



Emergency management of acute irreversible pulpitis by periapical injection of methylprednisolone

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Objective: Periradicular injection of corticosteroid, which has been used in endodontics since 2000, has been reported to be feasible and to have considerable efficacy in the emergency treatment of acute irreversible pulpitis. The aim of the present study was to confirm these findings and to document the drug intake over a period of a week.

Methods: After providing written informed consent, 31 patients consulting for acute irreversible pulpitis pain at the dental clinics affiliated with the university teaching hospital in Dakar, Senegal underwent periradicular injection with methylprednisolone acetate for emergency pain management. The patients were followed up at 1 week to evaluate the therapeutic outcome of their treatment.

Results: Immediately after the injection, 71% of the patients exhibited no spontaneous pain, and 87.1% had no pain on tooth percussion. The treatment lasted approximately 8 min. On day 7, 77.4% of the patients were reassessed. The evaluation of analgesic efficacy of the therapeutic procedure on the 24 available patients revealed a Sum of Pain Intensity Difference of 12.19 and a Sum of Pain Percussion Intensity Difference of 0.77. At follow-up, an absence of medication was observed, increasing at 83.3% on day 5 and a minimum of 58.3% on day 2. Ibuprofen was taken in 37.5% of the cases on day 2 and 4.2% of the cases on day 5. Paracetamol/codeine was taken in 29.2% of the cases on day 1 and 4.2% of the cases on day 5.

Conclusion: The present study established that methylprednisolone injection for acute pulpitis provides a minimally invasive pharmacological relief, and that it conserves dental resources.

Keywords: Emergency treatment; endodontics; pain management; pulpitis.

Irreversible acute pulpitis involves inflammation of the pulp, and it is characterized by the inability to revert its clinical and pathological signs to normal irrespective of the treatment that is provided.^[1,2]

Endodontic treatments, such as pulpotomies and pulpectomies, are typically the standard for pain man-

agement with irreversible pulpitis.^[3,4] When root canal debridement cannot be performed, the management of pain caused by pulp inflammation can only be achieved by using medications.^[5,6] However, pain associated with such inflammation is often severe and hard to control by merely prescribing analgesics and glucocorticoids. Nonetheless,

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these drugs exert anti-inflammatory activities that can neutralize inflammation mediators; therefore, they are able to exert a degree of pain control.^[7] These drugs remain underused; however, there has been very little data to date describing their use in odontology in general and endodontics in particular in endodontic practice. The first two studies on this topic are from the same American team, addressing the different outcomes of periradicular injection of glucocorticoids in the emergency treatment of irreversible acute pulpitis.

The protocol and outcomes of a small clinical trial were published by Gallatin et al.^[8] They provide support for the feasibility of emergency management of irreversible acute pulpitis with methylprednisolone before definitive treatment is performed, and they compared this with the standard treatment.

Bane et al.^[9] compared the efficacy of periradicular injection of prednisolone acetate and pulpotomy/pulpectomy for the emergency management of acute pulpitis in Senegal. The results of this randomized controlled trial indicated that injection of periradicular prednisolone was as effective as the standard treatment for the reduction of spontaneous pain caused by acute pulpitis. This drug also significantly reduced desmodontal nerve compression, thereby contributing to reduced pain on percussion.

All of the studies to date concur that pulpotomy/pulpectomy and periradicular prednisolone injection result in effective relief for patients suffering from pain caused by pulpal inflammation.

Bane et al.^[9] showed that prednisolone injection using a simple technical platform delivering a minimal amount of drug in a relatively short period is more effective than the reference pulpotomy.

This new therapeutic approach warrants being used in modern dental care. However, there is still a clear need to determine the extent of drug consumption by patients who receive this type of emergency treatment.

Therefore, the aim of the present study was to confirm that periradicular corticoid injection can provide pain relief in patients presenting with acute irreversible pulpitis and to document the drug intake over a 7-day period.

Materials and methods

Ethical considerations

The experimental protocol was approved by the ethics committee of the Ministry of Health of Senegal (letter no. 56, May 21, 2011). The patients were informed that even after having given their initial consent, they were free to

withdraw from the study at any time without this affecting their clinical management. Written informed consent was obtained from the patients.

Study population

Recruitment

The study population was recruited from the patients referred to the dental clinics affiliated with the University Teaching Hospital in Dakar, Senegal. Only one provider was considered in the present study to minimize inter-provider variability. The selected provider was trained to perform the injection on a sheep's head by an instructor experienced with the technique. Recruitment was made 2 days/week when the provider performed their clinical services.

Inclusion criteria

The patients included in the present study had been referred to the clinic for irreversible acute pulpitis, defined as spontaneous intermittent pain that changed location, a negative periodontal drilling, a positive pulp test of vitality to cold, and a source or signs of bacterial contamination. Patients who were of adult age and who were mentally and legally able to sign a consent form were included in the study. The participants had to be able to understand the protocol and, in particular, understand and correctly complete the 7-day evaluation questionnaire.

Exclusion criteria

The patients were excluded from the study if they met the following criteria:

- an immature tooth (open apex),
- pregnancy or breastfeeding,
- known intolerance to prednisolone, paracetamol, codeine, or ibuprofen or to one of the excipients of these drugs,
- contraindication to synthetic glucocorticoids:
- absolute: a progressive infectious condition (bacterial or viral),
- relative: type I diabetes,
- mentally unstable, particularly psychosis,
- contraindication to endodontic treatment.

Therapeutic procedure: intraosseous injection of prednisolone acetate

The study participants underwent the following procedures for pain management:

Anesthesia

After rinsing the site with an antiseptic agent (Betadine®; Meda Pharma, Paris, France),^[9] local or locoregional anesthesia was applied (vestibular supraperiosteal by maxillary infiltration and regional mandibular anesthesia completed by vestibular supraperiosteal infiltration).

Determination of the perforation site

The site for transcortical perforation was determined after clinical and radiological examination: in attached gingiva, approximately 5 mm below the cervical line, away from the dental roots.

Preparation of the prednisolone solution

Prednisolone (Depo-Medrol®, 40 mg/ml; Pfizer, NY, USA) was homogenized by inverting the bottle to avoid the generation of air bubbles. The contents were aspirated with a 10 cc syringe. Concurrently, the content of a capsule of distilled water conditioned by Septodont Laboratories (Paris, France) was emptied and replaced by Depo-Medrol®.

Perforation of the cortical bone The cortical bone was perforated using a disposable sterile device designed for intraosseous anesthesia injection (X-Tip®; Dentsply-Maillefer Instruments, Ballaigues, Switzerland). The device was mounted on a contra-angle rotating at 10,000 rpm. After perforation was achieved, the perforator was removed, leaving behind the catheter to be used to fill the medullary bone space with the product.

Injection of prednisolone acetate

Methylprednisolone acetate (Depo-Medrol®), conditioned beforehand, was slowly injected (1 ml in approximately 1–2 min) via a needle inserted into the catheter. The injection site was monitored to detect any backflow of the product indicating failure of the injection.

Prescription

The patients were discharged with a prescription for standard analgesics: ibuprofen 400 mg and paracetamol 500 mg+codeine 30 mg. The combination of these drugs is currently considered to be very effective for the management of pain due to irreversible acute pulpitis.^[3]

Pain follow-up

The patients were given a questionnaire to assess pain over a 7-day period. Prior to the first analgesic intake in the morning (if necessary), the patients indicated the following:

- the intensity of their spontaneous pain (0, 1, 2, or 3),
- the intensity of their pain (0, 1, 2, or 3) provoked by tapping on the tooth with their index finger,
- their ibuprofen intake. They recorded the times and the days when the use of paracetamol/codeine was necessary because ibuprofen alone was not sufficient for adequate pain relief.

The patients were seen 7 days later for a full endodontic treatment.

Evaluation

Immediately after treatment, the evaluation criteria were: immediate complications, injection time, and immediate efficacy.

On day 7, the evaluation criteria were: complications, efficacy of the emergency analgesic treatment, and medication intake.

The analgesic efficiency index was the Sum of Pain Intensity Difference (SPID), which is the sum, over a certain period, of the difference between the pain intensity at evaluation and the intensity before treatment. The intensity was verbally defined using a scale with four levels. Spontaneous pain was separated from pain provoked by percussion; therefore, the two criteria used were the SPID and the Sum of Pain Percussion Intensity Difference (SPPID).

The drug intake was evaluated using a scale with three levels: no medication, ibuprofen intake, and paracetamol/codeine intake. The medical record form that was provided to the patients at the end of the emergency treatment included a daily report of the intensity of spontaneous pain, the intensity of pain provoked by percussion, and the drug intake.

An examination by radiography was performed a week after the emergency treatment to assess the periodontal status.

A consultation with a physician or a dentist for pain in the treated tooth, within a week after the emergency treatment and before the appointment for endodontic treatment, was considered to represent the failure of the emergency treatment.

Although all of the complications in the oropharyngeal zone were recorded, these complications were not, a priori, attributed to the emergency treatment during the follow-up period. This was also the case for any event potentially attributable to an idiopathic reaction to the treatment compounds.

Statistical analysis

Data were analyzed using SPSS for Windows software version 18.0 (SPSS Inc., Chicago, IL, USA) for statistical analysis.

Data were presented as percentage (%) for qualitative variables and as mean and standard deviation for quantitative variables. The efficacy of the treatment over a 7-day period was evaluated as SPID and SPPID scores. The evaluation of the prognostic value of the initial variables on the analgesic efficacy and postoperative drug consumption was performed by logistic regression. An $\alpha < 0.05$ was accepted as statistically significant.

Results

Immediate evaluation

Three cases of benign hemorrhage at the injection site and 1 case of pain at the perforation site were noted.

The mean time to periradicular prednisolone injection was 8.2 ± 1.446 min following anesthesia infiltration.

Immediately after the injection, 71% of the patients did not exhibit spontaneous pain, and 87.1% did not exhibit pain on percussion.

Evaluation on day 7

A total of 31 patients were initially included in the present study. Of the 31 patients, only 24 presented for the day 7 follow-up. The remaining seven patients were included in the immediate post-injection results but excluded in the follow-up results for three following reasons:

- four patients were lost to follow-up,
- two patients had a consultation a day after the emergency treatment for severe spontaneous and provoked pain, and they received immediate pain management at that time,
- one patient with a history of sickle cell disease had a consultation at post-emergency treatment on day 5 with submandibular swelling and an inability to swallow saliva. They were treated immediately, and they underwent assessment by panoramic X-ray.

On day 7, one patient reported pain at the injection site, and two patients reported ulceration at the perfora-

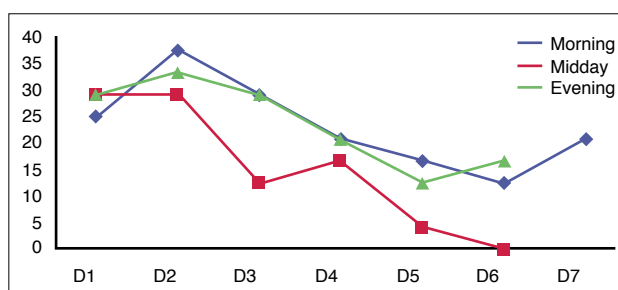


Fig. 1. Ibuprofen consumption.

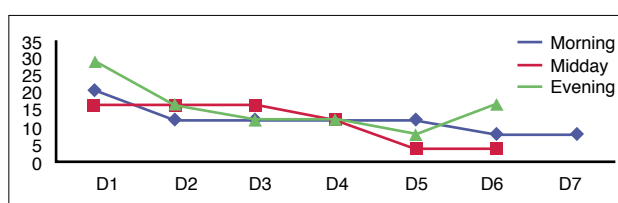


Fig. 2. Paracetamol/codeine medication.

tion site. No locoregional or regional reactions were reported on day 7.

The patients were monitored for a week to evaluate spontaneous and provoked pain (Table 1), as well as to evaluate their drug intake.

The efficacy of the treatment was evaluated by SPID and SPPID scores and the analgesic intake.

SPID was found to be 12.185, and SPPID was found to be 0.77.

One day following the injection, 70.8% of the patients did not take any pain medication, and the abstinence from medication intake increased, increasing at 83.3% on days 5 and 6 at midday.

In 25% of the cases, there was ibuprofen intake, increasing on day 2 to reach a maximum of 37.5% and then decreasing until it disappeared by day 6 (Fig. 1).

The patients were instructed to only take paracetamol/codeine if ibuprofen on its own was not sufficiently effective. Paracetamol/codeine was initially taken by 29.2% of the patients, and its use decreased during the week to reach 4.2% on day 6 (Fig. 2).

The investigation of putative prognostic factors did not find any initial variable that was associated with the postoperative drug consumption over the course of the assessment week.

Table 1. Change in the pain intensity during the week of follow-up (daily averages)

Pain intensity	Follow-up (days)							
	D0	D1	D2	D3	D4	D5	D6	D7
Spontaneous pain	2.160	0.542	0.750	0.435	0.227	0.409	0.286	0.286
Pain on percussion	0.420	0.400	0.370	0.304	0.273	0.364	0.286	0.190

Discussion

Methodology

Given the contraindication of corticosteroids in case of suspected or actual infection, injection of methylprednisolone has been limited to cases of irreversible acute pulpitis with local infection. Therefore, the application of our protocol faced a number of difficulties. One of these difficulties was related to the small number of participants due to a significant number of exclusion criteria for methylprednisolone injection (e.g., failure to understand the evaluation form, pregnancy, breastfeeding, poorly controlled diabetes, allergies to corticoids, and a suspected local infection).

The second difficulty was related to the substantial number of patients lost to follow-up due to many factors: a lack of financial resources and patients motivated solely by their pain management who did not return once they had achieved a sufficient degree of pain relief despite being contacted by phone to remind them of the follow-up. The 7-day follow-up period was too short; 6 months following the etiologic treatment would have been the ideal follow-up period. Finally, the absence of a control group in the study can be considered to be a limitation. However, control groups were included in the previous studies on this subject that revealed the feasibility and effectiveness of the technique.^[8,9]

The evaluation was limited to emergency treatment (i.e., periapical injection of prednisolone), and patients were then given etiologic treatment (i.e., the endodontic treatment itself), which had already been evaluated in the study by Bane et al.^[9]

Immediate evaluation

Three cases of benign hemorrhage were reported immediately after the injection of prednisolone. However, these hemorrhages were benign because they could be immediately controlled by local compression. They occurred due to abundant vascularization of the vestibular mucosa. Another patient suffered from a slight degree of pain at the site of the perforation, which could have been due to pressure during the cortical perforation.

The mean time required to inject dimethylprednisolone acetate was 8.2 ± 1.446 min. The need for this amount of time for the management of acute pulpitis is due to the straightforward nature of Depo-Medrol injection[®]. Indeed, the X-Tip System is the most preferred of the three techniques of intraosseous anesthesia (X-Tip[®] System, Regular Stabident[®] System, and Alternative Stabident[®] System). The reason for this is that injection

with the X-Tip[®] is straightforward because the perforator automatically places the catheter in the bone, in contrast to the Alternative Stabident[®] System, which requires the manual insertion of the catheter. Our results are similar to those obtained by Bane et al.^[9] who reported an injection time of 7.29 ± 2.74 min.

Immediately after the injection, 9.7% of the patients had moderate to severe spontaneous pain (grades 2–3), whereas 3.9% of the patients exhibited moderate to severe provoked pain (grades 2–3). Our findings using prednisolone injection are similar to those reported in 1996 by the Dental School of Minnesota in the United States.^[10] The authors evaluated the effects of periapical ketorolac injection, mepivacaine injection, and placebo in patients suffering from endodontic pain in a double-blinded randomized clinical trial with a single operator. Pain was significantly reduced within 15 min of its administration, and the intensity of pain was <0.5 (on a scale with four levels) 60 min after its administration for patients treated with ketorolac. Although the patient selection criteria were different (the American study addressed endodontic pain) and the drugs that were used were also different (ketorolac is a nonsteroidal anti-inflammatory drug), the two studies highlight the anti-inflammatory effect of periapical injection on endodontic pain. Moreover, Bane et al.^[9] revealed that patients in Senegal who underwent methylprednisolone injection did not have any spontaneous pain.

Evaluation on day 7

Of the 31 patients who had been recruited, only 24 were present on day 7, with the remaining 7 patients excluded from the study. Of these seven patients, four were lost to follow-up. A previous study, on the same topic and in the same region, obtained very similar results.^[9] Immediate etiologic treatment was successful for two patients who had severe pain 1 day after the emergency intervention. The patient who had swelling at the mandible on day 5 was also successfully treated in collaboration with his treating physician.

On day 7, one patient reported pain at the injection site, and two patients exhibited ulceration at the perforation site. Local complications resulted from inflammation caused by infection of the perforation site. However, these local complications are unlikely to be due to the perforation device itself because according to the manufacturer of X-Tip[®] needles (Dentsply-Maillefer) no inflammatory reaction occurs when the device is used in an appropriate manner. Many studies on the various techniques for intraoral anesthesia have shown that intraosseous anesthesia provides the most advantages with the least number of drawbacks.^[11] In our study, the local infections could

have been caused by a failure to adequately maintain sterile conditions at the injection site during the emergency injection or by a lack of postoperative hygiene.

Intraosseous Depo Medrol® injection significantly reduced spontaneous pain, as well as pain on percussion. At the initial consultation, 80% of the patients exhibited moderate to severe spontaneous pain, with a mean intensity of 2.16. This mean decreased from the time of the emergency treatment to when the etiologic treatment occurred, reaching 0.286 on days 6 and 7. Pain on percussion had a mean of 0.42 at the initial consultation, decreasing to 0.19 on day 7. Such a substantial reduction in postoperative pain was attributed to the effect of methylprednisolone on the dental pulp. Our findings are consistent with those by Gallatin et al.^[8] who, in a randomized clinical trial, found that periradicular injection of methylprednisolone relieves pain in patients referred to the emergency department for irreversible acute pulpitis for at least 7 days prior to the etiologic treatment. SPID was determined to be 12.18, which is indicative of the considerable efficacy of prednisolone injection on pain due to irreversible acute pulpitis. Our results confirm the findings by Gallatin et al.^[8] and those by Bane et al.,^[9] both of whom reported similar figures. Prednisolone acetate is thought to act on mediators of inflammation, resulting in a reduction in their levels in the pulpal area. A biochemical study conducted by Isett et al.^[12] showed that there is an irreversible reduction of prostaglandin E2 and interleukin-8 in the inflamed pulpal tissue 3 days after the injection of methylprednisolone. The value of SPPID was found to be 0.77. This substantial difference compared with the two previous studies can be explained in two ways. First, SPPID is subject to many variations due to the method of evaluation (the patient self-evaluates pain by tapping on their tooth). Second, SPPID does not reflect pain from the pulp but rather from the desmodontal area, and desmodontal pain only emerges when the inflammation reaches that area. For this reason, in the previous studies, the SPPID value was considered as a secondary variable.

The proportion of patients abstaining from medication use increased from 58.3% on day 2 to 83.3% on day 5 following Depo Medrol® injection. However, some patients took ibuprofen, although the amount of ibuprofen consumed was not substantial for the two treatments. The peak for medication intake was on the morning of day 2 at 37.5%. This could be due to the fact that the anti-inflammatory effect of methylprednisolone does not completely suppress pain caused by acute irreversible pulpitis. Some patients needed to also take paracetamol/codeine if pain did not completely disappear. Ibuprofen and paraceta-

mol/codeine are currently considered to be effective for the management of pain due to endodontic pathologies.^[13] Owing to the proportion of patients requiring ibuprofen with or without paracetamol/codeine, periradicular injection of prednisolone should include prescription of these drugs in case of irreversible acute pulpitis.

The initial characteristics did not influence the postoperative drug intake over the course of a week. Moreover, metabolic, hormonal, anatomic, and socioeconomic characteristics did not influence the outcome of emergency pain management.

Conclusion

The present study indicates that irreversible acute pulpitis can be managed in a timely, straightforward, and inexpensive manner in an emergency setting by periradicular injection of methylprednisolone acetate. It also indicates the need to complement topical injection by prescription of oral pain medications.

Conflict of interest: None declared.

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