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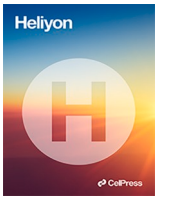

Major complications of caudal block: A prospective survey of 973 cases in adult anorectal surgery

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ABSTRACT

Background: We conducted a prospective study of surgical inpatients at a teaching hospital to assess the incidence and potential risk factors for major complications of caudal anesthesia in anorectal surgery.
Methods: A total of 973 patients undergoing anorectal surgery under caudal block were included in this prospective, observer-blinded trial after providing consent. Demographic information, detailed perioperative information, anesthesia-related complications and postoperative follow-up information were recorded. Meanwhile, the incidence and risk factors for major caudal anesthesia-related complications were analyzed.
Results: A total of 973 patients underwent caudal block. The effective rate was 95.38 % (928 cases). However, there were still 38 (3.91 %) cases with insufficient block and 7 (0.72 %) cases with no block. The major anesthesia-related complications were local anesthetic systemic toxicity (9, 0.92 %), cauda equine syndrome (1, 0.10 %), transient neurological symptoms (3, 0.31 %) and localized pain at the caudal insertion site (30, 3.08 %). The identified risk factor for local anesthetic systemic toxicity was multiple attempts locating the caudal space (OR = 5.30; 1.21–23.29). The identified risk factor for localized pain at the caudal insertion site was multiple attempts locating the caudal space (OR = 10.57; 4.89–22.86).
Conclusion: The main complications of caudal block in adult patients are transient neurological symptoms, cauda equine syndrome, serious local anesthetic systemic toxicity and localized pain at the caudal insertion site. Overall, the incidence of complications is low and symptoms are mild. Caudal block is still a safe and reliable method for anesthesia in adult anorectal surgery.

1. Introduction

Anorectal surgery requires deep anesthesia because the zone is innervated by multiple nerves and is reflexogenic [1]. A variety of

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anesthesia methods, including general, spinal, caudal, local and combined techniques, are used for anorectal surgery worldwide [2–6]. Anesthesia for anorectal surgery should be efficient and easily maneuverable. When general anesthetics were used, the change of patient's body position could complicate the surgical process. Meanwhile, the postoperative period can be complicated by such events as residual effects of anesthetics, nausea, vomiting or severe pain [7]. As for another classic method of anesthesia, subarachnoid anesthesia, the situation will also need to face changing body position and a relatively large number of postoperative complications such as postdural puncture headache, urinary retention, etc. These postoperative side effects might lead to prolonged hospital stays. Therefore, general anesthesia and subarachnoid anesthesia may not fully meet the needs of patients undergoing such surgeries.

Caudal block has various advantages in anorectal surgery. First, it is a simple procedure with a low cost, which are prerequisites for the widespread use of caudal block. Second, for patients, it can avoid general anesthesia-related complications, decrease the incidence of postoperative nausea and vomiting, improve postoperative pain relief, shorten the time in the recovery room, allow patients to communicate with staff during surgery and enable earlier mobilization. Third, for surgeons, it can enable the accurate assessment of function before the end of surgery and allows discussion with the patient of the operative findings and treatment options during surgery. Last, for institutions, it can shorten the patient's time in the recovery room, reduce postoperative nursing requirements and reduce hospital admissions.

The caudal block technique was introduced in the Department of Pediatric Surgery of Kaunas University of Medicine Hospital by Dr. Danguole Rugyte in 1993. Caudal anesthesia is widely used in pediatric lower abdominal and perineal/anal surgery. Meanwhile, its effect has been widely recognized. However, in recent years, caudal anesthesia has not been preferred in adult anorectal surgery because of the variable anesthetic effect and related complications [8,9]. To clarify the applicability of caudal block in adult anorectal surgery, we conducted a prospective study of the feasibility of caudal anesthesia in anorectal surgery in a single, large, tertiary teaching center. In this study, we evaluated the efficiency of caudal block for adults in anorectal surgery, the incidence and characteristics of complications and the risk factors for major complications.

2. Methods

2.1. Study population and observation indicators

The study was approved by the ethics committee of the First Affiliated Hospital of Zhejiang University, School of Medicine (2011–10) and was registered in the Chinese Clinical Trial Registry (http://www.chictr.org/usercenter/project/edit.aspx?proj=2353, ChiCTR–OCS–11001887). All participants provided written informed consent. Adult surgical patients undergoing anorectal surgery at the First Affiliated Hospital of Zhejiang University, School of Medicine, within 2 years were eligible.

We excluded subjects with an age below 18 years and contraindications to neuraxial analgesia techniques. Data were recorded for each surgical inpatient, including sex, age, height, weight, American Society of Anesthesiologists (ASA) physical health grade I or II, preexisting neurological conditions, and type and duration of surgery. Perioperative data were also recorded in detail, including block efficacy, complications during puncture and any major complications during or after the operation. The efficacy of caudal block was defined as follows: (1) satisfactory (perfect analgesia and muscle relaxation for the surgery); (2) unilateral block; (3) incomplete anesthesia; and (4) no block. Complications during puncture included traumatic block placement (evidence of bleeding), unplanned dural puncture, and paresthesia. Regarding the occurrence of any major complications during and after the operation, we recorded the following events, according to the literature [10,11][10, 11]: (1) serious cardiac events; (2) severe respiratory depression/acute respiratory failure; (3) local anesthetic systemic toxicity (LAST); (4) seizure; (5) epidural hematoma; (6) postoperative neurologic deficits; (7) postdural puncture headache (PDPH); (8) paraplegia; (9) cauda equina syndrome; (10) infectious complications; (11) localized pain at the caudal insertion site; and (12) death. Postoperative neurological deficits included motor deficits, sensory deficits, painful paresthesia, dysesthesia, or hyperreflexia at the time of subsequent epidural anesthesia. Localized pain at the caudal insertion site was defined by the symptoms of backache and the signs of marked tenderness localized to the puncture site.

2.2. Caudal block protocol and investigation method

The caudal block was performed with the patient in the prone position under sterile conditions. A beveled 20-gauge intravenous catheter with an inner stylet was inserted through the sacrococcygeal ligament into the caudal space. The caudal space was identified by the loss of resistance to air. After negative aspiration, 20 mL of local anesthetic solution (ropivacaine, AstraZeneca, Sodertalje, Sweden, with/without lidocaine, Hualu Pharmaceutical Co. Ltd, Shandong, China)) diluted with 0.9 % w/v saline to achieve the desired concentration without epinephrine was injected over 2 min. The efficacy of the caudal block was evaluated at 10 min after the administration of the local anesthetic solution by pinprick testing of the sacrococcygeal region and the presence of a lax anal sphincter [12–14]. All the related procedures and assessments were performed by experienced and skilled attending anesthesiologists. Meanwhile, all data in the operating room were accurately recorded in detail by the attending anesthesiologist responsible for the caudal anesthesia. The attending anesthesiologist also had the completely independent right to select the drug and treatment option throughout the study.

Postoperative follow-up was undertaken by three fixed anesthesiologists. Each patient was followed up on the first and second postoperative days by the same anesthesiologist. Neurological examination was performed carefully to identify major complications. The location and extent of postoperative pain was recorded using an 11-point visual analog scale, with 0 representing 'no pain'; 1–3, mild pain; 4–6, moderate pain; and 7–10, severe pain. All patients with postoperative complications were followed up by telephone on the 7th and 14th postoperative days. Follow-up ended when complications disappeared or the patient refused to continue contact.

Neurological complications that persisted for 6 months without remission were considered permanent. The duration of all complications and follow-up were recorded. All complications were diagnosed by an experienced anesthesiologist who had reviewed the initial evaluation.

Other investigators were blinded to the perioperative information. They were only responsible for collecting and analyzing all relevant perioperative information related to the included patients.

2.3. Statistical analysis

The data were analyzed using SPSS 12 software (IBM, Armonk, NY, USA). Continuous variables were checked for normal distribution using the Shapiro-Wilk test. Data are presented as the number or mean ± standard deviation for a normal distribution or as the median (interquartile range) for nonnormal distributions. One-sample T test was used to compare the mean values of normal distribution variables. Binary regression analysis was performed to identify risk factors for complications. Odds ratios (ORs) and 95 % confidence intervals (95 % CIs) were obtained from stepwise logistic regression analyses to quantify independent risk factors. *P* values of less than 0.05 were considered statistically significant.

2.4. Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research. The participants will be informed about the results of the study.

3. Results

To investigate the complications of caudal block, we examined the cases of 1021 anorectal surgery patients. A total of 973 (95.5 %) patients with complete data were included, and the other 48 patients with incomplete information were excluded, among which 31 patients had incomplete intraoperative data, 13 patients were lost to follow-up and 4 patients refused to follow-up (Fig. 1).

3.1. Overview

Among the 973 patients enrolled, 568 (58.38 %) were male and 405 (41.62 %) were female. The average age was 45.2 ± 14.4 years, and the average body mass index (BMI) was 22.69 ± 3.98. The majority of the subjects were in good physical condition.

The type of surgery was as follows: hemorrhoidectomy (590 cases, 60.64 %), anal fistulectomy (320 cases, 32.89 %), excision of anal fissure (35 cases, 3.60 %), and other surgeries (28 cases, 2.87 %). The vast majority of the operations were completed in 60 min (less than 30 min, 520 cases, 53.44 %; 30–60 min, 407 cases, 41.83 %), and the others exceeded 1 h (46 cases, 4.73 %) (Table 1). There was no significant difference in the incidence of postoperative anesthesia-related complications among procedures.

Caudal anesthesia was performed with 1.5 % lidocaine solution (74 cases, 7.61 %), 0.375 % ropivacaine solution (76 cases, 7.81 %), or a compound solution (0.5 % lidocaine + 0.375 % ropivacaine solution, 816 cases, 83.86 %). Caudal block procedures were performed according to the standard protocol described above. A total of 116 (11.92 %) cases of multiple punctures were recorded during the block procedures. In most cases, the block efficacy was satisfactory (928 cases, 95.38 %). However, there were still 38 (3.91 %) cases of insufficient block and 7 (0.72 %) cases of no block (Table 1).

The data of the 7 patients who were switched to another anesthesia method were excluded from the analysis of postoperative caudal anesthesia-related complications. The recorded perioperative caudal anesthesia-related complications included transient neurologic symptoms (TNS, 3 cases, 0.31 %), cauda equine syndrome (CES, 1 case, 0.1 %), LAST (9 cases, 0.92 %) and localized pain at the caudal insertion site (30 cases, 3.08 %) (Table 2).

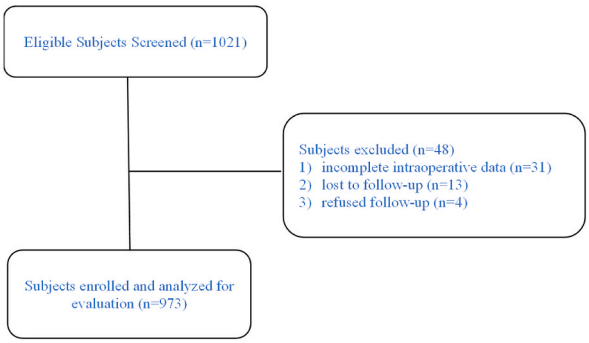

Fig. 1. Flow diagram of the study population.

Table 1
Characteristics of the patient cohort.

	Characteristics	Number of patients (n)	Proportion (%)
Sex	Male	568	58.38
	Female	405	41.62
Age	>50	358	36.79
	≤50	615	63.21
BMI	<25	243	24.97
	≥25	718	73.79
ASA status	I	781	80.27
	II ~ III	192	19.73
Type of surgery	Hemorrhoidectomy	590	60.64
	Anal fistulectomy	320	32.89
	Excision of anal fissure	35	3.60
	Perianal abscess debridement	19	1.95
	Perianal mass resection	4	0.41
	Combined surgery	5	0.51
Preexisting neurological condition	History of neuraxial anesthesia	19	1.95
	Lumbar intervertebral disc hernia	4	0.41
Duration of surgery	<30	520	53.44
	30~60	407	41.83
	≥60	46	4.73
Multiple attempts to locate caudal space	Yes	116	11.92
	None	857	88.08
Block efficacy	Satisfactory	928	95.38
	Incomplete anesthesia	45	4.62
Local anesthetic	Lidocaine	74	7.61
	Ropivacaine	76	7.81
	Mixture of lidocaine and ropivacaine	816	83.86

Proportions (%) are based on the number of patients with available data.

3.2. Major complications

3.2.1. TNS

TNS is a term coined to describe the occurrence of pain in the lower back and/or buttocks with or without radiation into one or both legs within 24~72 h. Three patients (0.31 %) developed new postoperative neurological symptoms attributable to caudal anesthesia (Table 2). None of the patients exhibited elicited paresthesia or bloody aspiration, but two of the three experienced multiple punctures during the puncture procedure. All three subjects showed mild numbness and/or sensory deficits in the posterior thigh region. Two subjects had a pain score of 4, and the other had a score of 3 (according to the 11-point visual analog scale). All TNS were significantly relieved within 24 h and completely disappeared within 2 days, with no remaining sequelae (Table 2).

3.2.2. CES

One case of moderate CES was detected (Table 2). Unfortunately, the patient suffered pain, decreased sensation of the lower limbs and urinary retention. During the puncture procedure, bloody aspiration occurred at the first attempt. Then the anesthesiologist tried to adjust the puncture angle. However, the subject suffered elicited paresthesia during the second attempt. Manifested by a transient tingling sensation in the sellar area. The third attempt was successfully, no bloody aspiration or paresthesia were occurred. 0.375 % ropivacaine was the only anesthetic used for caudal block. The onset of CES symptoms occurred 2 h after surgery. On the first and second postoperative days, the symptoms included symmetrical pain (pain score of 3, Visual Analogue Scale/Score) in the posterior thigh and posterior lateral region in the sciatic nerve distribution area and could be aggravated by factors such as coughing or changing body position. Then, progressive lower extremity weakness and perineal sensory disturbance were detected on the third and fourth days after surgery. With steroid therapy, all symptoms begin to resolve gradually on the ninth day after surgery, and nearly recovery was achieved on the 14th day after surgery.

Table 2
Categories and duration of major complication.

Major complications	<2 day	7~30 days	>30 days	Total (n)	Proportion (%)
Post-dural puncture headache	1	–	–	1	0.10
Local anesthetic systemic toxicity	9	–	–	9	0.92
Symptoms of neurological injury	3	–	–	3	0.31
Cauda equine syndrome	–	1	–	1	0.10
Postoperative pain surrounding puncture site	27	3	–	30	3.08
Total	40	4	–	44	4.52

Proportions (%) are based on the number of patients with available data.

3.2.3. LAST

We recorded 9 patients (6 male, 3 female) had experienced LAST (Table 3). Four of the nine experienced multiple punctures, and there were two cases of bloody aspiration during the puncture procedure (Table 3). Most of the symptoms were mild, such as dizziness, mild excitement, chills, ruddy complexion, elevated blood pressure, rapid pulse accompanied by tinnitus, headache or sweating. However, 3 patients had experienced severe symptoms, including convulsion. Fortunately, all these symptoms were relieved after the administration of a sedative (midazolam), respiratory support and psychological comfort, and no sequelae were recorded. No other serious local anesthetic toxicity events, such as coma, cardiac arrest or postoperative sequelae, occurred. Then, multiple regression analysis was performed to identify potential risk factors for local anesthetic toxicity. The results showed that multiple punctures ($P = 0.03$) might be closely related to the occurrence of this complication (Table 3).

3.3. Localized pain at the caudal insertion site

Localized pain at the caudal insertion site was defined by the symptoms of backache and the signs of marked tenderness localized to the puncture site. Surprisingly, a total of 30 (13 male, 17 female) patients experienced this complication. Seventeen patients experienced multiple punctures (Table 4). Eight (10.81 %) patients received 1 % lidocaine alone, 5 (6.58 %) patients received 0.375 % ropivacaine alone, and 17 (2.58 %) patients received a mixed solution as the caudal blocker. The pain in 27 cases was relieved within 48 h. However, in 2 cases, the pain lasted for 14 days. One patient suffered sustained pain for 30 days. Fortunately, all the pain scores were no more than 3 (according to the 11-point visual analog scale). Therefore, no relevant analgesic medication was provided. There were no recorded cases of puncture site infection or hematoma. Multiple regression analysis was also performed to identify potential risk factors for this complication. The results indicated that multiple punctures ($P < 0.001$) might be closely related to the occurrence of this complication (Table 4).

The clinical situation was complex. Concomitant conditions did not necessarily mean that complications would occur. So, we created Table 5 which including medication and dose of local anesthetics administered all the patients who had TNS, CES and/or LAST. We hope that it can serve as a warning to anesthesiologists.

4. Discussion

Caudal block is a relatively simple, inexpensive and widely used anesthesia technique. However, the success rate and complications of adult caudal anesthesia have rarely been reported. Surgical procedures for hemorrhoids and other minor anorectal disorders account for a large proportion of elective ambulatory surgeries [2]. The short in-hospital period made it difficult to collect postoperative information from these patients. This study was a single-center, large-sample, prospective, investigator-blinded trial designed to investigate the efficacy, complications and related risk factors for complications of caudal block in adult anorectal surgery. Complete follow-up was performed by three anesthesiologists, and complete postoperative follow-up data were obtained for 973 patients, which greatly improved the integrity of the results of this study.

However, in contrast with pediatric surgery, caudal block is not preferred in adult surgery. One of the reasons might be that adult caudal block sometimes cannot provide satisfactory anesthesia [8,15,16]. There can be technical difficulty, mainly due to the inconspicuous anatomical markings of fistulas in adults and possible anatomical variations [17,18]. As research progresses, assistive technologies to improve the success rate of caudal block have been developed, such as ultrasound guidance [19]and preoperative magnetic resonance examination [20]. In this study, the results showed that the caudal block efficacy resulted in unexpectedly high satisfaction (95.38 %). This may be related to the following two factors. First, all caudal block procedures were performed by experienced and skillful attending anesthesiologists. Second, caudal block was very suitable for these anorectal surgeries. A recent clinical randomized study also confirmed this view, the maximal resting anal pressure (MRP) and maximal squeezing anal pressure (MSP) were measured by anorectal manometry before and after caudal block, and caudal block could significantly decrease both pressures [21].

Table 3
Regression analysis of potential risk factors for systemic local anesthetic toxicity in patients.

Risk factors		Number of patients (n)	Incidence (%)	*P* value
Age (mean ± SD)	45.2 ± 14.4	967	0.93	0.52
BMI (mean ± SD)	22.69 ± 3.98	967	0.93	0.60
Sex	Male	568	1.06	0.37
	Female	399	0.75	
ASA status	I	775	0.65	0.73
	II	191	2.09	1.00
	III	1	0.00	1.00
Multiple attempts to locate caudal space	Yes	110	3.64	0.03 *
	No	857	0.58	
Local anesthetic	lidocaine	74	1.35	0.98
	Ropivacaine	76	1.32	0.86
	lidocaine with ropivacaine	817	0.86	0.92
Bloody aspiration	Yes	9	22.22	0.06

*P value < 0.05 present statistically significant.
BMI, body mass index; ASA, American Society of Anesthesiologists.

Table 4
Binary regression analysis of potential risk factors for local pain at insertion site in patients undergoing caudal block.

Risk factors		Number of patients (n)	Incidence (%)	*P* value	Odds Ratio (95 % CI)
Age (mean ± SD)	45.2 ± 14.4	967	3.10	0.891	0.99 (0.97–1.03)
BMI (mean ± SD)	22.69 ± 3.98	967	3.10	0.300	0.93 (0.82–1.07)
Sex	Male	568	2.29	0.216	1.65 (0.75–3.62)
	Female	399	4.26		
Multiple attempts to locate caudal space	Yes	110	15.45	<0.001*	10.57 (4.89–22.86)
	No	857	1.52		
Local anesthetic	Without ropivacaine	74	10.81	0.003*	0.25 (0.10–0.62)
	Ropivacaine	893	2.46		

*P value < 0.05 present statistically significant.
BMI, body mass index.

Table 5
Specifics of patients who suffered TNS, LAST and/or CES.

Complications	Patient code	Lidocaine(mg)	Ropivacaine (mg)	Times of punctures	Blood aspiration	Paresthesia during puncture
TNS	1#	100	75	1	No	No
	2#	0	75	1	No	No
	3#	100	75	2	No	No
LAST	3#	100	75	2	No	No
	4#	0	75	1	No	No
	5#	100	75	1	No	No
	6#	0	75	1	No	No
	7#	0	75	2	No	No
	8#	50	75	1	No	No
	9#	50	75	1	No	No
	10#	0	75	1	No	No
	11#	100	75	2	No	No
CES	12#	0	75	3	yes	yes

Specifics of patients who suffered TNS, LAST and/or CES. The volume of the local anaesthetics for caudal block was 20 mL.
TNS, transient neurologic symptoms; LAST, local anesthetic systemic toxicity; CES, Cauda equine syndrome.

Another limitation of caudal block in adults might be the potential complications. The research on complications of caudal block in children was very widely [22,23] , but there were few reports in adults. Several complications, such as LAST and TNS, have been reported. Therefore, we focused on complications related to caudal anesthesia in adults. Our results showed that the incidence of complications related to caudal block in anorectal surgery was not as high as expected. A reported study of a large sample of 5083 patients found an incidence of complications of adult epidural anesthesia of approximately 1.34[24]. The incidence of complications of adult caudal block in our study is acceptable compared with that reported in other's research. Meanwhile, we found that except for 3 cases of LAST, there were no malignant adverse events, such as serious cardiac events, severe respiratory depression/acute respiratory failure or total spinal anesthesia, throughout the process. Meanwhile, the 3 patients with LAST all recovered by nonoperative management without any sequelae. Therefore, our results indicate that caudal block in adult anorectal surgery is a safe anesthesia method when undertaken by experienced anesthesiologists.

It is worth noting that we recorded some complications of caudal block, including LAST, TNS, CES and localized pain at the caudal insertion site.

4.1. LAST

LAST is one of the most serious complications of caudal block. Such events range across a continuum from mild subjective prodromal symptoms to seizure, cardiac arrest, and/or death. Three cases of severe LAST were recorded. The clinical manifestations included dizziness, flushing, dysphoria and involuntary muscle twitches. Fortunately, all three patients had a good prognosis after treatment with sedation and respiratory support, and no sequelae were recorded. Therefore, it is particularly important to observe the patient after injection and to immediately discover and deal with LAST. We observed an incidence of LAST in caudal block of 0.31 %; while the incidence of complications of epidural anesthesia is 0.01 % [24,25], there was a lower probability of spinal anesthesia [25] at our hospital. The independent risk factor for this complication was "multiple punctures". The abundant anatomical blood supply to the soft tissue of the sacrococcygeal region might be one reason for this complication. Meanwhile, caudal anesthesia requiring a single large-dose injection of local anesthetics may be another reason. Recent studies have reported that large amounts of absorbed local anesthetic are stored in skeletal muscle, suggesting that both adult and pediatric patients with low muscle mass are at a higher risk for LAST [26,27]. Current guidelines recommend that haemodynamic deterioration caused by LAST should be treated by Intralipid® 20 % as first-line therapy along with epinephrine/adrenaline for cardiopulmonary resuscitation until circulation is restored or extracorporeal membrane oxygenation has been installed [28]. To prevent LAST, ultrasound guidance might be a wise choice. A meta-analysis showed that ultrasound reduced the incidence of vascular puncture associated with PNB compared with peripheral nerve stimulation

[29]. We will confirm this in future studies. It might be better to make patients awake to get instant feedback on paresthesia, pain, or symptoms of local anesthetic systemic toxicity during the whole anesthesia procedure [23]. Meanwhile it was reported that the risk of LAST has nothing to do with the type of anesthetic [30].

4.2. CES

In this study, we recorded one case of CES. The patient suffered reduced perineal sensation, altered bladder function leading to painless urinary retention, and loss of anal tone. CES has five characteristic features: bilateral neurogenic sciatica, reduced perineal sensation, altered bladder function leading to pain, reduced urinary retention, loss of anal tone and loss of sexual function [31]. It is usually caused by caudal nerve stimulation, infection, inflammation or tumors. The patient suffered elicited paresthesia during the puncture procedure. Unfortunately, we failed to perform magnetic resonance imaging (MRI) to rule out possible spinal cord hematoma or infection. Stimulation caused by puncture might be the most likely reason for this complication in this case. However, CES is a severe nerve complication, but the majority of patients who suffer this complication usually recover within 2 weeks of treatment with steroids or without any treatment. In this case, all symptoms began to resolve on the ninth day and completely recovered on the 14th day after surgery with steroid therapy. This event indicates that elicited paresthesia during the puncture procedure is a strong sign of nerve stimulation with the potential for CES. Switching to general anesthesia and providing steroid therapy are wise management choices. MRI might also help to diagnose changes in the spinal cord.

4.3. TNS

In this study, 3 patients suffered TNS, with symptoms of pain in the lower back and/or buttocks with or without radiating pain into one or both legs. All the symptoms resolved in 3 days without any treatment. All kinds of intraspinal anesthesia, including spinal, epidural and caudal anesthesia, could cause TNS. In the 1990s, TNS were first reported as clinical signs of mild, temporary neurologic dysfunction independent from the kind or concentration of local anesthetic, such as lidocaine, bupivacaine, mepivacaine or ropivacaine. Meanwhile, TNS have also been reported in both spinal and epidural anesthesia [32–37]. The mechanism of TNS is still a mystery, but no connections to neurological pathology have been suggested in the literature. The administration of a nonsteroidal anti-inflammatory drug has been suggested to produce significant relief from symptoms and might be a significant factor in reducing patient anxiety [38].

4.4. Localized pain at the caudal insertion site

We innovatively included another complication in this study. Surprisingly, we found that 34 patients suffered postoperative pain after caudal block, the incidence of which (3.08 %) was higher than that of any other complication. These similar complications could occur during any intraspinal anesthesia procedure, including the establishment of epidural and spinal anesthesia. Few previous studies have included this in the scope of caudal block-relevant complications. However, this complication was often present during clinical follow-up. A number of patients considered it the most unacceptable aspect of caudal block. However, the pain in most patients was not severe and usually disappeared without therapy in 48 h. However, it is still the main patient complaint after surgery, and thus merits attention. Then, we analyzed the independent risk factors for this complication to develop a strategy for reducing its incidence. Our results suggest that multiple attempts to locate the caudal space and the use of lidocaine may be closely related to the occurrence of this complication. It is easy to understand that multiple punctures can aggravate the skin and soft tissue damage at the puncture site and thus increases the likelihood of pain around the puncture site after surgery. Ultrasound guidance might be a feasible method to reduce the number of punctures [39,40].

To avoid interfering with the clinical behavior of the attending anesthesiologist, we did not specify a concentration of local anesthetic for use in caudal block. We also failed to record some objective numerical data to further evaluate the block efficiency, such as the MRP and MSP. However, these limitations did not affect the results of the study, as our research is focused on the safety and efficacy of sacral anesthesia and does not involve the comparison of these data.

5. Conclusion

In this study, we observed the main complications of caudal block. Some very serious cases of LAST occurred and merit attention. Localized pain at the caudal insertion site was the most frequent and overlooked complication in adult caudal block and needed more attention. Local anesthetic systemic toxicity has a high incidence in adult caudal block. Multiple punctures during the block were the independent risk factor for both local anesthetic systemic toxicity and localized pain at the caudal insertion site. It is worth avoiding multiple attempts to locate the caudal space.

The total incidence of caudal block complications was low, and patients usually presented with mild symptoms that did not need therapy. While caudal block is still a safe and reliable method for anesthesia in adult anorectal surgery, it was worth avoiding multiple attempts to locate the caudal space.

Availability of data and materials

Data are available upon reasonable request.

Ethics approval and consent to participate

The study was approved by the ethics committee of the First Affiliated Hospital of Zhejiang University, School of Medicine (2011–10) and was registered in the Chinese Clinical Trial Registry (http://www.chictr.org/usercenter/project/edit.aspx?proj=2353, number: ChiCTR–OCS–11001887). All participants provided written informed consent. This manuscript adheres to the applicable CONSRT Guidelines.

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CRediT authorship contribution statement

Liwei Xie: Conceptualization, Data curation, Writing – original draft. **Honglei Tao:** Data curation, Formal analysis. **Fangping Bao:** Investigation. **Yeke Zhu:** Investigation. **Fuquan Fang:** Data curation, Formal analysis. **Xiuxia Bao:** Investigation. **Shengmei Zhu:** Supervision, Writing – review & editing. **Xianhui Kang:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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