/30% and halothane. Inspired concentration of halothane determined by the vaporizer was maintained between 0.25% and 1% according to reactions to surgical stimulation (tachycardia, hypertension). After the induction of general anesthesia, patients of Group 1 were given a caudal block with bupivacaine 0.5% with epinephrine 1/200,000 1 ml/yr of age (usually 1 mg/kg).[3] To perform this block we used a 20- or 22-gauge plastic-covered needle (Angiocath® catheter—Deseret Medical, Inc., Parke Davis Company, Sandy, UT). Once the needle and the catheter had passed through the sacrococcygeal ligament, the plastic catheter was advanced into the peridural space. The injection was performed at S2–S3 level. In Group 2 patients, after induction of general anesthesia, the dorsal nerve of the penis was blocked with bupivacaine (without epinephrine) 0.5% 3–4 ml using the lateral approach described by Soliman *et al.*[1] Patients in Group 3 received only general anesthesia.

In the recovery room and on the ward, the nurses, who were unaware of the treatment groups, managed the children's postoperative pain as required by administering im or po codeine 1 mg/kg every 4–6 h. The following variables were recorded by the nursing staff:

1. The degree of agitation in the recovery room and during the first postoperative day on the ward was graded on a scale of zero to 3. (0: child awake and quiet; 1: child complaining of pain; 2: child crying; 3: child crying and moving).
2. Number of doses of codeine administered in the recovery room and during hospitalization.
3. The extent of leg movement in the recovery room.
4. The frequency of nausea and vomiting in the recovery room and during the first postoperative day.
5. The duration of stay in the recovery room. The criteria to discharge the patients were: a child fully awake, responding to orders with no respiratory and cardiovascular problems and a normal temperature.

TABLE 1. Postoperative Agitation

	Recovery Room				Ward (first 24 h)			
Agitation	0	1	2	3	0	1	2	3
Group 1 (general anesthesia + caudal block)	13	1	1		13	2		
Group 2 (general anesthesia + penile block)	2	9	3	1	1	13	1	
Group 3 (general anesthesia alone)		7	4	3	2	11	2	

Group 1 *vs.* Group 2 or 3 $P < 0.001$.
Group 2 *vs.* Group 3 showed no significance.

The three types of hypospadias (glandular, penile, penoscrotal) were equally distributed between the three groups. Patients had a first stage or secondary stage hypospadias repair. Five patients had a suprapubic catheter after surgery (two in Group 1, one in Group 2, and two in Group 3).

Differences in the quantitative variables among the three groups were examined for statistical significance using analysis of variance and Duncan's multiple range scale. Association between group and quantitative variables were tested using Chi-square.

RESULTS

Children having caudal block were less agitated in the recovery room and on the ward compared to the other two groups (table 1). In the recovery room, patients with caudal blocks requested codeine less often than patients in the other groups. Patients with a penile block requested codeine less frequently than those in whom no block was performed. During the first postoperative day, patients with caudal blocks requested fewer doses of codeine compared with the other groups. During hospitalization, patients with caudal blocks received fewer doses of codeine than those in whom no blocks were performed (table 2). There were no statistical differences in the frequency of

TABLE 2. Postoperative Analgesia

	Total Number of Doses of Codeine/Patient (mean ± SD)		
	Recovery Room	For First Postoperative Day	For Duration of Hospitalization
Group 1 (general anesthesia + caudal block)	0.06 ± 0.02 (1 in 15 patients)	0.53 ± 0.42	1.73 ± 1.2
Group 2 (general anesthesia + penile block)	0.6 ± 0.5 (9 in 15 patients)	1.2 ± 0.6	2.87 ± 2.03
Group 3 (general anesthesia alone)	1 ± 0 (15 in 15 patients)	1.66 ± 0.2	4.2 ± 2.2
Statistical analysis	1 *vs.* 2; $P = 0.005$ 1 *vs.* 3; $P < 0.001$ 2 *vs.* 3; $P = 0.017$	1 *vs.* 2 $P < 0.01$ 1 *vs.* 3; $P < 0.001$ 2 *vs.* 3; no significance	1 *vs.* 2; no significance 1 *vs.* 3; $P < 0.05$ 2 *vs.* 3; no significance

TABLE 3. Time in Recovery Room (min)

	Mean ± SD
Group 1 (general anesthesia + caudal block)	52 ± 6.2
Group 2 (general anesthesia + penile block)	62.7 ± 8.1
Group 3 (general anesthesia alone)	67.7 ± 9.8

1 *vs.* 3 $P < 0.05$.

nausea and vomiting, and no patient developed a paresis. Time in the recovery room was shorter for patients receiving caudal block (table 3). We had no complications in Group 1, but one patient developed a small benign hematoma in Group 2.

DISCUSSION

We found that caudal block was associated with less postoperative agitation and decreased narcotic requirements compared with penile block or no block. Soliman *et al.*[1] have used the block of the dorsal nerve of the penis in 50 patients, four of whom had hypospadias repair. They found the block effective in 96% of their patients; none of the patients having had hypospadias repair required analgesia for the first 48 h. Despite using the same technique, we found penile block less effective. The difference in our results compared with Soliman *et al.* could be explained by the fact that most of our patients had a more proximal hypospadias with the fistula involving the perineal part and the shaft of the penis. The penis is mainly innervated by the dorsal nerve of the penis. The proximal (penile and perineal) parts are innervated by posterior branches of the nerve of the penis, which leave the nerve behind the pubis, and receive more innervation from branches of the genitofemoral and ilioinguinal nerves.[16,17] These nerves are not blocked by a single lateral injection under the pubis. This was not considered prospectively, and we were unable retrospectively to correlate the site of surgery with the efficacy of the block of the dorsal nerve of the penis. For caudal block we used 0.5% bupivacaine with epinephrine 1/200,000 1 ml/yr of age; this represents on the average a dose of less than 1 mg/kg, well below the toxic dose of bupivacaine.[8,14-20]

Epinephrine was used as an indicator of intravascular injection and to prolong the duration of the block. We found that analgesia after the block lasted for many hours, the mean time elapsed before the first injection of codeine in our patients was 9 h 10 min after the block. This long duration has been observed by others[1,3,7,14] and either of two explanations seem plausible: a hypospadias repair is painful for only a short period after surgery, or children with complete regional analgesia do not manipulate the site of surgery[2] and therefore have less postoperative pain from swelling, hematoma, and infection.

Regional nerve blocks are easy, interesting, and safe techniques for postoperative analgesia after hypospadias repair. For glandular hypospadias, both techniques (penile block and caudal block) are effective; for hypospadias involving the shaft and the perineal part of the penis, caudal block alone is effective.

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