

Epidural filling with crystal-colloid solution prevented accidental dural-puncture-induced headache after cesarean section

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Research article

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Abstract

Background: Post dural puncture headache (PDPH) is a common anaesthetic complication caused by spinal puncture or accidental dural puncture during intraspinal anesthesia operation. There is no panacea, either preventive or therapeutic for PDPH.

Methods: This study retrospectively collected and analyzed data on the clinical features and outcomes of 20 puerperants with accidental dural punctures. Seventeen individuals received crystal-colloid solution fillers and three did not.

Results: The average epidural catheter retaining time was 35.97 hours; the average frequency of epidural filling was 2.65 times, with an average volume of 65.88 ml per fill. One patient developed tinnitus and three complained of head swelling during filling. The average bed-stay was 72.65 hours, with intravenous infusion volume of 2308.82 ml per day in the first three postoperative days. Two patients complained of slight dizziness and mitigation, and five felt weak. One individual had intermittent headaches and dizziness till the seventh postoperative day.

Conclusions: Epidural injection of crystal-colloid solution combined with hydration is an effective preventive strategy for PDPH after cesarean section based on this observational study.

Background

Although modern anesthesiology has changed dramatically in recent years, intravertebral anesthesia remains a popular option for cesarean sections because of the resultant neuromuscular paralysis [1]. Post-dural-puncture headache (PDPH) is a commonly reported anesthetic complication of intravertebral anesthesia and results from accidental dural puncture (ADP) following spinal or epidural block [2–4]. The prevalence of PDPH in patients undergoing intrathecal block is 10–80% depending on age [5]. Martinez et al. reported incidences of 0.76% for ADP and 59% for PDPH in 66,540 epidural labor analgesia procedures [6]. Cerebrospinal fluid (CSF) leakage is the most widely accepted cause of intracranial hypotension and is considered be the pathologic mechanism of PDPH. Many techniques have been developed to reduce CSF leakage. PDPH treatments include drug or fluid administration through intrathecal catheterization [7], epidural blood patches (EBPs), and epidural hydroxyethyl starch (HES) patches. In this article, we discuss the findings in 20 patients who were treated preventatively for PDPH following ADP during cesarean section.

Methods

Twenty puerperants with ADP admitted in Obstetrics Department of Chongqing Health Center for Women and Children all happened between January 1, 2017 and December 31, 2018 were retrospectively analyzed with the approval of hospital's ethics committee. In all instances, patients had received combined spinal-epidural anesthesia before undergoing a cesarean section; ADP had occurred incidentally. Following ADP, 17 individuals received epidural filling with crystal-colloid mixed solution for

conservative treatment; three cases did not receive filling treatment. One non-fill case switched to general anesthesia and was treated conservatively with hydration and bed rest. Informed consent was obtained from all 17 individuals before treatment with the epidural injection of crystal-colloid mixed solution.

For the 17 who received epidural filling, the treatment protocol was as follows: when ADP was confirmed, puncture needle was removed immediately and puncture point changed. The epidural catheter was retained for subsequent filling. To prevent PDPH, a 1:1 crystal (0.9% sodium chloride injection) and colloid (gelofusine) solution of 20–30 ml volume was injected at the end of the operation. Puerperants were instructed to lie flat in a bed without pillows for three days. Daily intravenous fluid infusion volume was increased to approximately 3000 ml. Filling was carried out by an anesthesiologist two or three times over the following three days.

Results

The total number of cesarean sections carried out under combined spinal-epidural anesthesia from January 1, 2017 to December 31, 2018 was 14,740 in Chongqing Health Center for Women and Children. The incidence of ADP per this year was 0.14% (20 cases out of 14,740).

Puerperant demographics are shown in *Table 1*. From the 20 total ADP cases, 17 received epidural filling. Six ADP cases occurred at L2–3 intervertebral space, the other 11 were L3–4. Subsequently, nine patients received subarachnoid anesthesia at contiguous intervals to complete anesthesia and surgery. The eight remaining cases received low concentration epidural anesthesia (repeated injections of 0.5% ropivacaine administered slowly) at the same intervals. Average epidural catheter retaining time was 35.97 hours, average frequency of epidural filling was 2.65 times totally, and average fill volume was 65.88 ml. One patient reported tinnitus and three described head swelling during filling. These symptoms disappeared when solution-filling rate was slowed down. Average bed-stay was 72.65 hours. Average daily intravenous infusion volume during the first three postoperative days was 2308.82 ml. Median hospitalization length after the operation was four days. Once patients adopted an upright position, two complained of slight dizziness and relieved within a few minutes, five felt weak. One puerperant complained of intermittent headaches and dizziness and could not sit or stand up until the seventh postoperative day. This individual was very nervous despite receiving detailed information from the anesthesiologist about ADP and assurances of a good prognosis. The incidence of PDPH in these puerperants was 1/17 (5.88%).

Two individuals did not receive epidural filling or any specific treatment. Both complained of severe headaches on getting out of bed on the first postoperative day. These symptoms worsened when they were sitting or standing and improved when recumbent. Headaches lasted until the eighth postoperative day in one case and to the fifth postoperative day in the other. The final puerperant changed to general anesthesia and received conservative treatment of hydration (average 2866.27 ml per day during the first three postoperative days) and bed rest (91 hours). Patient reported no complaints when sitting or

standing. Follow-up at four weeks confirmed that there had been no PDPH recurrences and no neurologic sequelae.

Discussion

The incidence of PDPH has decreased dramatically from ~70% to ~1% over the past century [8]. PDPH incidence differs across clinical institutions and disciplines because of the varying therapeutic techniques employed in its treatment.

Studies have found that age, female sex, pregnancy [9], oblique plane of needle insertion [10], repeated dural punctures [11], previous history of PDPH [12], and size and type of needle [13] are all risk factors for PDPH. A meta-analysis found that PDPH incidence is significantly lower in males than in non-pregnant females, with an odds ratio of 0.55 (95% confidence interval 0.44 - 0.67) [14]. Thus, PDPH is more likely to occur in cases of cesarean section and cannot necessarily be avoided as ADP is a relatively common complication.

The total volume of adult CSF is about 150 ml. Lumbar region CSF pressure is 5–15 cmH₂O when in the supine position. This figure increases to 40 cmH₂O when individuals adopt a vertical position. The connection between CSF leakage and PDPH pathogenesis is not entirely explained. Despite this, CSF leakage is generally accepted as the root cause since it is also the most common explanation for spontaneous intracranial hypotension. Researchers have found CSF density declines during pregnancy and briefly postpartum [15]. Therefore methods that address CSF leakage may be effective in preventing PDPH.

Drug or fluid administration [7] through intrathecal catheterization have both been used to treat PDPH. After ADP during cesarean delivery, research showed that locating catheters in the epidural space and retaining them for postoperative analgesia (36–72 hours) reduced PDPH incidence from 58% (non-catheterized patients) to 7.1% [16]. Other studies found that theophylline decreased PDPH severity significantly as compared with placebo. Theophylline was therefore suggested as a minimally invasive, simple, effective, and fast PDPH treatment [17]. Although dexamethasone was reported ineffective against PDPH and was even considered a risk factor for its onset [18], intravenous hydrocortisone injection has been found to be effective for relieving PDPH after spinal anesthesia (100 mg, every 8 hours for 48 hours) [19].

EBPs are a classic therapeutic strategy for PDPH; they have a low incidence of complications and high success rate [20–22]. However, they are invasive and can lead to permanent neurological sequelae, such as spinal-epiarachnoid or spinal-subdural hematoma, back pain, radiculopathy, arachnoiditis, intrathecal hematoma, and infection. In addition, the operation process is uncomfortable and therefore often refused by puerperants and their families.

In contrast, epidural filling with crystal-colloid solution is a more appealing treatment option. Initially, alternative filling solutions such as epidural saline or dextran were suggested [23]. In theory, epidural

filling with other materials should produce the same general effect. Indeed, this has been the case when treating PDPH in patients with EBP contraindications like leukemia and bacteremia [24–26]. A study showed that HES can be used for epidural volume extension in combination with spinal–epidural anesthesia for cesarean delivery [27]. Epidural administration of 20 ml HES plus 5 µg sufentanil was also effective for treating PDPH [26]. Epidural saline boluses or infusions were considered by 32% of anesthesiologists from a survey on PDPH treatment [28]. Another study supported this, revealing that headaches were significantly more common in a group without epidural saline filling, than in a filling group (48.8% vs. 16.4%, respectively, $P < 0.001$) [29]. Our data show a PDPH incidence of 1/17 (5.88%) in epidurally filled ADP puerperants. Epidural injection of 1:1 crystal-colloid solution combined with hydration and bed rest for preventative PDPH treatment following cesarean section is effective and safe. This could be the gold standard therapeutic option for PDPH.

Conservative therapy is widely recommended for PDPH, which does recover spontaneously. Pre-operative communication with patients is essential in order to inform them that ADP is a common complication. Patients must know that it will affect their daily functioning and result in a prolonged hospital stay if it occurs. As such, effective prevention of PDPH is hugely beneficial when ADP does occur

Psychological counseling is very important for puerperants if ADP develops. Reassuring patients with PDPH enhances their confidence in treatments and improves subsequent outcomes [30]. One of our 17 epidurally filled cases developed PDPH. This individual had been very tense and anxious before and after the operation despite adequate explanation and reassurance from the anesthesiologist. She lay motionless in her hospital bed during the first three postoperative days due to incision pain. Indeed, this may have been a contributing factor to her developing PDPH, as body and lower limb movements rebalance CSF pressure, thus promoting headache relief.

Conclusions

PDPH is an iatrogenic and unavoidable complication, which, although self-limiting, affects patients' daily lives. Our retrospective analysis suggest that epidural injection of 1:1 crystal-colloid solution combined with hydration treatment and bed rest is an effective and safe therapeutic strategy for PDPH following ADP during cesarean sections.

Declarations

Ethics approval and consent to participate

This study was conducted with the approval of the hospital's ethics committee of Chongqing Health Center for Women and Children.(Approval No. 2018-LS(S)–017).

The verbal consent approved by the ethics committee was obtained from the study participants.

Consent for publication

The consent for publishing the clinical details was obtained from all the patient.

Availability of data and material

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that there is no conflict of interest regarding the study and publication of this article.

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Authors' contributions

JY contributed to the study design and writing the manuscript;

MA contributed to the data obtaining and statistically analysis;

YY contributed to the study planning and data interpreting;

YL contributed to the manuscript editing or commenting;

CL contributed to the conceive of the study and accuracy and integrity of the article.

All authors have read and approved the manuscript.

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List Of Abbreviations

PDPH: Post dural puncture headache

ADP: accidental dural puncture

CSF: Cerebrospinal fluid

EBPs epidural blood patches

HES: hydroxyethyl starch

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Table

Table 1 Clinical features of puerperants

	n=17	Case 1	Case 2	Case 3
Age (years)	30.24±3.80	28	31	29
Gestation (weeks)	39.29±1.13	40.57	38.43	39.43
Height (cm)	158.15±3.44	164	152	152
Weight (kg)	65.32±8.89	67	54.5	66
Systolic pressure (mmHg)	114.00±8.51	116	116	111
Heart rate (beats/min)	88.35±9.04	110	88	115
Intervertebral space punctured (L2-3/L3-4)	6/11	L3-4	L3-4	L3-4
Anesthesia method	Subarachnoid anesthesia at contiguous intervals (n=9) / Low concentration epidural at the same interval (n=8)	Subarachnoid anesthesia	Subarachnoid anesthesia	General anesthesia
Fill frequency	2.65±0.79	/	/	/
Total fill volume (ml)	65.88±20.63	/	/	/
Symptoms during filling		/	/	/
Tinnitus	1			
Head swelling	3			
Time in supine position (hours)	72.65±9.80	12	16	91
Average intravenous infusion volume per day during first three days (ml)	2308.82±611.52	1700	1167	2866.27
Time epidural catheter retained (hours)	35.97±9.89	/	/	/
Postoperative hospitalization length (days)	4.41±1.80 (4.4-4.5)	9	5	5
Symptoms on taking an upright position		□	□	No
Slight dizziness	2			
Weakness	5			
PDPH	1 (□)	Yes	Yes	No

□ Case 1 complained of a severe headache on getting out of bed on the first and second postoperative days. Pain worsened on sitting or standing and improved when recumbent. Symptoms persisted until the eighth postoperative day.

□ Case 2 complained of a severe headache after getting out of bed on the first postoperative day. This worsened when sitting up and improved when recumbent. Symptoms persisted until the fifth postoperative day.

□ One patient retained an epidural catheter for 50 hours and was given four filling treatments with a total fill volume of 80 ml. This case received conservative treatment of hydration (average 2733.33 ml per day for the first three postoperative days) and bed rest, remaining supine for 72 hours. This individual tried a semi-recumbent position on the fourth postoperative day but felt weak and dizzy. She was reluctant to get out of bed due to fear of incision and lumbar pain. She complained of a headache after neck rotation for six postoperative days; headache was localized to the occiput and crown. Neurological examination was normal and there was no nuchal rigidity. She complained of intermittent headaches and dizziness until the seventh postoperative day. She tried to sit on the eighth postoperative day and had no observable symptoms on day eight or nine. The patient was discharged on the eleventh postoperative day.