Original Article/*Özgün Araştırma*

doi: 10.54875/jarss.2026.99907

Reduction in Epidural Blood Patch Requirement after Switching from 22G Quincke to 26G Atraumatic Needles for Lumbar Puncture in Adults: A 4-Year Single-Centre Experience

Erişkinlerde Lomber Ponksiyon için 22G Quincke İğnesinden 26G Atravmatik İğneye Geçildikten Sonra Epidural Kan Yaması Gereksiniminde Azalma: Dört Yıllık Tek Merkez Deneyimi

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ABSTRACT

Objective: Post-dural puncture headache (PDPH) is the most common complication of lumbar puncture (LP), and severe cases may require an epidural blood patch (EBP). Smaller-gauge atraumatic needles reduce PDPH, yet cutting needles remain in routine neurological use. We assessed whether a change in LP needle made by a single operator was associated with a lower requirement for EBP in adults.

Method: We conducted a retrospective, single-centre, before-and-after study of consecutive LPs performed in adult (≥18 years) patients by a single neurologist over a 4-year period. A 22-gauge Quincke cutting needle was used in the first period and a 26-gauge atraumatic (Atraucan) needle in the second. The primary outcome was the proportion of patients requiring EBP. A procedure-level rate and a pre-specified sensitivity analysis were also reported. Groups were compared with the Fisher exact test.

Results: Fifty-nine patients (24 in Period 1 and 35 in Period 2) underwent 97 procedures (27 and 70, respectively). Patient-level EBP was 25.0% (6/24) versus 2.9% (1/35) (odds ratio 11.3, 95% confidence interval 1.3–101.5; p=0.015). Procedure-level rates were 22.2% (6/27) versus 1.4% (1/70) (p=0.002). The sensitivity analysis yielded 28.0% (7/25) versus 2.9% (p=0.007).

Conclusion: A change from a 22-gauge Quincke to a 26-gauge atraumatic needle by a single operator was associated with a lower EBP requirement. Given the retrospective before-and-after design and the small number of events, this association should not be interpreted as causal; nevertheless, the findings are consistent with existing evidence supporting small-gauge atraumatic needles for diagnostic and therapeutic LP.

Keywords: Atraumatic needle, epidural blood patch, lumbar puncture, post-dural puncture headache, spinal needle

ÖZ

Amaç: Postdural ponksiyon baş ağrısı (PDBA), lomber ponksiyonun (LP) en sık komplikasyonudur ve şiddetli olgularda epidural kan yaması (EKY) gerekebilir. Küçük çaplı atravmatik iğneler PDBA'yı azaltır; ancak kesici iğneler nöroloji pratiğinde yaygın kullanılmaktadır. Tek bir uygulayıcının iğne değişikliğinin erişkinlerde daha düşük EKY gereksinimiyle ilişkili olup olmadığını değerlendirdik.

Yöntem: Dört yıllık bir süre boyunca tek bir nörolog tarafından yetişkin (≥18 yaş) hastalarda arka arkaya gerçekleştirilen LP'ler üzerine retrospektif, tek merkezli, öncesi-sonrası bir çalışma yürüttük. İlk dönemde 22G Quincke kesici iğne, ikinci dönemde 26G atravmatik (Atraucan) iğne kullanıldı. Birincil sonlanım, EKY gereken hasta oranıydı. İşlem düzeyinde oran ve duyarlılık analizi de bildirildi. Gruplar Fisher kesin testiyle karşılaştırıldı.

Bulgular: Elli dokuz hasta (24 birinci dönem, 35 ikinci dönem) 97 işlem geçirdi (27 ve 70). Hasta düzeyinde EKY birinci dönemde %25,0 (6/24), ikinci dönemde %2,9 (1/35) idi (olasılık oranı 11,3; %95 güven aralığı 1,3–101,5; p=0,015). İşlem düzeyinde oranlar %22,2 (6/27) ve %1,4 (1/70) idi (p=0,002). Duyarlılık analizinde %28,0 (7/25) ve %2,9 bulundu (p=0,007).

Sonuç: Tek uygulayıcının LP yaptığı erişkinlerde 22G Quincke'den 26G atravmatik iğneye geçiş, daha düşük EKY gereksinimiyle ilişkiliydi. Geriye dönük öncesi-sonrası tasarım ve az sayıdaki olay nedeniyle bu ilişki nedensel olarak yorumlanmamalıdır; bununla birlikte bulgular, tanısal ve tedavi amaçlı LP'de küçük çaplı atravmatik iğneleri destekleyen mevcut kanıtlarla uyumludur.

Anahtar sözcükler: Atravmatik iğne, epidural kan yaması, lomber ponksiyon, postdural ponksiyon baş ağrısı, spinal iğne

Received/Geliş tarihi : 14.07.2026
Accepted/Kabul tarihi : 12.10.2026
Publication date : 28.10.2026

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Cite as: Dogan AT, Kahyaoglu B, Cosarcan SK, Ercelen O, Erturk Accordino G. Reduction in epidural blood patch requirement after switching from 22G quincke to 26G atraumatic needles for lumbar puncture in adults: A 4-year single-centre experience. JARSS 2026;34(4):298-303.

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INTRODUCTION

Lumbar puncture (LP) is among the most frequently performed invasive procedures in clinical neurology, used for diagnostic cerebrospinal fluid (CSF) sampling, measurement of opening pressure, and the administration of intrathecal therapy (1). Post-dural puncture headache (PDPH) is its most common complication, attributed to persistent CSF leakage through the dural defect with consequent intracranial hypotension (2,3). Most cases resolve with conservative management; however, some are severe or prolonged and require epidural blood patch (EBP), an additional invasive procedure, while a minority persist and impair quality of life and work ability (2,4,5).

The two needle properties influence the risk of PDPH. Thinner needles produce smaller dural defects, and atraumatic (non-cutting) tips separate rather than transect the dural fibers (6,7). A Cochrane review of more than 17,000 patients reported that cutting (Quincke) needles were associated with approximately twice the risk of PDPH compared with atraumatic needles (relative risk 2.14, 95% confidence interval 1.72–2.67) (4). A subsequent meta-analysis found that atraumatic needles also reduced the need for EBP (relative risk 0.50, 95% confidence interval 0.33–0.75), with no difference in first-attempt success or number of attempts (8). A randomized trial showed that smaller-caliber atraumatic needles conferred further benefit, and in a network meta-analysis, the 26-gauge atraumatic needle ranked highest for both the avoidance of PDPH and procedural success (9,10). The use of atraumatic needles is endorsed by the American Academy of Neurology and by recent multisociety consensus guidelines (11,12).

Despite this evidence, cutting needles remain widely used for LP in neurologic practice, and atraumatic needles have been employed in a minority of procedures in several reported series (1,13,14). Data on the effect of changing needle type in routine practice remain useful, particularly when the comparison is not confounded by differences between operators (15). We reviewed consecutive adult LPs performed by a single neurologist over a 4-year period, spanning a transition from 22-gauge Quincke needle to a 26-gauge atraumatic needle, and compared the requirement for EBP before and after the change.

MATERIALS and METHODS

Study Design

This was a retrospective, single-centre, before-and-after observational study based on the retrospective analysis of routinely collected quality-improvement data. Reporting follows the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidance for observational studies (16).

Participants

We reviewed consecutive LPs performed in adult patients (age ≥18 years) by a single neurologist between January 2018 and January 2022. All LPs were included irrespective of indication (diagnostic CSF sampling, measurement of opening pressure, or administration of intrathecal therapy). Patients younger than 18 years were excluded because the epidemiology and management of PDPH differ in the pediatric population.

Needles and Outcome Measures

During the first period (period 1), all LPs were performed using a 22-gauge Quincke cutting-tip needle (B. Braun Melsungen AG, Melsungen, Germany). Following a department decision prompted by a perceived increase in EBP referrals, the same operator transitioned to a 26-gauge Atraucan needle, an atraumatic double-bevel design (B. Braun Melsungen AG, Melsungen, Germany), for all subsequent LPs (period 2). Because every procedure in both periods was performed by the same operator, inter-operator variability in technique and outcome ascertainment was minimized, and the change of needle was the intended difference between the two periods.

The primary outcome was the proportion of patients who required an EBP for PDPH that persisted despite conservative management, as described below. Epidural blood patch procedures were identified from pain-clinic records maintained independently of the LP records; therefore, the EBP case count was considered complete. Because LPs may be repeated in the same patient, the number of procedures exceeded the number of patients; we therefore report a patient-level rate (pre-specified primary analysis) and a procedure-level rate. For patients who required EBP but whose index LP was not recorded in the procedure log, a single LP was imputed and classified according to the documented indication. Patients who underwent at least one LP for intrathecal therapy were classified in the intrathecal therapy group.

Management of PDPH and Indication for EBP

No written protocol for the management of PDPH was in place; management followed institutional practice, and the same pain-clinic team applied the same approach in both periods. After LP, patients were advised bed rest and oral hydration. Patients who developed headache received analgesics, intravenous fluids, and continued bed rest. The diagnosis of PDPH was made clinically according to the criteria of the International Classification of Headache Disorders (17). Patients whose orthostatic headache persisted for more than 2 days despite these measures were referred to the pain clinic and offered EBP. No formal severity threshold was ap-

plied; restriction of daily activities was the main criterion, and accompanying symptoms such as diplopia or hearing disturbance were also taken into account. The EBP was performed by experienced anesthesiologists at or near the level of the preceding LP, aiming to inject at least 15 mL of autologous blood. Patients then remained in bed for 2 hours, were advised to limit mobilization on the first day, and continued analgesic treatment. A second EBP was offered to patients without marked improvement within 3 to 4 days of the first procedure.

Statistical Analysis

Categorical variables are presented as counts and percentages, and continuous variables as mean and range. Baseline characteristics were compared between periods using Fisher's exact test for categorical variables and the Mann–Whitney U test for age. The EBP rates were compared using Fisher's exact test, and odds ratios (OR) with 95% confidence intervals (CI) were calculated using the Woolf (logit) method. A two-sided p-value below 0.05 was considered statistically significant. Because of the small number of events, EBP rates within indication subgroups are reported descriptively without statistical comparison. A pre-specified sensitivity analysis added one patient who required EBP after a period-1 LP whose original record could not be retrieved. Analyses were performed using the IBM SPSS statistics software (IBM Corp., Armonk, NY, USA).

Ethics

The study was approved by the Koç University Institutional Review Board (approval number 2023.039.IRB1.009; date 26-01-2023). The requirement for individual informed consent was waived by the ethics committee because the study was based on the retrospective analysis of routinely collected quality-improvement data. The study was conducted in accordance with the Declaration of Helsinki.

RESULTS

A single neurologist performed LPs in 59 adult patients over the study period: 24 during period 1 (22-gauge Quincke needle; June 2018 to February 2021) and 35 during period 2 (26-gauge atraumatic needle; February 2021 to January 2022). These patients underwent a total of 97 LP procedures (27 in period 1 and 70 in period 2). Baseline characteristics are shown in Table I. The mean age was 47 (range, 18–80) years in period 1 and 56 (range, 19–91) years in period 2; the proportion of female patients was 50% and 31%, respectively. Twelve of 24 patients (50%) in period 1 and 15 of 35 (43%) in period 2 received intrathecal therapy, and diagnostic or pressure-measurement procedures accounted for 12 of 27 (44%) and 23 of 70 (33%) procedures, respectively. No statistically significant differences were found between the periods in age (p=0.125), sex (p=0.181), the proportion of patients receiving intrathecal therapy (p=0.607), or the distribution of indications at the procedure level (p=0.348).

At the patient level, EBP was required in six of 24 (25.0%) patients in period 1 compared with one of 35 patients (2.9%) in period 2 (OR 11.3, 95% CI 1.3–101.5; p=0.015) (Table II, Figure 1). At the procedure level, EBP was performed after 6 of 27 procedures (22.2%) in period 1 vs. 1 of 70 procedures (1.4%) in period 2 (OR 19.7, 95% CI 2.2–173.1; p=0.002). In the sensitivity analysis, in which one additional period-1 patient was included, the patient-level rate became seven of 25 (28.0%) vs. 1 of 35 (2.9%) (OR 13.2, 95% CI 1.5–116.0; p=0.007).

Among patients who underwent diagnostic LP only, EBP was required in four of 12 (33.3%) in period 1 and one of 20 (5.0%) in period 2; among those who received intrathecal therapy, it was required in two of 12 (16.7%) and none of 15, respectively. Among the seven patients who required EBP, the patch was repeated once in two patients because of incomplete symptom resolution; all patients ultimately experienced resolution of headache.

Table I. Baseline characteristics and procedure indications by period.

	Period 1 (22G Quincke)	Period 2 (26G atraumatic)
Patients, n	24	35
Study interval	Jun 2018 - Feb 2021	Feb 2021 - Jan 2022
Age, mean (range) (years)	47 (18-80)	56 (19-91)
Female, n (%)	12 (50)	11 (31)
Patients receiving intrathecal therapy, n (%)	12 (50)	15 (43)
LP procedures (n)	27	70
Diagnostic / pressure, n (%)	12 (44)	23 (33)
Intrathecal therapy, n (%)	15 (56)	47 (67)

LP: Lumbar puncture.
Between-period comparisons: age, p=0.125 (Mann–Whitney U test); female gender, p=0.181; patients receiving intrathecal therapy, p=0.607; distribution of procedure indications, p=0.348 (Fisher's exact test).

Table II. Epidural blood patch requirement by period.

Analysis	Period 1 (22G Quincke)	Period 2 (26G atraumatic)	OR (95% CI)	p
Patient-level (primary)	6/24 (25.0%)	1/35 (2.9%)	11.3 (1.3–101.5)	0.015
Procedure-level	6/27 (22.2%)	1/70 (1.4%)	19.7 (2.2–173.1)	0.002
Sensitivity (patient-level)*	7/25 (28.0%)	1/35 (2.9%)	13.2 (1.5–116.0)	0.007

*Includes one additional period-1 patient whose original LP record could not be retrieved. OR and 95% CI were calculated using the Woolf (logit) method; p values are from Fisher's exact test.
CI: Confidence interval, **EBP:** Epidural blood patch, **LP:** Lumbar puncture, **OR:** Odds ratio.

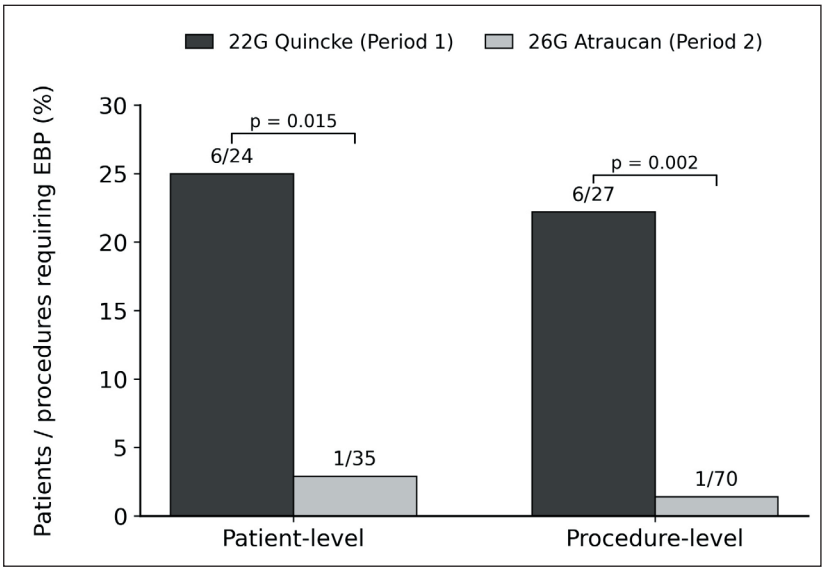


Figure 1. Proportion of patients and of procedures requiring epidural blood patch with the 22-gauge Quincke needle (Period 1) and the 26-gauge atraumatic needle (Period 2). Fractions above each bar show the number of events over the denominator.

DISCUSSION

Replacing the 22-gauge Quincke needle with a 26-gauge atraumatic needle was associated with a lower requirement for EBP in adult patients undergoing LP, from 25.0% to 2.9% at the patient level (p=0.015) and from 22.2% to 1.4% at the procedure level (p=0.002). Because all procedures in both periods were performed by the same neurologist, the comparison was less likely to be affected by inter-operator differences in technique or outcome ascertainment. The direction of this association is consistent with randomized and meta-analytic data showing that thinner, atraumatic needles reduce both PDPH and the need for EBP (4,8). However, the number of events was small, some patients underwent repeated procedures, and the two periods were not contemporaneous; the wide confidence intervals indicate that the magnitude of the association is imprecise, and the findings should be interpreted as an association rather than as evidence of a causal effect.

The risk of PDPH is determined largely by the size and nature of the dural defect. Thinner needles produce smaller defects, and atraumatic tips separate rather than transect the dural fibers, which favors more rapid closure (6,7). When the dural defect fails to seal, continued CSF leakage can produce intracranial hypotension, presenting with orthostatic headache and, in severe cases, cranial nerve palsy or subdural collections (18). Patient-related factors, including younger age, female sex, lower body mass index, and previous PDPH, also influence risk but are not modifiable by the operator (2). Needle selection is the principal determinant that the operator can modify, and a change of needle is therefore a plausible means of reducing the rate of severe PDPH and subsequent EBP.

Despite consistent evidence and guideline endorsement, atraumatic needles remain underused for diagnostic and therapeutic LP. Atraumatic needles were used in only 8% of procedures in a series of more than 6500 LPs from two university hospitals, and comparable rates have been reported elsewhere, with unfamiliarity, perceived difficulty, cost, and established habit cited as barriers (1,13,14). In anesthetic practice, by contrast, the influence of needle gauge and tip design on PDPH has long been recognized: audits and prac-

tice surveys of spinal anesthesia in Turkey indicate that thin, pencil-point (atraumatic) needles are in routine use and that needle selection is treated as a principal determinant of headache (19,20). The role of needle choice as the main modifiable determinant of PDPH is now widely accepted across specialties, and the present study illustrates its application by a neurologist to diagnostic and therapeutic LP. One frequent objection is slower CSF flow through a thinner needle. Cerebrospinal fluid collection time was not measured in this study; the procedural team's informal impression was that sampling took approximately 4 to 5 minutes with the 22-gauge needle and 15 to 20 minutes with the 26-gauge needle. This impression is in keeping with the gauge-dependent increase in collection time measured by van Dongen et al. and with the Hagen–Poiseuille relationship, in which flow is proportional to the fourth power of the internal radius, but it should be regarded as an anecdotal observation rather than a study findings (21). Such a difference may be relevant in high-volume settings but appears modest relative to the burden of severe PDPH and EBP. The transition required no change in technique, and no procedural failures attributable to the new needle were noted.

The needle change was introduced as a department-level quality-improvement measure rather than as part of a planned trial, after a perceived increase in EBP referrals, and the outcome was audited subsequently. A formal economic analysis was not performed; however, atraumatic needles, although more expensive per unit, have been associated with lower overall healthcare costs through a reduction in PDPH, EBP, and additional care (15,22,23). The single-operator design limits generalizability but reduces operator-related confounding.

Because the needle change altered gauge and tip design simultaneously, the contribution of each cannot be separated in the present study, and the reduction in EBP should not be attributed to the atraumatic tip alone. The size of the dural perforation is considered the principal determinant of PDPH, and the Atraucan needle is itself a hybrid design with a narrow cutting tip and an atraumatic bevel; part of the observed difference may therefore reflect the reduction from 22 to 26 gauge (2). Gauge alone appears to matter: in a before-and-after study in which the tip design was unchanged, switching from 20-gauge to 22-gauge Quincke needles was associated with a reduction in the proportion of patients requiring EBP from 11% to 3% (24). In a randomized trial of diagnostic LP, a 25-gauge atraumatic needle was associated with a lower PDPH rate than both a 22-gauge atraumatic needle (22.0% vs. 30.2%) and a 25-gauge cutting needle (22.0% vs. 32.8%), indicating that gauge and tip design each contribute (9). Similarly, van Dongen et al. found no difference in PDPH between 20-gauge cutting and 20-gauge atraumatic needles (32.9% vs. 33.3%), whereas the incidence was lower with a 22-gauge atraumatic needle (18.1%) (21). Taken together, these data suggest that a smaller gauge and an atraumatic tip both contribute to a lower risk and that their effects may be additive; the present findings reflect the combined effect of both changes.

This study has several limitations. It is retrospective and single-centre, with a modest sample size and few EBP events; the confidence intervals around the effect estimates are therefore wide, and the magnitude of benefit should be interpreted with caution. Some patients underwent repeated procedures, so procedure-level observations were not independent, and the procedure-level analysis should be regarded as supplementary. The two periods differed in length and were not contemporaneous, allowing for temporal confounding. Although the differences were not statistically significant, patients in period 2 were older and more often male, both factors associated with lower PDPH risk; some of the observed reduction may therefore reflect differences in case mix rather than needle type alone. Management of PDPH and the indication for EBP followed institutional practice rather than a written protocol, and no formal severity threshold was used, although the same pain-clinic team applied the same approach in both periods. The endpoint, EBP requirement, captures only severe PDPH; milder headaches managed conservatively were not recorded, so the true incidence of PDPH was higher than reported in both periods. Some early LP records could not be retrieved; this was addressed through a sensitivity analysis and conservative imputation. The strength of the study is the single-operator design, which removes the inter-operator variability that confounds most before-and-after comparisons.

CONCLUSION

In adult patients undergoing LP by a single operator, a change from a 22-gauge Quincke to a 26-gauge atraumatic needle was associated with a lower EBP requirement. Given the retrospective before-and-after design, the small number of events, and possible temporal and case-mix confounding, this association should not be interpreted as evidence of a causal effect. Nevertheless, the findings are consistent with existing evidence and add real-world support for the use of small-gauge atraumatic needles in diagnostic and therapeutic LP, including repeated procedures. Where slower CSF flow is a practical constraint, it can be anticipated rather than treated as a reason to use a cutting needle. Larger, multicentre prospective studies would help confirm the magnitude of benefit.

ACKNOWLEDGEMENT

The authors declare no conflict of interest. No financial or material support was received for this study. An artificial intelligence tool (Claude, Anthropic; model Claude Opus 4.8) was used for language editing, drafting, structuring of the manuscript, and preparation of the figure; the authors reviewed and verified all content and took full responsibility for the manuscript.

AUTHOR CONTRIBUTIONS

Study concept-desing: ATD, SKC, OE, BK
Data collection: ATD, GEA
Data analysis and interpretation: ATD, BK
Manuscript draft: ATD, SKC, BK, GEA
Critical review of content: ATD, SKC, BK, OE
Other (study supervision, fundings, materials, etc): ATD, BK, GEA
The authors (ATD, BK, SKC, OE, GEA) reviewed the results and approved the final version of the manuscript.

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