Case 6 Ultrasound guided midfoot injection Ngozi Joy Nwokoma

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Introduction

Amber (a pseudonym for the patient) is an eighty-three-year-old female who was referred by her General Practitioner (GP) with worsening right foot pain which was causing significant limitation of her activities of daily living.

Assessment

I met Amber when she attended for her appointment. History-taking revealed that she had right foot pain for several years which had been diagnosed as osteoarthritis based on her symptoms supported by x-ray findings. Her symptoms were initially well-controlled with various oral and topical analgesia including paracetamol, co-codamol and topical non-steroidal anti-inflammatory agents. However, in the preceding 6months, her symptoms had worsened. There was no history of trauma though her symptoms were worse after going out for a walk, the walk-symptom distance also decreasing. She had not observed any swelling or redness.

Her past medical history included generalised osteoarthritis, Type II diabetes mellitus and sciatica. Her regular medications were Metformin, Aspirin, Atorvastatin and Amitriptyline. In addition, she took Paracetamol and Co-codamol (8/500) as required; higher strengths made her light-headed. She had no drug allergies or sensitivities. She was an ex-smoker and did not take alcohol. She lived alone independently in her own home and required no assistant with her personal care or activities of daily living.

On examination, she looked generally well with no evidence of cardio-respiratory concern. She walked unaided with an antalgic gait to her right lower limb. Focused examination of her right foot revealed normal perfusion, normal alignment, colour, temperature and sensation. There was no swelling or redness or local skin lesion. She had full range of movement in her ankle. She indicated tenderness in her mid-foot on palpation.

Blood tests revealed a satisfactory and stable glycaemic control with HbA1c consistently in the mid 50's. A review of her x-rays revealed the presence of osteophytes in the right cuneiform-metatarsal joint (CMTJ) with narrowing of the joint space. Ultrasound was performed using a Sonosite Edge Turbo GE ultrasound machine with a linear transducer probe of frequency 15-6mHz with HFL 50. The patient was positioned comfortably in a semi-recumbent angle on the adjustable hydraulic clinical couch with the right knee flexed and the foot flat, supported on the couch. The machine controls were used to adjust the depth and focus to give the best possible image, complimented by the use of ample ultrasound gel to maximize skin contact and eliminate air which in turn further optimized the image quality. The right mid-foot was examined using the probe in the transverse and longitudinal planes. The images were congruent with x-ray findings and reported as follows:

> There are florid osteophytic projections from all surfaces of the right medial cuneiform-metatarsal joint with significant narrowing of the joint space. There is

mild thickening of the joint capsule and minimal neovascularization on Doppler scanning. The patient indicated mild discomfort over the joint during scanning.

The ultrasound findings were discussed with the patient, indicating that, together with her history, physical examination and x-ray report, the findings supported the diagnosis of osteoarthritis to the right medial cuneiform-metatarsal joint.

Further management

Management options were discussed with the patient as follows

1. Continue as she had been – administering oral and topical analgesics,
2. Try other stronger analgesics,
3. Have ultrasound-guided intra-articular local anaesthetic and corticosteroid injection,
4. Undergo surgical fusion of her mid-foot joints.

The patient demonstrated ability to understand the information she was given and weighed up her options. She enquired about the risks and benefits of all the options given. Though she was already administering the first option, she was made aware of the risks and benefits including constipation with the co-codamol and on-going poor pain control. The second option could potentially offer better pain control but with possible risk of greater side effects including constipation and dizziness as she had found with stronger dose of Co-codamol previously. Other opiate medications could have similar effects, in particular because of her age. This would also increase her risk of falling and sustaining serious injury with possible further limitation on her mobility and even a small risk of mortality.

The third option of ultrasound-guided corticosteroid injection was explained with risks including pain during the injection, a steroid flare in the subsequent 24-48hours, infection in the joint, short-lived or no benefit, hypopigmentation and subcutaneous tissue atrophy at the injection site. The potential of rise in her blood sugar in the following week was discussed but considering the small dose of corticosteroid that would be given, the risk was projected to be a low risk and self-monitor was sufficient precautionary action. The risk of bleeding and bruising was also discussed as she had been on Aspirin. The benefits were also discussed including the ability to administer the treatment on same day (avoiding another hospital visit) and the prospect of good symptom control facilitating her independent living. Her requirement for opiate analgesic could also diminish along with its side effects.

The fourth option of surgery would involve use of internal fixators in a more invasive procedure that would require her to mobilise in a walking cast boot, with the consequence of on-going limitation to her mobility for the early recovery time of 4-6weeks. This would be done with a regional block as a day procedure with risks including bleeding/bruising, infection, poor wound healing, fixator displacement, non-union and possibility of on-going pain.

Amber was given the option to go home and come back another day to discuss the options further. She indicated that she had had corticosteroid and local anaesthetic injection to her knee for osteoarthritis and had got similar information as we had given her from her GP who had indicated that she may be offered this option by our team. She was therefore very happy to proceed with the third option. A step-wise explanation of the procedure of intra-articular injection of local anaesthetic and corticosteroid was given her. The discussion was documented in her notes. The patient signed a procedure-specific consent form in line with the departmental policy.

In line with the departmental policy, a safety check was performed. A systemic review revealed that had no on-going symptoms of infection in any part of the body. Amber's allergy status was re-affirmed as none known, as well as no adverse reaction to previous steroid/ local anaesthetic injection. She was on Aspirin but not on any anticoagulant. The specialty nurse assistant helped to prepare the equipment used for the procedure including a blue 23 guage hypodermic needle, a prefilled 1ml of 1% lidocaine syringe, 1ml of 40mg Depomedrone (Methylprednisolone) in 1ml of 0.25% chirocaine, a single use 2% Chlorhexidine Gluconate with 70% isopropyl alcohol solution, non sterile gloves and sterile probe cover. The patient was positioned at a smaller angle incline to be nearly fully flat as she indicated that due to on-going osteoarthritic problems in her spine, she would be more comfortable in that position. Her right foot was maintained flat on the clinical couch. The medications were checked with the nurse practitioner, the expiry dates and batch numbers were recorded.

An aseptic technique was used. The skin overlying the injection site was cleaned using the antiseptic agent. The ultrasound was used to visualize the right medial cuneiform-metatarsal joint and a safe approach was identified, taking into consideration the surrounding structures, in particular the blood vessels. A transverse in line approach was undertaken with the covered ultrasound probe in a transverse position over the joint and the 23 guage needle attached to the syringe containing 1ml of 1% Lidocaine was introduced into the joint under vision along the long axis of the probe (Figure 1). The syringe was aspirated to ensure the needle tip was not intravascular. On observation of a negative flash back, the plunger was advanced and the local anaesthetic was noted to flow into the joint easily and the joint capsule was seen to rise at the same time. The patient indicated brief discomfort during this part of the procedure. After a minute interval, a 21guage blue hypodermic needle was introduced into the joint under ultrasound guidance in the transverse in line approach. 0.5ml of the 40mg Depomedrone (20mg) in 1ml 0.25% Chirocaine solution was introduced into the joint; this flowed easily (Figure 2). This part of the procedure elicited feeling of pressure in the joint space but no pain. There was no immediate complication. A light dressing was applied to the injection site. She reported immediate relief of her symptoms and her gait was noted to be normal on leaving the department after a few minutes' observation period.

Images

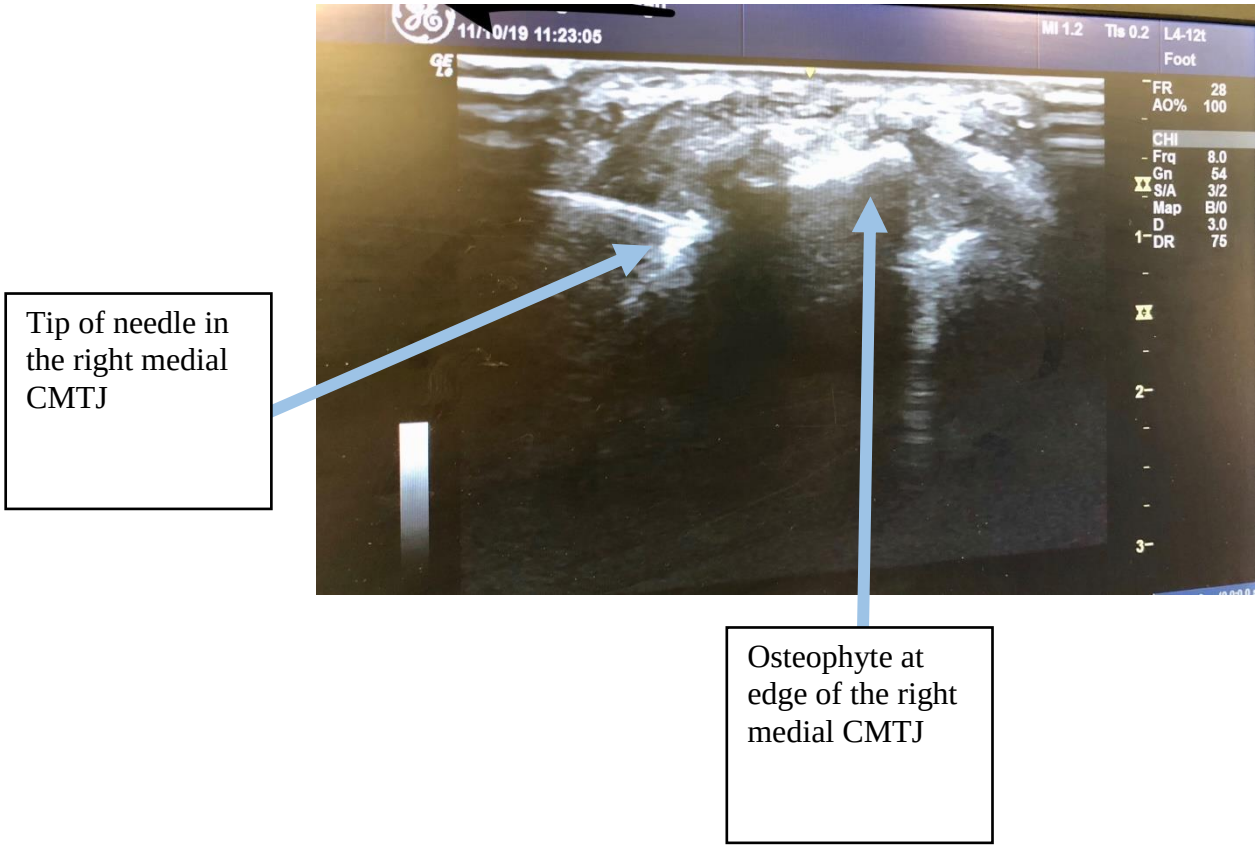
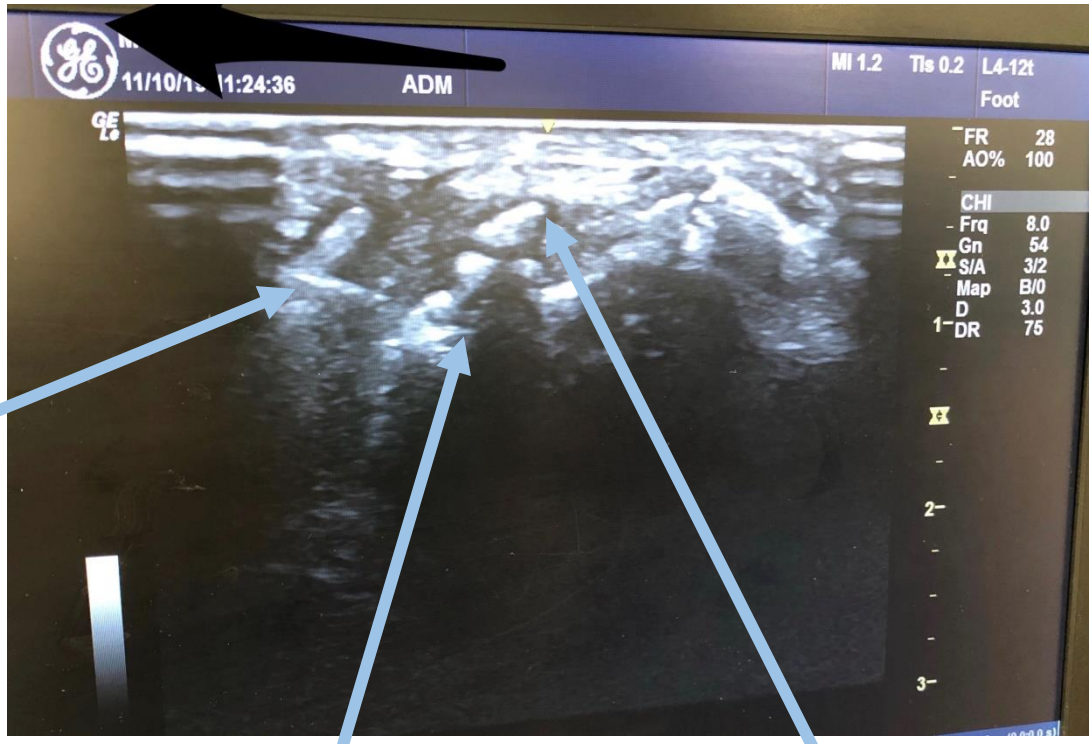


Figure 1. The needle tip is demonstrated in the right medial cuneiform-metatarsal joint (CMTJ) before the injection.



Tip of needle in the right medial CMTJ

Osteophyte at edge of the right medial CMTJ

Injected particles within the now expanded joint space of the right medial CMTJ

Figure 2. The needle tip is demonstrated in the right medial cuneiform-metatarsal joint (CMTJ) after the injection. Post injection joint space increase is noted.

Aftercare

Amber was advised to leave the dressing on for 48hours and to look out for any signs of complications including bleeding, redness and swelling. She was advised to notify her GP if she had any concerns. She was also advised to take her usual analgesics for the next few days to give time for the steroid effect to manifest and to cover for any possible risk of steroid flare in the subsequent few days. She was given information on how to contact the team if she had any concerns by way of an open appointment for the subsequent 4 months in line with the departmental policy, following which she would require review by her GP before any further appointments.

Discussion

A case of midfoot osteoarthritis involving the right medial cuneiform-metatarsal joint treated with intra-articular local anaesthetic and corticosteroid is presented. Midfoot osteoarthritis is commoner with advancing age and in females. Treatment options include physiotherapy, orthotics, analgesics, steroid injection and arthrodesis (Kalichman & Hernandez-Molina, 2014). The diagnosis was made based on the patient's symptoms of intermittent right mid-foot pain, findings on physical examination and radiological investigation. The differential diagnoses considered included cellulitis, midfoot fracture, soft tissue trauma and other forms of inflammatory arthritis including rheumatoid, psoriatic and gouty arthritis. These were excluded from her history, examination and investigations. Radiological features of midfoot arthritis include presence of osteophytes, joint space narrowing, erosions with or without neovascularization on Doppler scanning with ultrasound being more diagnostic than radiograph (Camerer et el, 2017). However, in this case, the radiographic features were enough to make the diagnosis.

Midfoot osteoarthritis is a common cause of significant pain and functional impairment (Kalichman & Hernandez-Molina, 2014; Frangež et al, 2014). Management should be tailored to individual patient with the overall goal of achieving pain control and maximizing functional capability to facilitate activities of daily living (Frangež et al, 2014). The World Health Organisation (WHO) pain management ladder initially proposed in 1987 for the management of cancer-related pain but later adapted for management of acute and chronic cancer and non-cancer pain recommends the use of a graded stepwise increase of analgesia to ensure effective pain management by administering the right medicine at the right dose and the right time. The 3-step ladder progresses from non-opioid analgesia and non-steroidal anti-inflammatory agents in step1 to weak opioids in step 2 and strong opioids in step 3 (WHO, 2019). In addition, adjuvants medications could be used within any of the three steps and include steroids, anxiolytics, antidepressants, hypnotics, anticonvulsants, antiepileptic-like gabapentinoids, membrane stabilizers, sodium channel blockers, *N*-methyl-D-aspartate

receptor antagonists cannabinoids (Vargas-Schaffer, 2010). Amber, who was otherwise well, had significant limitation imposed on her activities of daily living by the midfoot pain. Unable to tolerate stronger opiates which would have moved her from step 2 of the analgesic ladder to step 3, was quite receptive to intra-articular ultrasound-guided steroid/ local anaesthesia injection which would fall into the adjuvant group.

Ultrasound is a widely available, quick, radiation-free and relatively affordable alternative to CT scan or fluoroscopy-assisted intra-articular injections. There is evidence to support the increased accuracy of ultrasound-guided injections over landmark or blind injection in several joints but there still remains some controversy as to whether it offers significant outcome advantage (Koutsiana & Klocke, 2016). Furthermore, Bloom et al concluded that although the accuracy of ultrasound-guided injections was not questionable, it had no outcome advantage over blind or even distant corticosteroid injections to justify the extra cost (Bloom et al, 2012). I would opine that, to reduce the risk of local tissue injury consequent upon local steroid infiltration into the wrong tissue structure, e.g. tendons, or from blind instrumentation, ultrasound-guided injections remain highly recommended. In this case, it would have been quite difficult and traumatic for the patient to gain access into the severely arthritic joint due to the florid osteophytes. This difficulty was significantly reduced with ultrasound guidance.

Naturally occurring corticosteroids are produced in the adrenal cortex. Their physiological effects are mediated through specific receptors all over the body and relate to the regulation of metabolism (of carbohydrate, protein and fat), cardiovascular function, inflammatory response, growth as well as immunity. These effects are dose related and lead to the therapeutic and adverse consequences of exogenous or synthetic corticosteroids. The synthetic corticosteroids are grouped according to their potency and duration of action with hydrocortisone used as a reference point being a weak short to medium acting corticosteroid. Methylprednisolone used in this case, also a short to medium acting corticosteroid, has a relative anti-inflammatory activity of 5:1 compared to hydrocortisone. As corticosteroids are not usually curative, and pathologic process may progress while clinical manifestations are suppressed, it is recommended that chronic use be undertaken with care; careful patient assessment ensuring their condition merits their use and that less hazardous therapies have been exhausted. The lowest effective dose should be used with interval between doses where possible. High infrequent doses are especially beneficial in the management of inflammatory conditions. Possible adverse effects include insomnia, behavioural changes, gastric erosions, hyperglyacemia, glycosuria, sodium retention, oedema, hypertension, hypokalaemia and rarely acute pancreatitis. Extra care should be taken to identify and minimize risk of harm when administering corticosteroids to patients who already have these health conditions. However, it is unusual to see serious adverse effects with short periods of even moderately high doses of corticosteroid use (Chrousou, 2012). In the case presented, a single high dose of a moderately potent corticosteroid was given intra-articularly to control the inflammatory process and hence pain associated with the osteo-arthritis. The risk assessment identified pre-existing type II diabetes and patient was advised accordingly on how to monitor and address any abnormality in her glycaemic control in the following days.

Local anaesthetic (LA) agents are used to achieve localized analgesia and loss of sensation at the target. The mechanism of action is the disruption of afferent nerve transmission by the inhibition of the generation and propagation of nerve impulses. Recovery is typically spontaneous, predictable and without residual effects. Their chemical composition is responsible for their characteristics. The ester group, are more subject to hydrolysis than the

amide group and hence have a shorter duration of action. LA are weak bases, the proportion of their active agent being dependent on the pH value of the local tissue. Consequently, most local anaethetic agents are predominantly in their active form in a high pH or alkaline or neutral environment, as is the case in normal body physiological state. It is the active form that binds to the sodium channels to produce the clinical effect of the local anaesthetic. Conversely, they are less effective in tissues with low pH values, for example, infected tissue where their use is discouraged. Systemic absorption, distribution and elimination leads to the reduction and eventual termination of their effect. Variations in these, due to local anaesthetic agent or tissue or patient characteristics may contribute to the development of adverse reactions or toxicity. The amides are converted to a more water soluble form in the liver which are later excreted in the urine. Hence, hepatic or renal functional impairment may affect their elimination and increase risk of toxicity. The toxicity of local anaesthetic agents arises as a consequence of systemic effects following accidental intravenous injection or neurotoxicity from direct effect on local nerves. The maximum recommended dose is aimed at minimizing the risk of toxicity. Features of systemic toxicity manifest in different systems. In the central nervous system it may cause sedation, light-headedness, restlessness, visual and auditory problems, circum-oral and tongue numbness and a metallic taste or even seizures. Cardiac toxicity may cause arrhythmias and even cardiac arrest. (Drasner et al., 2012). Lidocaine is an amide form local anaesthetic of medium potency and medium duration of action with an elimination half of 1.6hours. It has a good safety record as an intermediate duration local anaesthetic, being to a large extent the reference agent for comparism of most LA agents. Hence, it is our department's choice for initial local anaesthetic agent. Chirocaine (Bupivacaine) is a slow onset of action, high potency agent, (relative potency with Lidocaine 1:4) that has a long duration of action with a half-life of 3 and half hours. The maximum dose of Lidocaine is 200mg and for Bupivacaine, 150mg. The strength of Bupivacaine used was 2.5mg/ml (0.25%) solution. This concentration is recommended and widely used for prolonged peripheral anaesthesia and analgesia for postoperative pain control, the aim here being to allow Amber get home comfortably and enough time for her to take her usual oral analgesia. Hence 1.25mg of Bupivacaine and 10mg of Lidocaine respectively was administered to the patient, well away from the maximum dose. The patient was observed in the department for a few minutes to allow for any early manifestation or adverse reactions and was allowed home thereafter in good condition.

Chlorhexidine gluconate (CHG) is an antiseptic agent used to reduce the risk of health care – associated infections. It has a broad spectrum activity covering gram-positive, gram negative non-spore-forming bacteria, yeast and certain viruses including the Human Immunodeficiency Virus. It has both bacteriostatic and bactericidal activity. The combination of 2% CHG with 70% isopropyl alcohol has been shown to offer significant reduction in risk of post-operative skin infection in the foot, being found better at this than other standard antiseptic agents (Edmiston C E Jr. et al, 2013). It was used in this case to minimize the risk of infective complication following intra-articular injection.

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