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Abstract

Introduction: Postoperative pain in spine surgery is an issue. Erector Spinae Plane Block (ESPB) may reduce such postoperative pain, but its usefulness has never been evaluated in the specific context of trauma surgery. We thus studied the effect of bilateral ultrasound-guided ESPB on postoperative pain and opioid requirement after percutaneous lumbar arthrodesis for trauma.

Methods: All patients who underwent percutaneous lumbar arthrodesis for spine trauma between December 2019 and March 2020 were retrospectively studied. Some patients received preoperative bilateral ESPB (30 mL of 0.375% ropivacaïne on each side) (ESPB group), other received the standard of care (i.e. postoperative muscular infiltration with 30 mL of 0,75% of ropivacaine) (control group), according to the anesthesiologist's preference in charge of the patient. The rest of the management was identical in all patients. The primary outcome was the cumulative morphine consumption at 24 hours postoperatively. Secondary outcomes included pain score at various time points until 24 hours.

Results: 55 patients were included, of whom 24 received an EPSB and 31 standard of care. The cumulative morphine consumption (mean [SD]) at 24 hours was 13 (12) mg in the ESPB group, and 35 (17) mg in the control group ($p<0.001$). Pain scores were significantly lower in the ESPB group compared with the control group up to 9 hours after surgery ($p<0.01$).

Conclusion: In this pilot study, compared with standard analgesia, ESPB reduced opioid requirement and postoperative pain after percutaneous lumbar arthrodesis for trauma. A randomized controlled trial is required to prove this effectiveness.

Key words: erector spinae plane block; spine trauma; lumbar arthrodesis; analgesia; postoperative pain

Ethics approval: The research protocol was also submitted to the ethics committee of the French Society of Anesthesia and Intensive Care (SFAR), which approved the research without further declaration (IRB-00010254-2020-107).

Introduction

Trauma spinal surgery is a common surgery. Postoperative pain has been reduced with the advent of minimally invasive techniques, such as percutaneous spinal arthrodesis [1–3]. However, immediate postoperative pain remains relatively high, especially due to muscle pain following trauma.

The erector spinae plane block (ESPB) is a technique first described in 2016 [4]. Erector muscles of the spine consist of a group of three muscles (iliocostalis, longissimus and spinalis) located on the deep side of the back. Separated at the cranial part of the back, they join to form a common mass at the level of the sacrum. They allow the extension of spine in a symmetrical contraction. At the upper thoracic level, they are covered by the rhomboid muscle (T1-T5) and more superficially by the trapezius muscle (up to T12). Cadaveric studies have confirmed the blockade of dorsal rami of multiple spinal nerves above and below the injection site when dye is injected below the fascia of the erector spinae muscle [4,5]. The ventral rami are blocked inconsistently and could be involved in the analgesic effects of ESPB without extension to the paravertebral zone. The local anesthetic spread, in both the cephalad and caudad directions is facilitated by the presence of the thoracolumbar fascia. It has been studied in several types of surgery, whether thoracic, abdominal or even breast surgery, and has shown efficacy in these indications [6–10].

Recently, few case reports and studies reported efficacy in elective spinal surgery, scoliosis, or spinal decompression spine surgery [11–14]. Based on these results, we recently introduced this technique in spinal surgery at the Lille University Hospital (France). To our knowledge however, no study has evaluated the usefulness of ESPB in the surgery of spinal fractures treated by percutaneous osteosynthesis. The aim of this pilot study was thus to provide a first evaluation of the usefulness of ESPB in the specific context of percutaneous surgery for spinal trauma.

Materials and methods

The study has been declared to the National Commission for Data Protection (CNIL, Commission Nationale de l'Informatique et des Libertés), according to French law. The data processed within the framework of this research project were treated in compliance with the applicable data protection regulations. The corresponding processing is registered with the Lille University Hospital under the reference DEC20-127. The research protocol was also submitted to the ethics committee of the French Society of Anesthesia and Intensive Care (SFAR), which approved the research (IRB-00010254-2020-107).

We studied all patients 18 years of age or older who underwent percutaneous osteosynthesis for spinal fractures from December 2019 to March 2020 at the University Hospital of Lille. If a conversion to open surgery or a second procedure was necessary, the patient was excluded.

Patients were all given general anaesthesia according to our institutional protocol: induction with sufentanil (0.2-0.3 µg kg^{-1}), propofol (2-3 mg kg^{-1}), and ketamine at analgesic dose (0.5 mg kg^{-1}). Tracheal intubation was facilitated by administration of a muscle relaxant at the discretion of the anesthesiologist in charge of the patient. Maintenance of anaesthesia was achieved with sevoflurane (Sevorane, Abbott, Chicago, Illinois, USA) to reach 1 minimum alveolar concentration (MAC). Oxygen administration was such that pulse oxymetry (SpO_2) was >95%. Tracheal extubation was performed in the operating room when usual criteria were met. Patients were then moved to the postanaesthesia care unit.

After anaesthesia induction and installation on the surgical table, some patients were given bilateral ESPB with the help of a high-frequency linear ultrasound transducer (Samsung Health Care, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea), according to the anesthesiologist in charge of the patient. Regional anaesthesia was performed sterile. The ultrasound probe was placed sagittal axis between the T10 and T12 vertebrae. The spinous processes were visualized first, then after lateralizing the probe, the transverse processes were visualized at about 2-3 cm from the middle. An 80mm sonovisible needle was inserted from the cranial to the caudal portion using the in-plane technique. The needle was directed towards the transverse process in order to perform the injection of local anaesthetics between the fascia of the erector spinae muscle and this transverse process. An injection of 30 mL of 0.375% ropivacaine was performed. Then, the same procedure was performed on the contralateral side.

For postoperative analgesia the same protocol was applied in all patients: administration of non-steroidal anti-inflammatory drugs (ketoprofen) in the absence of contraindications, paracetamol, and nefopam. In case of pain (numerical rating scale [NRS] > 4/10), patients received i.v. morphine titration in the post-anaesthesia care unit. Patients were then given intravenous patient-controlled analgesia that comprised morphine boluses of 1 mg. The minimum interval between boluses was 7 minutes. Patients who did not have ESPB benefited from a muscular infiltration with 30 mL of ropivacaine 0.75% by the surgeon in charge of the patient at the end of surgery as per the analgesic protocole.

All pre-, and intraoperative data were obtained from the Anaesthesia Information Management System used in our hospital (DIANE, Bow Medical, Amiens, France). Postoperative data were obtained from our Electronic Patient Record (SILLAGE, SIB, Rennes, France).

The primary outcome was the cumulative morphine consumption during the first 24 postoperative hours. Secondary outcomes were pain assessment using NRS at 1, 2, 6, 9, 12, and 24

hours after surgery, intraoperative sufentanil consumption, and the incidence of postoperative nausea or vomiting.

Statistical analyses were performed using R ver. 3.6.3 (R Foundation, Vienna, Austria). Normal distribution was tested for all data before analysis. Results were expressed as median (interquartile range [IQ]) or mean (standard deviation [SD]), according to distribution. Quantitative data, including morphine consumption at 24 hours and NRS were analysed using a Student t test, and qualitative data were compared using a chi2test or Fisher exact test. The level of significance for the tests was set at $p<0.05$

Results

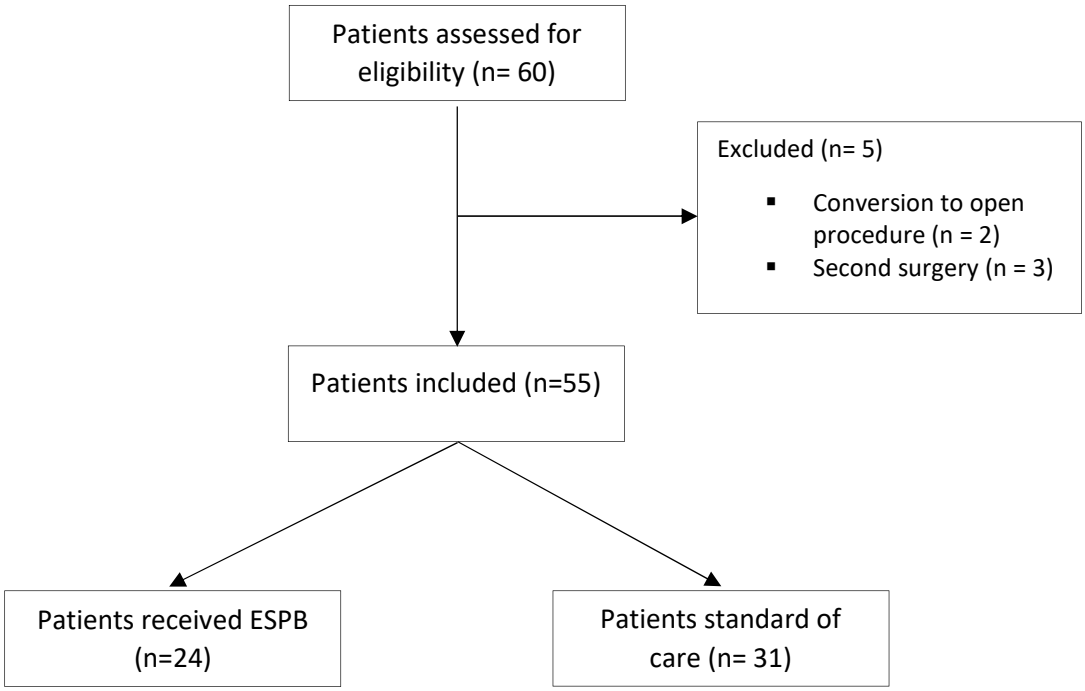


Figure 1. Flow-chart diagram

In total, sixty patients had percutaneous surgery for spinal trauma during the study period in our institution; of these, 5 were excluded. Of the remaining 55 patients, 24 patients received ESPB in addition to general anaesthesia (ESPB group), whereas 31 received the standard of care (general anaesthesia and muscular infiltration) (control group). (Fig 1.). Patient demographic data are reported in Table 1. Patients in both groups were comparable. The cumulative morphine consumption at 24 hours was 13 (11) mg in the ESPB group and 35 (17) mg in the control group ($p<0.001$). The evolution of morphine consumption in the first 24 hours is shown in Fig 2. Intraoperative sufentanil consumption was significantly lower in the ESPB group than in the no ESPB group (20 [15 ; 26]mg and 27 [20 ; 35]mg, respectively, p=0.002). There was a significant difference in NRS in the first 9 hours (Fig 3.).. The two groups did not exhibit significant differences in the incidence of nausea and vomiting, 1 episode for ESPB group (4%) and 8 for control group (25%) (p=0.06).

Table 1. Pre- and peroperative patient data

	ESPB (n=24)	**Control (n=31)**	**p**
Age, median [IQ]	57 [41 ; 62]	51 [41 ; 59]	0.54
Sex, male (%)	13 (54%)	22 (71%)	0.19
Height (cm), median [IQ]	170 [163 ; 177]	177 [170 ; 180]	0.11
Weight (kg), median [IQ]	76 [60 ; 82]	74 [66 ; 80,5]	0.99
BMI (kg/m^2), median [IQ]	25 [21 ; 30]	24 [23 ; 26]	0.23
ASA, median [IQ]	2 [1 ; 2]	1 [1 ; 2]	0.02
Morphine preoperative, No (%)	3 (13%)	4 (13%)	1
NRS preoperative, median [IQ]	4 [3 ; 5]	3 [3 ; 4]	0.13
Surgery duration (min), median [IQ]	69 [44 ; 114]	60 [47 ; 68]	0.11
Anesthesia duration (min), median [IQ]	135[118 ;	118 [112 ; 138]	0.02

	190]		
Muscular infiltration, No (%)	0 (0%)	31 (100%)	
N levels of arthroplasty			0.1
N=1	11	22	
N=2	11	6	
N=3	2	3	

ASA: American Society of Anesthesiologists classification (I/II/III); BMI: Body Mass Index; NRS: Numerical Rating Scale; NSAI: Nosteroidal anti-inflammatory drugs

Discussion

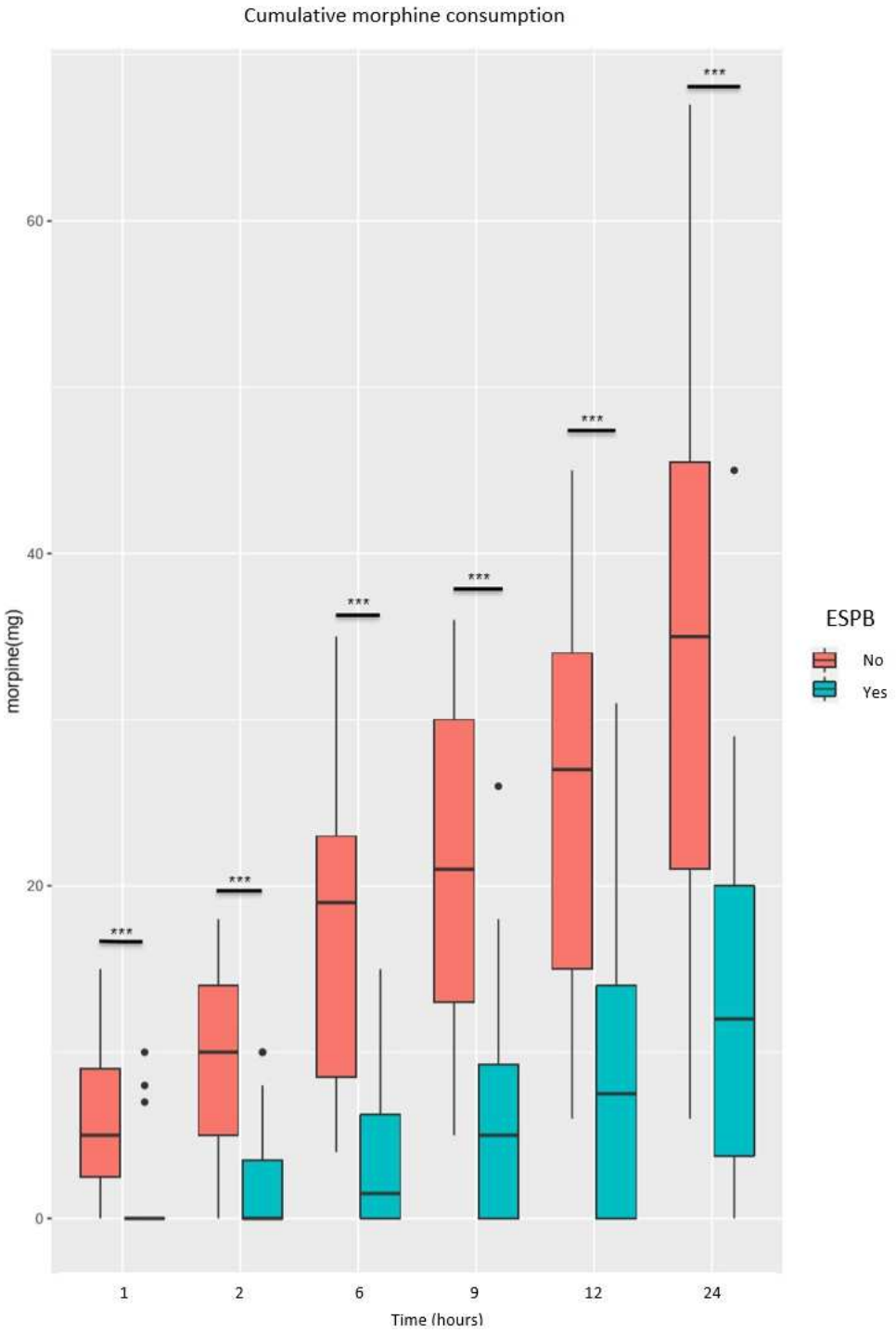
In this study, bilateral ultrasound-guided ESPB was associated with a reduction in morphine consumption during the first 24 postoperative hours as compared with a control (no ESPB) group in the pain management of percutaneous lumbar osteosynthesis after vertebral fracture. In addition, compared with the control group, pain was better controlled (lower NRS) upon awakening, and during the first 9 hours. A reduction in intraoperative sufentanil consumption was also observed in the ESPB group.

Lumbar spine surgery, and especially percutaneaous fixation, is characterized by intense and diffuse pain that can last up to 4 days postoperatively [15,16]. Pain management is a central and very difficult issue in this surgery.

To our knowledge, this study is the first to evaluate ESPB in percutaneous lumbar osteosynthesis for spinal trauma. ESPB is a simple to perform and safe block. There are few risk of complications because there are no structures at risk of needle injury as it is distant from the spinal cord and vital organs. ESPB is safer than paravertebral or epidural analgesia because it is a pure sensory block, with no sympathetic block or motor [17,18]. This provides better hemodynamic stability and facilitates early mobilization of the patient.

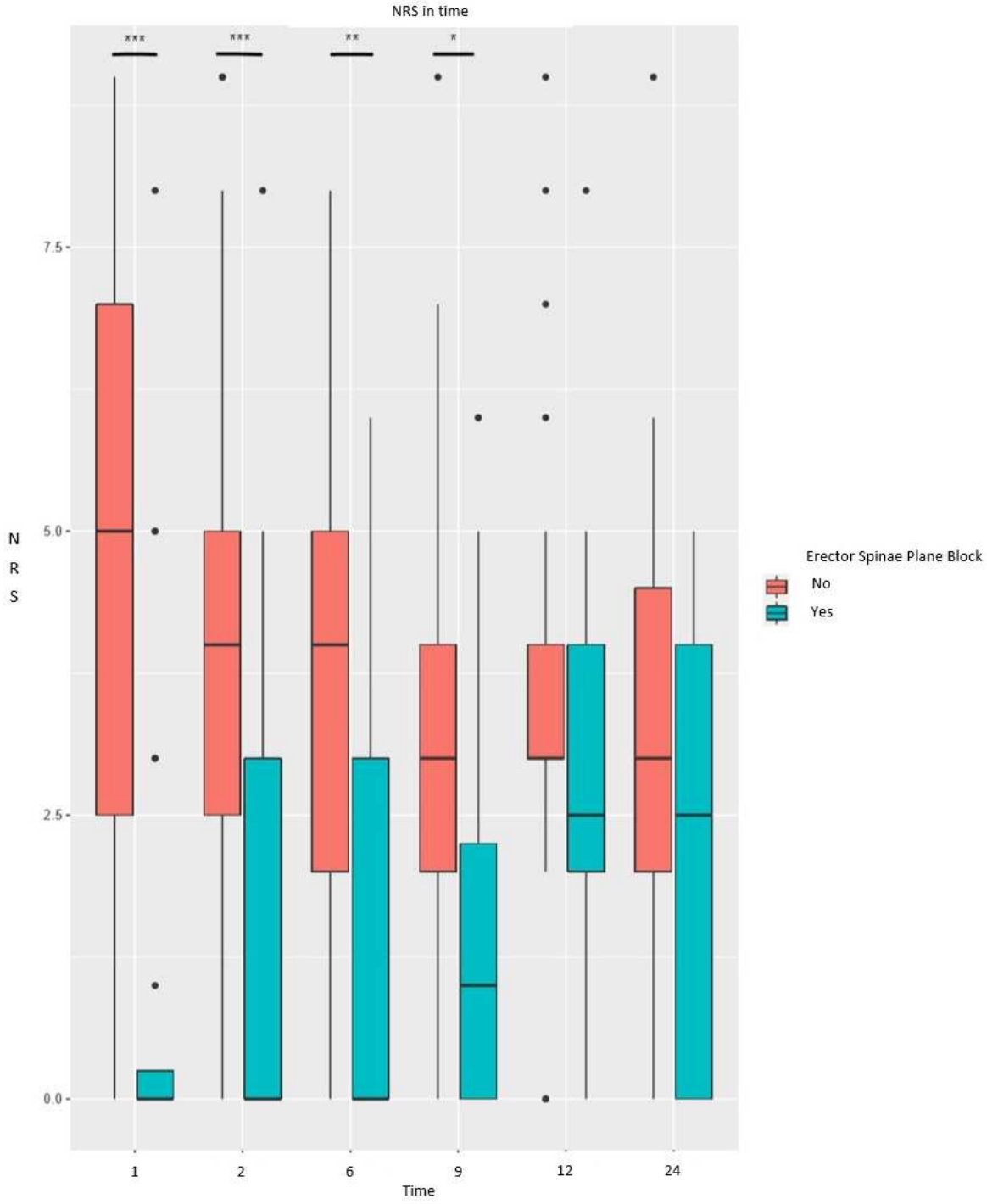
The results of this study are consistent with those of Singh et al. [14] who showed a reduction in morphine consumption at 24 hours after open lumbar spine surgery. Another study by Yayik et al. [13] showed a decrease in morphine consumption at 24 hours postoperatively after lumbar decompression surgery. Our results extend these data to the specific context of post-traumatic surgery where (1) preoperative acute pain is more often present, (2) the lesions causing pain may also involve tissues and muscles around the spine, and (3) the traumatic and emergency context may modify the patient's perception of pain compared with planned surgery.

We found no difference in pain after the 9th hour postoperatively corresponding to the duration of action of ropivacaine. This difference could suggest that a continuous infusion by bilateral catheter may be useful to achieve optimal pain control. On the other hand, the relatively low levels of pain after the 9th hour in both groups (NRS < 5 in the majority of patients) would suggest that the single injection block is suitable for this surgery.



*: p < 0.05; **: p < 0.01; ***: p < 0.001

Figure 2. Cumulative morphine consumption at 24 hours



*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$

Figure 3. Numerical Rating Scale for pain in time

The present study has a major limitation. It was monocentric and retrospective, and included a relatively small sample of patients, which may have biased the results. Another weakness of the

study was the absence of randomization. Patients who did not benefit from ESPB was due to a lack of skill in the technique by the anesthesiologist in charge of the patient. Despite this, patients were comparable in both groups in terms of demographics (weight, height, preoperative morphine consumption and pain).

However, unlike many retrospective studies, it did not compare a "before" versus "after" period, where confounding factors related to other changes in practice are possible. In addition, the assessment of postoperative pain was performed as part of usual practice by nurses who were unaware of the realization of a block in some patients. Nevertheless, a double-blind randomized controlled trial would make it possible to prove the usefulness of ESPB in the management of percutaneous lumbar osteosynthesis after trauma. Our results provide a useable basis for estimating the number of patients that would need to be enrolled in such trial.

Conclusion

In conclusion, ESPB allowed a reduction in cumulative morphine consumption in the first 24 hours postoperatively in patients undergoing percutaneous lumbar arthrodesis after spine trauma. A randomized controlled trial is required to prove the effectiveness of ESPB. This study was a pilot study to base sample size calculations for future trials.

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