Impact of spinal needle type on postdural puncture headache among women undergoing Cesarean section surgery under spinal anesthesia: A meta-analysis

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Impact of spinal needle type on postdural puncture headache among women undergoing Cesarean section surgery under spinal anesthesia: A meta-analysis

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Background

Spinal anesthesia (SA) is commonly used in obstetric, lower abdominal, and lower limb surgery. However, postdural puncture headache (PDPH) is a significant harm associated with SA.

PDPH is usually self-limiting and resolves with conservative management, but severe PDPH is known to be incapacitating.[1]

The size of dural perforation is known to be an important factor influencing the incidence of PDPH.[2-4] Cutting-bevel spinal needles (SNs) sever dural fibers, while pencil-point SNs make a dural hole by splitting the fibers, thus leaving a smaller dural hole.[5]

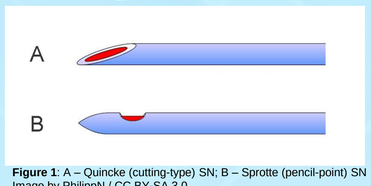

Figure 1: A – Quincke (cutting-type) SN; B – Sprotte (pencil-point) SN
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There is no formal consensus regarding which needle type is superior for PDPH.

Problem Statement

Do pencil-point spinal needles reduce the incidence of postdural puncture headache compared to cutting-bevel spinal needles in women undergoing spinal anesthesia for Cesarean deliveries?

Methods

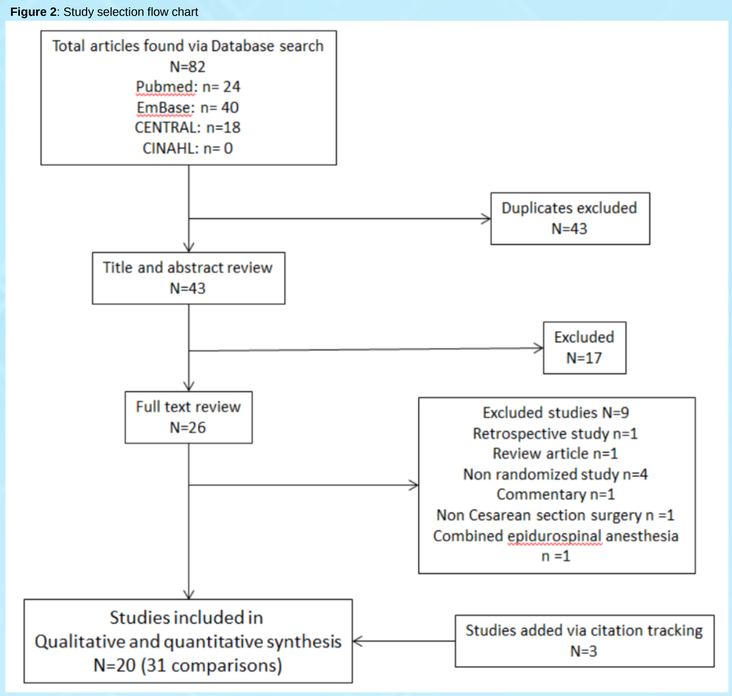
This systematic review and meta-analysis included randomized controlled trials comparing the incidence of PDPH of pencil-point SNs with cutting-bevel SNs in patients undergoing Cesarean section with SA. A comprehensive search of PubMed, Cochrane Library, EMBASE, and CINAHL without using any language and time restrictions was performed. All titles, abstracts, and full-text reports were reviewed by two authors. Subgroup analyses were conducted for all outcomes according to preoperative hydration, postoperative hydration, and additives to local anesthetics.

OpenMetaAnalyst software was utilized to conduct meta-regression analysis to investigate the association of gauge of cutting and pencil SNs and incidence of PDPH separately. Power was based on prespecified relative risk reduction (RRR) estimates and the total number of patients. A conservative RRR of 25% and RRR of 65 % and type I error $\alpha = 0.05$ and power $(1 - \beta) = 0.80$ were used for the trial sequential analyses. Overall evidence quality was categorized according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) method.

Results

A total of 4936 patients from 20 studies (31 comparisons) were included.

Figure 2: Study selection flow chart



Pencil-point SNs lead to reduced PDPH (risk ratio [RR] 0.33, 95% confidence intervals [CI] 0.25 to 0.45) compared to cutting-bevel SNs. The incidence of anesthesia failure, non-PDPH, backache, and other adverse effects was not statistically significantly different.

Figure 3: Meta analysis – total PDPH

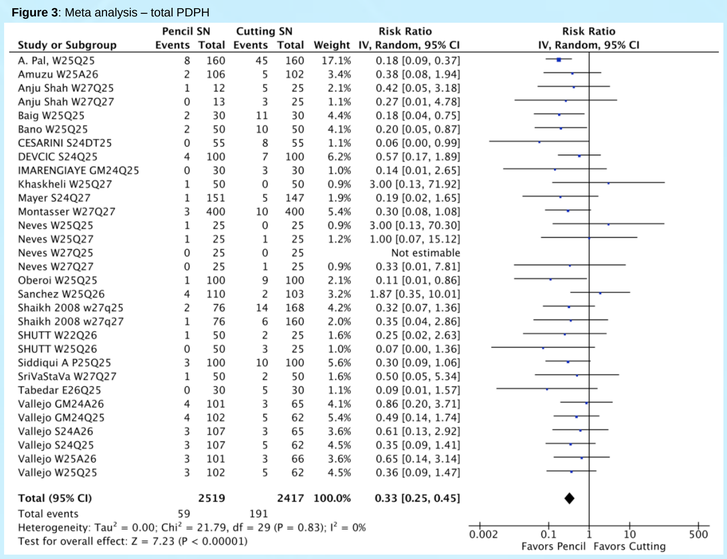


Table 1: Summary of findings

Outcomes	Illustrative comparative risks (95% CI) Assumed risk**	Corresponding risk**	RR (95% CI)	No. of participants (RCTs/comparisons)	Quality of the evidence (GRADE)
	Cutting spinal needle	Pencil spinal needle			
Total PDPH	Study population		0.33 (0.25, 0.45)	4936 (20/31)	⊕⊕⊕⊖ Moderate[a,b]
	79 per 1000	26 per 1000 (20, 36)			
Mild PDPH	Study population		0.50 (0.28, 0.91)	2348 (11/14)	⊕⊕⊕⊖ Moderate[a,b]
	35 per 1000	17 per 1000 (10, 31)			
Moderate PDPH	Study population		0.25 (0.11, 0.6)	2348 (11/14)	⊕⊕⊕⊖ Moderate[a,b]
	22 per 1000	6 per 1000 (2, 13)			
Severe PDPH	Study population		0.33 (0.13, 0.81)	2348 (11/14)	⊕⊕⊕⊖ Moderate[a,b]
	14 per 1000	5 per 1000 (2, 11)			
Epidural blood patch requirement	Study population		0.21 (0.09, 0.51)	3335 (11/19)	⊕⊕⊕⊖ Moderate[a,b]
	14 per 1000	3 per 1000 (1, 7)			
Non-PDPH	Study population		0.76 (0.51, 1.14)	1251 (7/8)	⊕⊕⊖⊖ Low[a,b,c]
	84 per 1000	64 per 1000 (43, 96)			
Failure	Study population		1.28 (0.56, 2.93)	1313 (9/11)	⊕⊕⊖⊖ Low[a,b,d]
	16 per 1000	20 per 1000 (9, 46)			

CI = confidence interval, RR = risk ratio.
a Only 25 % (5/20) of included studies reported the method of generation of the randomization sequence. However, the allocated intervention assignment was adequately concealed in 20% (4/20) of trials. Moreover, only 15% (3/20) of studies both the method employed for the generation of the randomization sequence and method of allocation concealment was adequate. However, we conducted sensitivity analyses according to each risk of bias domain for all outcomes. The results did not change for any outcome. Hence, we did not downgrade the quality of evidence due to the potential for selection bias.
b Downgraded the quality of evidence by one level due to imprecision. All included RCTs and also the pooled estimates have wide confidence intervals.
c Downgraded the quality of evidence by one level due to the potential for publication bias. The non-PDPH data were extractable from only 35% (7/20) of studies.
d Downgraded the quality of evidence by one level due to the potential for publication bias. The failure data were extractable from only 45% (9/20) of studies.
** The corresponding risk (and its 95% CI) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

Discussion

- Pencil-point SNs effectively reduce the incidence of PDPH compared with cutting-bevel SNs in Cesarean sections without a meaningful increase in adverse events.
- The majority of included trials were free of attrition bias, selective reporting, and other biases. However, the risk of selection bias remained high. Sensitivity analyses according to each risk of bias domain did not result in a change for any outcome.
- A limitation of this study was the lack of information about exact pain management and its impact on findings in included studies. The overall quality of evidence according to the GRADE criteria across all outcomes was moderate to low.

Conclusions

- This study demonstrates the superiority of pencil-point SNs over cutting-bevel SNs for women undergoing SA for Cesarean section surgery.
- Values-based patient-centered care (VBPCC) emphasizes the role of the patient in their own care to optimize satisfaction and outcomes. In seeking to reduce the incidence of a harm associated with SA, this project demonstrates a core tenet of VBPCC.
- Future studies may examine the role of needle gauge in conjunction with needle type to further reduce the incidence of PDPH.

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