

Effect of Gabapentin vs Pregabalin on Pain Intensity in Adults With Chronic Sciatica

A Randomized Clinical Trial

Kelvin Robertson, BPharm, MClintRes; Laurence A. G. Marshman, MBBS, MD; David Plummer, MBBS, PhD; Elena Downs, MBBS

 Supplemental content

IMPORTANCE Optimal pharmacologic treatment for **chronic sciatica (CS)** is currently unclear. While **gabapentin (GBP)** and **pregabalin (PGB)** are both used to treat CS, equipoise exists. Nevertheless, pharmaceutical regulation authorities typically subsidize one drug over the other. This hinders interchange wherever the favored drug is either ineffective or ill-tolerated.

OBJECTIVE To assess GBP vs PGB head to head for the treatment of CS.

DESIGN, SETTING, AND PARTICIPANTS A preplanned interim analysis of a randomized, double-blind, double-dummy crossover trial of PGB vs GBP for management of CS at half the estimated final sample size was performed in a single-center, tertiary referral public hospital. A total of **20 patients** underwent randomization from March 2016 to March 2018, and 2 were excluded with 1 lost to follow-up and the other requiring urgent surgery unrelated to the study. Patients attending a specialist neurosurgery clinic with unilateral CS were considered for trial recruitment. **Chronic sciatica** was defined as **pain lasting for at least 3 months** radiating into 1 leg only to, at, or below the knee level. Imaging (**magnetic resonance imaging with or without computed tomography**) corroborating a root-level lesion concordant with **symptoms and/or signs** was determined by the trial clinician. Inclusion criteria included patients who had not used GBP and PGB and were 18 years or older. Analyses were intention to treat and began February 2018.

INTERVENTIONS Randomly assigned participants received GBP (400 mg to 800 mg 3 times a day) then PGB (150 mg to 300 mg twice daily) or vice versa, each taken for 8 weeks. Crossover followed a 1-week washout.

MAIN OUTCOMES AND MEASURES The primary outcome was **pain intensity (10-point visual analog scale)** at baseline and 8 weeks. **Secondary** outcomes included **disability** (using the **Oswestry Disability Index**) and severity/frequency of adverse events.

RESULTS The total trial population (N = 18) consisted mostly of men (11 [61%]) with a mean (SD) **age of 57** (16.5) years. A third of the cohort were smokers (5 [28%]), and more than half consumed alcohol (12 [67%]). **Gabapentin was superior to PGB**, with **fewer** and **less severe adverse events**. **Both** GBP (mean [SD], 7.54 [1.39] to 5.82 [1.72]; $P < .001$) and PGB (mean [SD], 7.33 [1.30] to 6.38 [1.88]; $P = .002$) displayed **significant visual analog pain intensity scale reduction** and **Oswestry Disability Index reduction** (mean [SD], 59.22 [16.88] to 48.54 [15.52]; $P < .001$ for both). Head to head, **GBP showed superior visual analog pain intensity scale reduction** (mean [SD], GBP: 1.72 [1.17] vs PGB: 0.94 [1.09]; $P = .035$) irrespective of sequence order; however, Oswestry Disability Index reduction was unchanged. **Adverse events for PGB were more frequent** (PGB, 31 [81%] vs GBP, 7 [19%]; $P = .002$) especially when PGB was taken first.

CONCLUSIONS AND RELEVANCE Pregabalin and GBP were both significantly efficacious. However, **GBP was superior with fewer and less severe adverse events**. **Gabapentin should be commenced before PGB** to permit optimal crossover of medicines.

TRIAL REGISTRATION anzctr.org.au Identifier: [ACTRN12613000559718](https://anzctr.org.au/cttrdetails.aspx?cttrid=12613000559718)

JAMA Neurol. 2019;76(1):28-34. doi:[10.1001/jamaneurol.2018.3077](https://doi.org/10.1001/jamaneurol.2018.3077)
Published online October 15, 2018. Corrected on December 3, 2018.

Author Affiliations: Department of Pharmacy, Medical Services Group, The Townsville Hospital, Douglas, Townsville, Queensland, Australia (Robertson); College of Medicine and Dentistry, James Cook University, Douglas, Townsville, Queensland, Australia. (Robertson, Marshman); Department of Neurosurgery, Institute of Surgery, The Townsville Hospital, Douglas, Townsville, Queensland, Australia (Robertson, Marshman, Downs); Public Health & Topical Medicine, James Cook University, Douglas, Townsville, Queensland, Australia (Plummer).

Corresponding Author: Kelvin Robertson, BPharm, MClintRes, Department of Pharmacy, Medical Services Group, The Townsville Hospital, Douglas, Townsville 4810, Queensland, Australia (kelvin.robertson@health.qld.gov.au).

jamaneurology.com

Chronic sciatica (CS), like most neuropathic pain states, is often resistant to simple treatment regimens.^{1,2} Chronic sciatica is sciatica lasting longer than 3 months.³ Neuropathic pain states are typically managed by super-adding anticonvulsant drugs onto simple drug regimens. The drugs most commonly used are gabapentin (GBP) or pregabalin (PGB). Chronic sciatica has therefore been increasingly treated with super-added GBP or PGB.^{1,2,4} Pregabalin and GBP are both analogs of γ -aminobutyric acid, a substance known to modulate calcium channel subunits. Both GBP and PGB may therefore possibly act by decreasing neurotransmitter release associated with central sensitization in CS and neuropathic pain.

Optimal pharmacological treatment for CS is unclear. In particular, the precise role of the 2 principal drugs, PGB or GBP, in treating CS has been surprisingly underexplored.⁵

Thus, while GBP and PGB are both currently used to treat CS, a position of equipoise appears to exist regarding which to choose.⁶ Notwithstanding, pharmaceutical regulation authorities across different countries typically subsidize one drug over the other. This hinders interchange wherever the favored drug is either ineffective or not tolerated. Paradoxically, in many countries, the drug favored for subsidy has actually been the more expensive regardless of whether PGB or GBP was chosen.⁶

In 2017, a prospective randomized placebo-controlled clinical trial demonstrated a null effect for PGB in treating sciatica.⁷ However, this study included patients recruited from multiple sources who experienced acute sciatica and CS; subgroup analysis specifically targeting CS was not performed.⁷ Perhaps more importantly, no adequately powered direct head-to-head study, which would compare PGB with any drug (including GBP), exists, to our knowledge.

Our study therefore represents the first prospective randomized cohort of patients with CS to comprehensively assess the head-to-head efficacy of PGB and GBP, the associated frequency and severity of adverse events (AEs), and the impact of PGB-GBP interchange.

Methods

Trial Design and Oversight

The study design used was a prospective, single-center, double-blind, randomized, double-dummy, crossover in patients with CS (Figure). The trial was conducted in accordance with the Standard Protocol Items: Recommendations for Interventional Trials statement and procedures following Good Clinical Practice principles.⁸ The trial protocol has been published previously⁹ and is available in open-access full text and in Supplement 1. The statistical analyses plan is available in Supplement 2. Ethics approval was by the Townsville Hospital and Health Service Human Research Ethics Committee. The trial was initiated by the investigators and funded by an internal hospital grant. No drug company had any involvement in drug supply, trial conduct, or manuscript review. Written informed consent was obtained before any procedures took place.

Key Points

Question Is gabapentin or pregabalin the more optimal pharmacological treatment for chronic sciatica?

Findings This randomized clinical trial of pregabalin vs gabapentin in 18 patients with chronic sciatica found that gabapentin was superior to pregabalin with greater reduction of leg pain intensity and fewer adverse events.

Meaning Gabapentin was superior to pregabalin and should be commenced before pregabalin to permit optimal crossover of medicines.

Eligibility and Recruitment

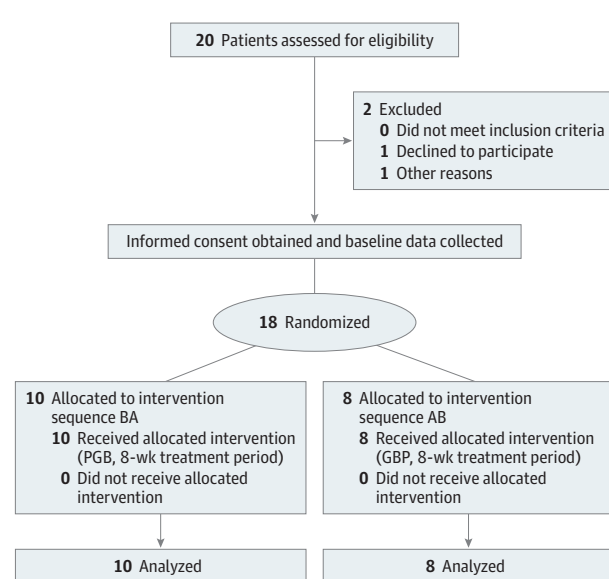
Patients with unilateral CS attending a specialist neurosurgery clinic in a large tertiary hospital were considered for trial recruitment. Chronic sciatica was defined as pain lasting for at least 3 months³ radiating into 1 leg only to, at, or below the knee level. Imaging (magnetic resonance imaging with or without computed tomography) corroborating a root-level lesion concordant with symptoms and/or signs was determined by the trial clinician (L.A.G.M.). Inclusion criteria also included patients who had not used GBP and PGB, patients 18 years or older, and patients with a sufficient understanding of English (or an available appropriate interpreting service) to complete the study treatments and assessments. Concomitant medications (including analgesics) could be continued if the dose was stable 30 days prior to the start of the study. No more than 2 dose modifications were permitted throughout the study.

Patients were excluded from the trial if they were pregnant, breastfeeding, or women planning conception during the study; had a history or diagnostic results that suggested an inherited neuropathy or neuropathy attributable to other causes (hypothyroidism, B₁₂ deficiency, connective tissue disease, amyloidosis, toxic exposure); had a major organ system disease; had cardiovascular autonomic neuropathy; had baseline postural hypotension of more than 20 mm Hg; had specific contraindications to PGB or GBP (allergy to or significant renal impairment); had cancer, dementia, severe mental illness, or other condition that would significantly reduce their ability to consent and/or fully undertake the program; and were unlikely to comply with study procedures (eg, those with high opiate/opioid tolerance, inconsistent clinic attendances). Because PGB and GBP are predominantly renally excreted, patients with an estimated creatinine clearance of less than 60 mL per minute were also excluded.

Randomization and Blinding

The trial pharmacist (K.R.) (unblinded/independent) generated the randomization code using a computer-derived permuted block with varying block size sequence. Manufacturing and preparation of the medication capsules was performed by an external Good Manufacturing Practice-accredited facility. The unblinded pharmacist was involved in preparing medication kits according to the trial randomization schedule. Treatment was allocated according to a 2 × 2 sequential design in which participants received PGB first, then subsequently GBP

Figure. CONSORT Flow Diagram



Sequence AB is gabapentin (GBP) followed by pregabalin (PGB).
Sequence BA is PGB followed by GBP.

(or vice versa) in a double-blinded fashion. Owing to the variability in regular dosage frequency between the medications (PGB, twice daily and GBP, thrice daily) study medication packs contained 3 bottles, 1 for each dosage time (morning, lunch, and night) to maintain blinding. Medication packs for the PGB arm had a placebo incorporated as the lunch time dose such that both drug regimens were indistinguishable. The randomization schedule remained concealed from other researchers. The randomization process ensured concealed allocation and blinding of the specialist, the participant, and the outcome assessor during recruitment, data collection, and analysis.

Trial Regimen and Procedures

All patients were fully informed of the possible types of AEs associated with either GBP or PGB, as listed in the Australian Medicines Handbook,¹⁰ prior to participation. Participants were randomized to commence treatment on either PGB or GBP. Because of the crossover design, participants had the unique opportunity to experience both PGB and GBP in succession. Because of the 1-week washout period, carryover effects (medium or long term) were considered improbable. Participants received standard neurosurgical care independent of and parallel to the trial.

The starting dose of PGB was 150 mg once daily for the first week. This was titrated to the participant's optimal dose, up to a maximum of 300 mg twice daily, depending on their progress and tolerance at each dose level. The starting dose for GBP was 400 mg once daily for the first week. Likewise, this drug was titrated to the participant's optimal dose, up to a maximum of 800 mg thrice daily, depending on their progress and tolerance at each dose level. These doses are based on national recommendations from the Australian Medicines Handbook.¹¹ In the standard study dosing regimen, there was

a 4-week titration period, after which the maximum tolerated dose for each participant was maintained for 4 weeks before the first study medication was ceased for washout. The washout period between treatment phases lasted for 1 week; this was deemed sufficient for these medications since they both possess a short half-life (5–7 hours). The dosage of either PGB or GBP could be amended at any stage in the trial based on efficacy and/or AE by communication between the study specialist and the study pharmacist. The maximum treatment period was 8 weeks for each medication.¹⁰

Participants could continue concomitant medications (including analgesics) throughout the study, given the stipulations stated above. Such concomitant medications were closely monitored and recorded as part of the case report form. This practice is entirely consistent with National Institute for Health and Care Excellence-UK guidelines, which state that, when super-adding second-line agents for analgesic control (such as GBP and PGB), “overlap with first-line agents is encouraged to avoid decreased pain-control.”¹² To our knowledge, only 1 prospective cohort study has reflected this practice with GBP in CS.¹³ However, participants did not take concomitant medications that were contraindicated because of a known interaction with PGB or GBP.¹¹ No other pain interventions were permitted throughout the study; if considered necessary, such patients were withdrawn from the trial.

Outcomes and Data Collection

The primary outcome was leg pain intensity using the visual analog scale (VAS). Participants were asked to rate their average leg pain during the last 24 hours out of 10, with 0 representing no leg pain and 10 representing the worst pain imaginable.⁴ A clinically important minimum difference of 1.5 points was chosen based on previous literature.¹⁴

The key secondary outcome was the Oswestry Disability Index (ODI) questionnaire⁴ to assess disability in which scores range from 0 to 100, with higher scores indicating greater disability. The clinically important difference is represented by 10 points.¹⁵

Details of AEs were collected throughout the course of the trial and were noted as a description including a score of 0 to 10 for frequency and severity, whereby an increasing number denotes a higher frequency or severity. Outcomes were assessed at baseline, then at weeks 4, 8, 10, 14, and 18. Baseline and weeks 8, 10, and 18 were considered the primary times for the primary outcome that represented the start and finish of each medication.

Data collection was conducted by the study researchers from telephone, email, or online. Week 10 data collection served as the crossover secondary baseline for the purpose of analysis. Data were entered into case report forms by dedicated trained staff. Adherence to study medication was documented through a self-reported daily medication diary and by counting the returned medicine.

Statistical Analysis

It was estimated that a sample of 38 patients would be required to provide the trial with 80% power to detect a conservative minimum between-treatment difference of 0.9 points in the pain score on the 10-point scale at weeks 8 and 18 and to detect a clinically important between-treatment differ-

ence of 10 points on the ODI at the same assessment interval. These assumptions included an SD of the difference between the 2 same values for the same patient of 1.2 points (given a crossover study design) and a 2-sided α level of .05. The estimated sample size would also allow for a dropout rate of 20%.

As a result of our study representing the first head-to-head trial between PGB and GBP to our knowledge, an interim analysis was planned at 50% sample size to assess AEs and efficacy and to confirm trial viability. No formal stopping rules were used owing to the lack of previous head-to-head data enabling the presetting of boundaries. Instead, the investigators and independent trial monitor would make a judgment based on AEs and outcomes in the primary measure. Missing data were handled by a single imputation method whereby the last observation is carried forward and used as a surrogate for the missing value. This is the favored approach for replacing missing data as it is conservative, yields an appropriate estimate of variation in outcome, and is unlikely to bias toward the alternative hypothesis.¹⁶

Data were deidentified prior to interim statistical analysis and performed on an intention-to-treat basis. Unadjusted means (SDs) were calculated and presented for descriptive statistics of the population. Normality of data distribution was assessed, and the appropriate t tests performed for between-groups differences including repeated measures linear models. Binary variables were tested using χ^2 analysis. Statistical significance was set at a 2-sided P value of less than .05. The frequency and severity of AEs were reported descriptively with calculated mean (SD) based on unadjusted mean scores of patients. Data imputations were not required because less than 5% of the primary outcome data were missing. Analyses were performed using both Excel (Microsoft Inc) and SPSS statistical software version 22 (IBM Inc).

Results

Twenty participants underwent randomization from March 2016 to March 2018. This equated to 40 drug and patient episodes. Two patients were excluded. Ten patients were allocated to receive GBP followed by PGB, and 10 patients received PGB followed by GBP (Figure). After randomization, 2 patients were excluded from analysis. Both dropouts had been randomized to the GBP-then-PGB sequence. One patient did not collect study medication and was subsequently lost to follow-up. Each participant reached maximal dosing for the medications with less than 10% requiring any dose reductions (either temporary or permanent).

The total trial population ($N = 18$) experienced efficacy in VAS reduction and ODI reduction with the medication regimens. Two-thirds (12 [67%]) of the population reported at least 2 AEs while in the trial. More than half of the population (10 [55.6%]) were taking concomitant acetaminophen alone or in combination with codeine, while one-third (6 [33%]) of the population were stable taking a background opioid before and during the trial (Table 1).

Efficacy

At the end of an 8-week treatment period, a significant pain intensity VAS reduction was recorded for GBP (mean [SD],

Table 1. Patient Characteristics of the Total Study Population

Description	No. (%)
Total population	18 (100)
Age, mean (SD), y	57 (16.5)
Smokers	5 (28)
Alcohol intake	12 (67)
Men	11 (61) ^a
Women	7 (39)
Adverse events	12 (67)
Efficacy	18 (100)
Concomitant medications	
Nonsteroidal anti-inflammatory drug	3 (17)
Acetaminophen (\pm codeine)	10 (56)
Opioid	6 (33)
Antiepileptic/anticonvulsant	1 (5)

^a $P = .23$.

Table 2. Efficacy for Total Population^a

Variable	Mean (SD)	P Value
GBP		
VAS		
Start	7.54 (1.39)	
Finish	5.82 (1.72)	<.001
ODI		
Start	59.22 (16.88)	
Finish	48.54 (15.52)	<.001
PGB		
VAS		
Start	7.33 (1.30)	
Finish	6.38 (1.88)	.002
ODI		
Start	59.22 (13.24)	
Finish	50.44 (16.58)	<.001
Head to Head		
VAS, difference		
GBP	1.72 (1.17)	
PGB	0.94 (1.09)	.035
ODI, difference		
GBP	10.66 (9.90)	
PGB	8.78 (8.86)	.63

Abbreviations: GBP, gabapentin; ODI, Oswestry Disability Index; PGB, pregabalin; VAS, visual analog scale.

^a Efficacy defined as reduction in VAS and/or ODI from both PGB and GBP.

7.54 [1.39] to 5.82 [1.72]; $P < .001$) and PGB (mean [SD], 7.33 [1.30] to 6.38 [1.88]; $P = .002$) (Table 2). A significant ODI reduction was also observed at 8 weeks for GBP (mean [SD], 59.22 [16.88] to 48.54 [15.52]; $P < .001$) and PGB (mean [SD], 59.22 [13.24] to 50.44 [16.58]; $P < .001$) (Table 2).

When unadjusted mean differences in pain intensity VAS reduction were compared head to head, GBP proved superior (mean [SD], GBP: 1.72 [1.17] vs PGB: 0.94 [1.09]; $P = .035$) (Table 2). However, when unadjusted mean differences in ODI

Table 3. Adverse Events Experienced by Population^{a,b,c}

Description	Prevalence, No. (%)	Population With Adverse Event, %
Pregabalin (n = 31)		
Nausea, vomiting, headache	7 (22.6)	39
Bowel disturbance	5 (16.1)	28
Diplopia, dysarthria	5 (16.1)	28
Dizziness, vertigo	4 (12.9)	23
Drowsy, sedation	3 (9.7)	17
Lethargy, numbness	2 (6.5)	11
Dry mouth	1 (3.2)	6
Alertness	1 (3.2)	6
Weight gain	1 (3.2)	6
Erectile dysfunction	1 (3.2)	6
Psychiatric disturbance	1 (3.2)	6
Gabapentin (n = 7)		
Drowsy, sedation	3 (42.9)	17
Dizziness, vertigo	2 (28.6)	11
Nausea, vomiting, headache	1 (14.3)	6
Alertness	1 (14.3)	6

^a Frequency and severity measured on a scale of 1 to 10 with 10 being the worst possible score.

^b The same participant may have experienced multiple adverse events of different descriptions.

^c Gabapentin count was 7, and pregabalin count was 31 ($P = .002$).

reduction were compared head to head, no significant difference was found (mean [SD], GBP: 10.66 [9.90] vs PGB: 8.78 [8.86]; $P = .63$) (Table 2).

Adverse Events

Thirty-eight AEs (21 types) were reported in 12 of 18 patients (67%) at some stage in the study. The most common AEs overall were dizziness (5 [13%]), drowsiness (5 [13%]), and nausea (4 [11%]). There were significantly more AEs associated with the PGB arm than with GBP (31 [81%] vs 7 [19%], $P = .002$) (Table 3 and Table 4).

When the per-patient-recorded AEs were clustered based on body system affected into central nervous system, respiratory, gastrointestinal, and genitourinary, both GBP and PGB demonstrated predominantly central nervous system AEs (eTable 1 in Supplement 3). However, PGB was associated with more severe central nervous system AEs than GBP (mean [SD] severity: GBP, 4.57 [2.07] vs PGB, 6.35 [1.32]; $P = .01$) (eTable 1 in Supplement 3).

Interchangeability

A total of 8 patients completed the GBP-then-PGB sequence, while 10 patients completed the PGB-then-GBP sequence (Table 4). Table 4 shows that GBP demonstrated superior efficacy in VAS reduction irrespective of the sequence order. Specifically, in the GBP-then-PGB sequence, there was a significantly greater mean VAS reduction associated with GBP than with PGB (mean [SD], GBP: 1.35 [0.81] vs PGB: 0.33 [0.22]; $P < .01$). Likewise, in the PGB-then-GBP sequence, there was a significantly greater mean VAS reduction with GBP (mean [SD], PGB: 1.43 [1.28] vs GBP: 2.01 [1.37]; $P = .01$).

However, ODI severity was not significant by crossover (Table 4). Notably, both PGB and GBP demonstrated a clinically important mean ODI reduction at the start of treatment (mean [SD], PGB: 12.4 [9.83] and GBP: 11.25 [9.32]), with only the PGB-then-GBP sequence continuing the trend of a mean clinically important result solely for GBP (mean [SD], PGB: 4.25 [4.95] and GBP: 10.20 [10.85]).

eTable 2 in Supplement 3 shows that sequence order affected AEs only with PGB. Thus, while GBP AEs occurred at similar frequency irrespective of sequence order, PGB AEs were significantly affected by sequence order. Specifically, PGB AEs were doubled when PGB was prescribed first. Thus, there were 3 AEs for GBP and 21 for PGB in the PGB-then-GBP sequence compared with 4 for GBP and 10 for PGB in the GBP-then-PGB sequence.

Reduced ODI Efficacy in Those With AE

eTable 2 in Supplement 3 shows that AEs specifically tended to affect ODI severity only with GBP. Specifically, efficacy was significantly less in those with AEs (GBP mean ODI reduction: with AEs, 9.33 [10.10] vs without AEs, 13.33 [9.85]; $P = .04$; eTable 2 in Supplement 3).

Discussion

The clinical trial protocol required the independent data monitor to review data after 50% of participants were recruited. The predetermined criteria for stopping the trial was a significant difference in recurrence rates or incidence of AEs between groups. Simultaneously, the trial would have considered to be stopped if any superiority was observed between the medications. After consultation in March 2018, the independent data monitor made a recommendation to the investigators that stopping the trial early was justified.

This predetermined interim analysis of this randomized clinical trial showed that while PGB and GBP were both significantly efficacious in reducing pain intensity in patients with CS, GBP was superior when compared head to head. Moreover, GBP was associated with fewer and less severe AEs irrespective of the sequence order. However, while PGB and GBP were both significantly efficacious in reducing pain-associated disability (using ODI), neither were superior when compared head to head.

This clinical trial was adequately powered to detect a conservative difference between medications of 0.9 of 10 on the pain intensity score. We acknowledge the current clinically important treatment effect of 1.5 of 10 for pain intensity and 10 of 100 for disability severity. Our results showed that GBP was the only medication to show a clinically important difference in VAS reduction (mean [SD], 1.72 [1.17]) and ODI reduction (mean [SD], 10.66 [9.90]). Compliance with the medication regimen was high based on patient diaries and pill containers returned at each visit. Our selection criteria were based on an established definition of CS with 1 specialist neurosurgeon involved in screening and recruitment for consistency. The dose of the medications were adjusted using an increasing titration schedule with AE monitoring according to National Formulary recommendations.¹¹

Table 4. Interchangeability of GBP and PGB

Description	GBP to PGB	PGB to GBP	P Value
Patients, No.	8	10	NA
Adverse events, No.			
Drug 1	3	21	NA
Drug 2	10	4	NA
VAS, mean reduction (range)			
Drug 1	1.35 (0.5-2.9)	1.43 (0.1-4.2)	.62
Drug 2	0.33 (0.0-0.7)	2.01 (0.6-5.5)	.01
P value	<.01	.34	NA
ODI, mean reduction (range)			
Drug 1	11.25 (0-30)	12.4 (2-28)	.31
Drug 2	4.25 (0-12)	10.2 (0-30)	.24
P value	.14	.36	NA

Abbreviations: GBP, gabapentin; NA, not applicable; ODI, Oswestry Disability Index; PGB, pregabalin; VAS, visual analog scale.

The crossover method chosen for this trial provides many advantages and particularly strengthens the study findings. In clinical trials, a crossover design should be limited to a disease that is long-term and stable and for which treatments should not result in a total cure but, instead, only alleviate the condition. Chronic sciatica and treatment with either PGB or GBP satisfied both these criteria, particularly considering that PGB and GBP are currently considered equivalent. This clinical trial therefore achieves a more efficient comparison of treatments than is possible with a parallel trial design. Any potential disadvantage relating to a carryover effect between medications in sequence was obviated by having set the washout period to more than 6 half-lives of either PGB or GBP (effectively, 1 week).

Notably, this study showed that PGB AEs were more frequent and severe when PGB was taken prior to GBP. This suggests that GBP may in some way sensitize tissues such that, despite subsequent washout, tolerance to PGB AEs was significantly enhanced. If so, then putative PGB-induced sensitization did not appear to affect tissue tolerance to GBP; GBP AEs were significantly lower irrespective of sequence order. Given these findings, this study suggests that GBP should be commenced before PGB to permit optimal crossover whenever PGB may ultimately be warranted.

Limitations

There are limitations of this study. The low recruitment frequency reflects the difficulty associated with recruiting pa-

tients with CS who have not already been prescribed either PGB or GBP by practitioners in primary or tertiary care. Another limitation is the effects of treatment duration. The duration of the study for each participant is 8 weeks. In some rare cases, this might be considered insufficient time to test efficacy at the optimum dose.⁴ Also, given the restricted doses and study time available in this study, it was not possible to introduce either drug in low and slow fashion. Because the latter potentially offsets the development of AEs,⁴ this clinical trial may therefore potentially overestimate AEs with either drug. Moreover, the maximal dose of GBP prespecified in the study design is lower than what can be prescribed and was compared with the maximal dose of PGB. Last, maintenance of background therapies including prior analgesia is a limitation. This may affect both efficacy and AE development, potentially increasing both. However, this practice is entirely consistent with National Institute for Health and Care Excellence—UK guidelines^{4,12} and, indeed, standard clinical practice.

Conclusions

Pregabalin and GBP were both significantly efficacious. However, GBP was superior to PGB in reducing pain intensity and was associated with fewer and less severe AEs. Gabapentin should be commenced before PGB to permit optimal crossover.

ARTICLE INFORMATION

Accepted for Publication: July 9, 2018.

Published Online: October 15, 2018.
doi:10.1001/jamaneurol.2018.3077

Correction: This article was corrected on December 3, 2018, to fix an error in the Results section of the Abstract.

Author Contributions: Mr Robertson and Dr Marshman had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Robertson, Marshman, Plummer.
Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: All authors.
Critical revision of the manuscript for important intellectual content: Robertson, Marshman, Plummer.
Statistical analysis: Robertson.
Obtained funding: Robertson, Marshman.
Administrative, technical, or material support: Robertson, Marshman, Downs.
Supervision: Marshman, Plummer.

Conflict of Interest Disclosures: None reported.

Funding/Support: Funding for the trial was supplied by an internal grant received from the Townsville Hospital's Study, Research and Education Trust Account.

Role of the Funder/Sponsor: The funds were used to purchase consumables. The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

REFERENCES

1. Konstantinou K, Dunn KM. Sciatica: review of epidemiological studies and prevalence estimates. *Spine (Phila Pa 1976)*. 2008;33(22):2464-2472. doi:10.1097/BRS.0b013e318183a4a2
2. Pinto RZ, Maher CG, Ferreira ML, et al. Drugs for relief of pain in patients with sciatica: systematic

- review and meta-analysis. *BMJ*. 2012;344(e497):e497. doi:10.1136/bmj.e497
3. Cedraschi C, Robert J, Goerg D, Perrin E, Fischer W, Vischer TL. Is chronic non-specific low back pain chronic? definitions of a problem and problems of a definition. *Br J Gen Pract*. 1999;49(442):358-362.
4. Robertson KL, Marshman LA. Gabapentin superadded to a pre-existent regime containing amitriptyline for chronic sciatica. *Pain Med*. 2016;17(11):2095-2099. doi:10.1093/pm/pnw052
5. Chou R. Treating sciatica in the face of poor evidence. *BMJ*. 2012;344(e487):e487. doi:10.1136/bmj.e487
6. Robertson K, Marshman LA, Plummer D. Pregabalin and gabapentin for the treatment of sciatica. *J Clin Neurosci*. 2016;26:1-7. doi:10.1016/j.jocn.2015.05.061
7. Mathieson S, Maher CG, McLachlan AJ, et al. Trial of pregabalin for acute and chronic sciatica. *N Engl J Med*. 2017;376(12):1111-1120. doi:10.1056/NEJMoa1614292
8. Chan AW, Tetzlaff JM, Gøtzsche PC, et al. SPIRIT 2013 explanation and elaboration: guidance for protocols of clinical trials. *BMJ*. 2013;346(e7586):e7586. doi:10.1136/bmj.e7586
9. Robertson K, Marshman LAG, Hennessy M, Harriss L, Plummer D. Pregabalin versus gabapentin in the treatment of sciatica: study protocol for a randomised, double-blind, cross-over trial (PAGPROS). *Trials*. 2018;19(1):21. doi:10.1186/s13063-017-2400-y
10. About eTG complete. Therapeutic Guidelines <https://tgldcdp.tg.org.au/index>. Accessed September 5, 2018.
11. Australian Medicines Handbook 2014. <https://www.bookdepository.com/Australian-Medicines-Handbook-2014-Simone-Rossi/9780987550125>. Accessed September 5, 2018.
12. Neuropathic pain in adults: pharmacological management in non-specialist settings. National Institute for Health and Care Excellence. <https://www.nice.org.uk/guidance/cg173>. Accessed September 5, 2018.
13. Dworkin RH, O'Connor AB, Backonja M, et al. Pharmacologic management of neuropathic pain: evidence-based recommendations. *Pain*. 2007;132(3):237-251. doi:10.1016/j.pain.2007.08.033
14. Kelly AM. The minimum clinically significant difference in visual analogue scale pain score does not differ with severity of pain. *Emerg Med J*. 2001;18(3):205-207. doi:10.1136/emj.18.3.205
15. Ostelo RW, de Vet HC. Clinically important outcomes in low back pain. *Best Pract Res Clin Rheumatol*. 2005;19(4):593-607. doi:10.1016/j.berh.2005.03.003
16. Committee for Medicinal Products for Human Use. Guideline on Missing Data in Confirmatory Clinical Trials London: European Medicines Agency. http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2010/09/WC500096793.pdf. Accessed September 5, 2018.