Jodie Fisher

Ultrasound Guided Injection of the Subacromial Bursa

This essay will be based on me observing my supervisor (Consultant Radiologist) perform an ultrasound guided injection (USGI) on a patient into the right shoulder. For the purposes of this essay and to adhere to confidentiality the patient will be referred to as Patient A. Due to the different terminology used when diagnosing shoulder pain, for consistency throughout this essay, subacromial impingement syndrome (SIS) will be used.

The machine used during the procedure was a GE LOGIQ E9 with a ML6-15 linier probe. Frequency was set at 10.0; Gain at 45; and depth at 3.5. Patient A was in long sitting with her shoulder in extension and hand placed in the back pocket position. The probe was positioned transversely over the tendon of supraspinatus and subacromial bursa. A Green 21 gage 40mm needle was used to deliver an anteromedial, in plane, longitudinal injection with the needle at a 30-degree angle to the probe into the subacromial bursa. Patient A was injected with a 3ml total volume made up of 2ml of 0.5% Marcain and 1ml of 40mg Depo-Medrone with both drugs mixed in the syringe before injecting.

Patient A is a 58-year-old female who has a 9-month history, insidious onset of right shoulder pain. Her progress has plateaued despite 3 sessions of exercise-based physiotherapy and oral analgesia. Her pain is aggravated by overhead and behind back movements as well as repetitive movements at work (patient A is a scrub nurse in theatre). Patient A had an X-Ray which showed mild degenerative changes of the acromioclavicular joint (ACJ). She also had an ultrasound scan (USS) which showed degenerative changes of the ACJ, small quantity of fluid in the biceps tendon sheath, distal thickening and loss of normal fibrillar pattern of the supraspinatus tendon in keeping with tendinopathy, and moderate fluid distention of the subdeltoid bursa consistent with impingement. Patient A has a past medical history of type II diabetes and high blood pressure. She is taking metformin, amlodipine and over the counter anti-inflammatories as needed. A systematic approach was used to scan the shoulder, in line with the European Society of Musculoskeletal Radiology (ESSR, 2016), prior to injecting. Objective findings from previous physiotherapy assessments

showed a painful arc in abduction and flexion with pain at 120-170 degrees, reduced movement with hand behind back, and active versus passive range of movement was done to rule out adhesive capsulitis (Vermeulen *et al.*, 2002).

Shoulder pathology

Shoulder pain is third most common musculoskeletal issues seen in primary care. This had led to a growing number of corticosteroid injections (CSI) being used as an adjunct to treat shoulder pathology (Dean *et al.,* 2012). Diagnosing shoulder pain can be difficult due to the complexity of the joint and surrounding structures. SIS relates to pathology of the bursa and rotator cuff which occupy the subacromial space (Veen *et al*., 2019). The multifactorial causes of SIS consist of overload, weakness, repetitive movement, and degenerative changes to name a few (Lewis, 2009). Patient A fits the picture of repetitive, overuse issues due to her work demands. She also has tendinopathic changes which are likely degenerative in nature given her age. No special orthopaedics tests were used to aid diagnosis, however the accuracy of special tests alone to diagnose shoulder pathology is questionable. A systematic review and meta-analysis by Alqunaee, M. et al. (2012) looked at the diagnostic accuracy of 5 impingement/pain provocation tests: Hawkins-Kennedy test, Neer's sign, empty can test, drop arm, and lift off test. Due to the high sensitivity and lower specificity of the Hawkins-Kennedy, Neer's and empty can tests, they are better used to rule out SIS if negative. The drop arm and lift off tests are better used to rule in SIS if positive as they have a higher specificity. These tests should be used as a cluster, alongside subjective findings and imaging to aid diagnostic accuracy.

Guided vs Blind

There are conflicting conclusions in studies regarding the effectiveness of CSI on shoulder pathologies. This may be associated with injection accuracy when administered blind or ultrasound-guided (USG) and how different pathologies respond to CSI. A systematic review by Aly et al. (2014) looked at accuracy and efficacy of USG versus blind on shoulder girdle injections. Significant improvement of

injection accuracy when performed guided was seen in all injection sites except for subacromial space, where only a 5% difference was seen in favour of USG. Despite this patient outcome, the functional gain was better with the USG group.

A study by Rutten et al. (2007) looked at injection accuracy of USG versus blind. 20 subjects were used, 10 guided and 10 blind, with 100% accuracy seen in both groups. There are limitations in this study as a small sample size was used and no report on patient outcome post injection. The orthopaedic consultant administering the blind injections had years of experience which may not be representative of less experienced clinicians working in different clinical settings.

Ucuncu et al. (2009) compared patient outcome following USG and blind injections into the shoulder. There was a significant difference in the guided group in relation to decreased visual analogue scale (VAS) and increased range of movement (ROM) at 6 weeks post injection. Limitations to this study are; a small sample size of 60; subjects were only followed up 6 weeks post injection with no comparison immediately after injection or long term follow up; subjects were not asked to stop oral anti-inflammatories; no report on injection accuracy with USG and blind; and there was a lack of diagnostic evidence of shoulder pathology. This makes it difficult to determine patient outcome was influenced by injection technique or how different shoulder pathologies respond to corticosteroids.

A randomized double-blind prospective study by Dogu et al. (2012) showed no difference in accuracy or patient outcome in blind versus USG in 46 subjects. Blind injections were done using a posterior approach whereas USG was performed anteriorly. Mattie and Kennedy retrospective analysis (2016) looked at 160 subjects who received a blind glenohumeral joint injection by either an experienced or an inexperienced clinician using an anterior or posterior approach. Statistically significant difference was seen in accuracy in favour of the experienced (64.6%) compared to inexperienced (37.6%). There was no difference between injecting anteriorly or posteriorly but the sample size who received a posterior approach was

likely too small to carry any meaning. In summary more studies with larger sample sizes are needed which compare accuracy and patient outcome at short and long term follow up. Clinician experience and injection approach may also play a part in accuracy which may not be reflected in all of these studies. Mattie and Kennedy who used the largest sample size highlight even experienced clinicians were still giving a high percentage of misplaced injections. Despite the inconsistency of the evidence, I am keen to only use USGI in my current clinic setting as I class myself as a novice regarding the length of time I have been injecting blind. My confidence will grow knowing that my injections are accurate, minimising any detrimental effects the steroid may have on other structures in the surrounding area. Ultrasound is not harmful to the patient unlike X-ray which emit radiation and it is quick therefore it will not impact wait times.

Pharmacology

Chronic inflammatory conditions are thought to be an indication for CSI and it is suggested, although poorly evidenced, they can break up the inflammatory damage repair cycle (Ines and da Silva, 2005). In the event of stress or tissue damage, the body triggers its own anti-inflammatory and immunosuppressive action by producing Glucocorticoids via the adrenal cortex. It is suggested that Injectable synthetic corticosteroids target the cells involved in this process to control mRNA synthesis and reduce the production of proinflammatory mediators. The steroids are lipid soluble therefore able to cross the targeted cell membrane and be transported to the cells via Transcortin (Goulding, 1998 -1999). Given patient A's duration of symptoms and evidence of thickening/inflammation of the bursa, it seems they are an appropriate candidate

CSI has been used more frequently over the past 70 years, but there remains limited literature on the exact pharmacology. Careful consideration is needed when deciding which type of steroid to use, dosage and frequency. Due to the lack of consensus, it isn't uncommon to see differences in the aforementioned across clinical settings. Patient A is a perfect example of this. My supervisor used an anterior approach to administer a volume of 3ml made up of 2ml 0.5% Marcain and 1ml of 40mg Depo-

Medrone under guidance. In my current setting I would inject blind using a posterior approach to inject a premix of 1ml 1% lidocaine and 40mg Depo-Medrone. However, Saunders and Longworth pp136 (2019) recommends using a lateral approach using 1ml/40mg Kenalog and 4ml, 1% lidocaine giving a total volume of 5ml. Despite these recommendations of drug type, dose and volume, there are no guidelines therefore clinicians make the decisions empirically more so than based on scientific evidence.

A high quality prospective randomised study by Kim et al. (2017) compared steroid does and out come when injecting to treat shoulder stiffness. 76 subjects received an USGI of 40mg triamcinolone acetonide and 71 subjects received 20mg. Both groups had a significant improvement in pain levels, function and range of movement but no statistical difference was seen between the groups regarding patient outcome in relation to steroid dosage.

Derendorf et al. (1985) looked at the absorption rate of steroids and found that less soluble steroids have a longer duration of action with Betamethasone leaving the system after 1-4 days and Triamicinolone acetonide (Kenalog) and Methylprednisolone acetate (Depo-Medrone) at 2 weeks. It is recommended that less soluble steroids are used for soft-tissue injections for longer lasting effects and to reduce the risk of side effects. A recent systematic review by Cushman et al. (2019) found that Depo-Medrone and Lederspan were the most commonly used steroid across 28 studies where injections were performed on small and intermediate sized joints. However, there were no comparisons in any of the studies on the effects of different drugs used regarding patient outcome or adverse reactions.

Randomised control trials (RCT) by Gaujoux-Viala et al. (2009) and a review of 10 RCT’s by Ang (2015) did compare patient outcome when using a variety of different injectable steroids to treat shoulder pain, lateral epicondylitis and plantar heel pain. All studies were consistent in showing on significant difference in patient outcome, making it difficult to comment on the superiority of corticosteroids. A double-blind study by Pereira et al. (2015) compared patient outcome when injecting 20mg compared to 40mg with no significant difference, therefore it is recommended to use the lowest dosage to reduce the risk of adverse effects. Given the lack of evidence, both my supervisor and myself are able to justify our choices and dosage of drug to

injects SIS when in our usual clinical setting. This highlights that steroid choice and dosage is based on experience, clinical judgement, available drugs in clinic, and personal preference. It is suggested the lowest dosage for optimal effect is preferred to avoid post injection complications (Yoon *et al*., 2013).

Patient consent

Consenting patients prior to any procedure is vital although there are few UK legal requirements to gain written consent. The law around informed consent changed following Montgomery (2015), making it vital for risks to be presented to the patient before any treatment. Guidelines from the Medical Protection Society advised risks, benefits and alternative treatment should be listed although this does not need to be exhaustive (Pcrmm, 2021). Sulmasy (1994) highlight the 4 vital elements when gaining informed consent: Patient must have capacity, explanation of what the procedure involves (including risks and alternative treatment) patient understanding, and patient authorisation. This can lead to the question around what is too much and what is too little information. Patient A consented prior to the appointment and my supervisor briefly went over some of the risks, benefits and post injection care. In my current clinical setting where I offer landmark based injections, all patients are given a Versus Arthritis steroid injection leaflet to take away and read before the procedure (versusarthritis, 2021). They consent on the day and asked to sign a consent form. Post injection instructions are given verbally and a trust post injection information leaflet is given in line with the Chartered Society of Physiotherapy (CSP) recommendations (CSP, 2019). My supervisor is happy for me to use my current consent process while I undergo my supervised injections in their clinic.

During the consent process, it was identified that patient A had type II diabetes myelitis (TIIDM) which is controlled with diet and medication. As recommend by Saunders and Longworth (2019) patient must be warned about the possible increase in blood glucose levels post injection. A study by Younis et al. 2007 showed a significant increase in blood glucose levels at one day post injection which lasted up to 7 days. A small sample size of 29 Subjects (12 with TIIDM and 19 without) were injected with Cortivazol. Cortivazol has a long half life and a strong hypothalamic-pituitary-adrenal axis suppression which may not be representative of other commonly used injectable corticosteroids. Habib and Safia (2008) support Younis

findings. Their study looked at glucose sugar levels of 6 subjects who completed the study. They documented blood glucose levels before and 2 hours after meals 1 week prior to injection, daily for 4 days then every other day for 10 days following the injection. Subjects were injected into the knee joint with 1 ml of Betamethasone. Brisk increases in blood glucose levels were seen 1 hour after injection and normalised at 48 hours. Betamethasone has a short half-life unlike the steroid used in Younis study.

Kim et al. (2017) compared high versus low dosage steroid (triamcinolone acetonide) to treat shoulder stiffness. 27 out of the 164 subjects had a diagnosis of TIIDM. Although this wasn't the primary focus of the study, they reported on blood glucose levels post injection. There was no significant increase in blood glucose, fructosamine, and HbA1c in the 2 groups at each time point after injection. However, a higher level of blood glucose was detected at 6 weeks after injection of 40mg of triamcinolone acetonide compared with the lower dose. Although two studies used small sample sizes and different injectable steroids were used, it is evident that there is a systemic effect on blood glucose levels. Therefore vital to council the patient on risk of elevation post injection and to be mindful of dosage when injecting diabetic patients. Patient A's TIIDM was well controlled therefore I feel it was safe to offer her the injection.

Medico legal frameworks

Injection therapy has been used in Physiotherapy practice since 1997 following the regulatory and educational framework (Health and Care Professionals Council, 2016) with further guidance provided by the CSP in their information papers (Therapeutic Injection-Therapy in Physiotherapy Practice. 6th Edition (2021); CSP Expectations of Educational Programmes in Injection Therapy for Physiotherapists. 3rd Edition (2021); Medicines Use in Physiotherapy Practice 6th Edition (2021)). Physiotherapists are permitted to administer licensed prescription medications only. Any person prescribing or giving medication must adhere to the laws which control the use of medicines in the UK (The Human Medicines Regulations, 2012; The misuse of Drugs Act, 1971; The Misuse of Drugs Regulations, 2001). The Medicines and Healthcare Products Regulatory Agency (MHRA) are the statutory organisation

which gives advice and enforces the law around medicine and the frameworks around using medicine in practice.

Concerns were raised during the session as there are limitations to what and how I can inject due to the framework I work under in my current injection clinic. As an independent prescriber my supervisor has the freedom to administer a wider variety of medicines and is able mix 2 licenced medicines prior to injecting. A discussion was had to overcome this barrier in preparation for when I start my USGI under supervision. The framework under which I am able to inject is a Patient Group Direction (PGD). Following the legal criteria of a valid PGD, this limits me to administering the prescribed medicines to a specific patient group as per written instruction of the senior doctor and pharmacist who signed the PGD. Mixing of 2 medicines prior to injecting is not allowed under the PGD however the use of a premix (Depo-Medrone and lidocaine) and changing the syringe during the injection is permitted (NICE, 2017). If necessary, I can work under Patient Specific Direction (PSD). This framework allows independent prescriber to give written instruction to use licenced and unlicenced medicines from the British National Formulary (BNF) to be prescribed within local and national guidelines according to the National Institute for Health and Care Excellence (NICE) NG5 Guidelines (NICE, 2015).

Conclusion

In summary, I feel that patient A was a suitable candidate for the injection taking her current presentation and past medical history into consideration. I understand that my drug choice and dosage will be limited working under a PGD. However, given the evidence on patient out come in relation to drug type and dosage I can justify my decisions and be confident in my own clinical practice. While I undergo my supervised injections, I will likely follow my mentors preferred method until I become confident to explore my own preferred technique. Performing USGI's will improve my accuracy and limit adverse effects on surrounding tissues with out impacting patient wait times.

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