Case study Topic: Ultrasound guided Aspiration and Injection of Baker cyst

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Introduction:

A Baker cyst or Popliteal cyst is a benign condition, one of the most prevalent periarticular lesions in the popliteal fossa and source of knee pain in the general population. It's a synovial cyst; fluid filled sac which forms in the posterior aspect of the knee as a result of gastrocnemius-semimembranosus bursa fluid distension **(Akgul, Guldeste and Ozgocmen, 2014)**. This condition was first described by Robert Adams in 1840 but was popularized in 1877 after British surgeon Dr William Morant Baker who described popliteal cysts cases and the eponym 'Baker's cyst' honours Dr Baker(**Smith et al., 2015)**.

Patient presentation:

A 53-year-old lady came in my Musculoskeletal ultrasound clinic for Right knee ultrasound scan referred from the trauma and orthopaedic team outpatient clinic. This patient has been treated for melanoma stage 3 B and now on adjuvant immunotherapy. Recently in last few months she started complaining of pain in her right knee which is progressing with tenderness in the popliteal area. There is no history of trauma. She tried non-steroidal anti-inflammatory drugs (NSAIDs) for the pain relief with rest, however this was ineffective and there was no improvement in her knee pain. Clinically, there was swelling medially behind her knee, knee joint movement specially knee extension/flexion was very painful and it was difficult and pain worsen with walking/standing. Her Right knee Xray report showed mild osteoarthritis with medial joint space narrowing and osteophytosis of the tibial spines. And also, mild patellofemoral joint osteoarthritis (see Figure 1 and 2).

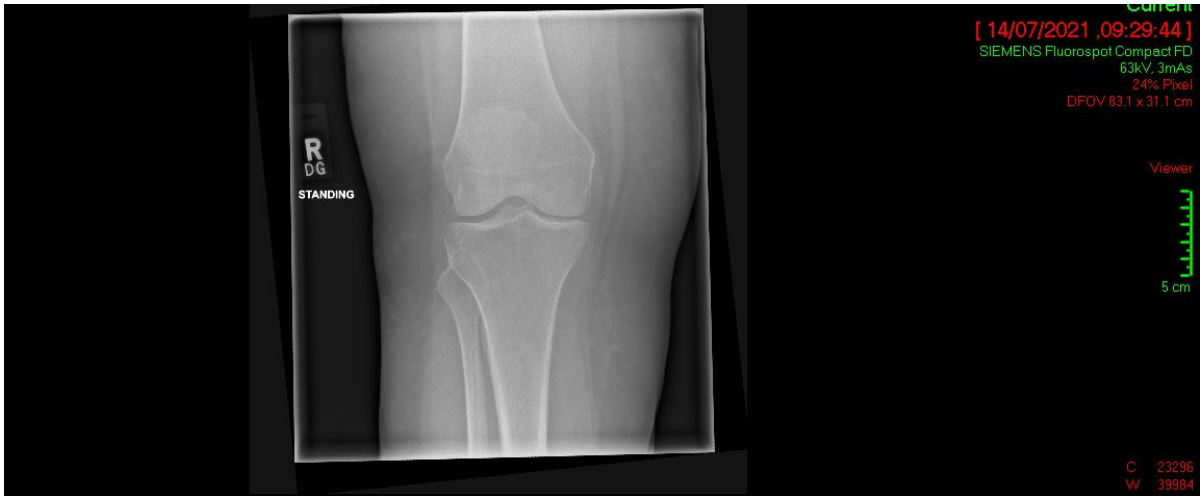

Figure 1: Anterior posterior Radiograph Right Knee

Figure 2: Lateral Radiograph Right Knee

Ultrasound findings:

A GE Logiq E 10 ultrasound machine was used to carry out the ultrasound examination. A high frequency Linear array Transducer ML 6-15 was selected for the scan. Rather than focussing on clinically symptomatic area which was the right popliteal fossa in this case, a complete examination of all knee areas was performed. The patient was positioned in the supine position with knee placed in 20 to 30 degrees flexion for anterior knee evaluation and then patient was positioned in prone position to evaluate the popliteal fossa. The ultrasound examination showed that the quadriceps and patellar tendons appear intact with no features of tendinopathy. There was a large suprapatellar pouch effusion with synovial pannus which showed some

vascularity when colour Doppler applied. Consistent with synovitis. The medial and lateral collateral ligaments were grossly intact. The medial and lateral menisci were unremarkable. Mild degenerative changes noted in the medial and lateral tibiofemoral joints. Triphasic flow seen in the popliteal artery. The Popliteal vein was compressible.

The swelling indicated by the patient correspond to an avascular cystic structure with echogenic internal debris measuring approximately 92 x 30 x 53 mm in the popliteal fossa. A fluid filled neck was seen arising from between the medial gastrocnemius muscle and semimembranosus tendon. The ultrasound features were suggestive of a Baker's cyst (See Figure 3-7).

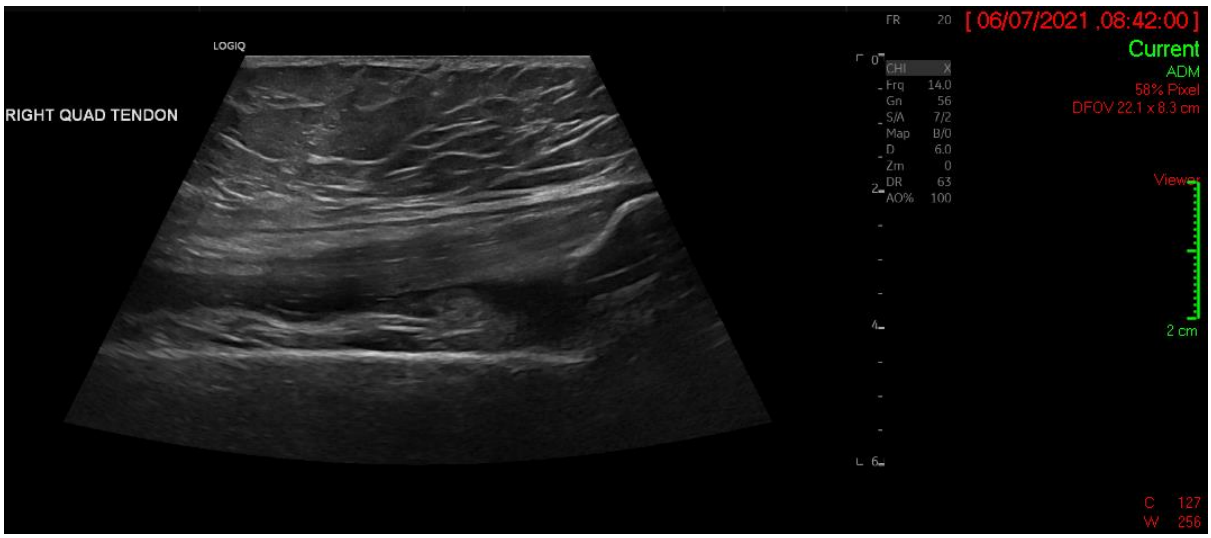

Figure 3: Longitudinal image of the suprapatellar region of the knee. The quadriceps tendon can be seen to have intact fibrillar pattern.

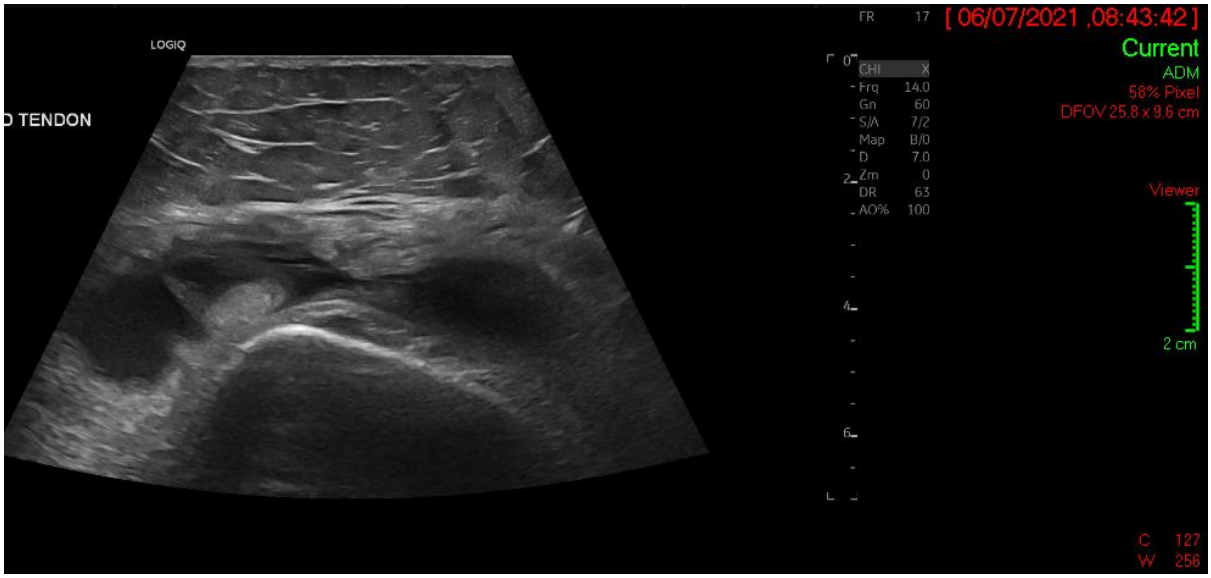

Figure 4: Transverse image of the suprapatellar region showed joint effusion and synovial proliferation.

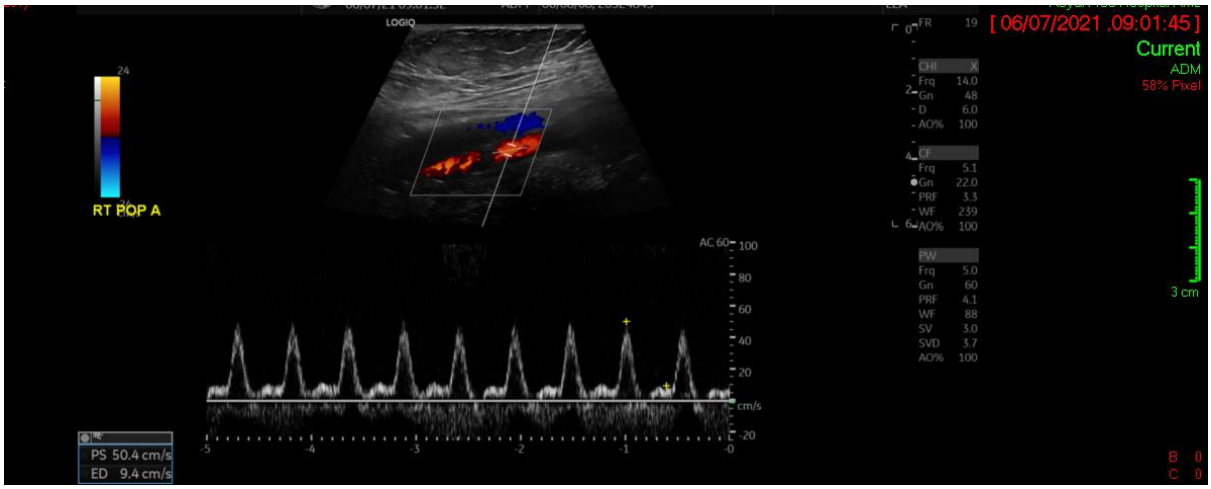

Figure 5: Duplex ultrasound. Spectral waveforms obtained from a normal right popliteal artery. The waveforms show a normal triphasic velocity pattern.

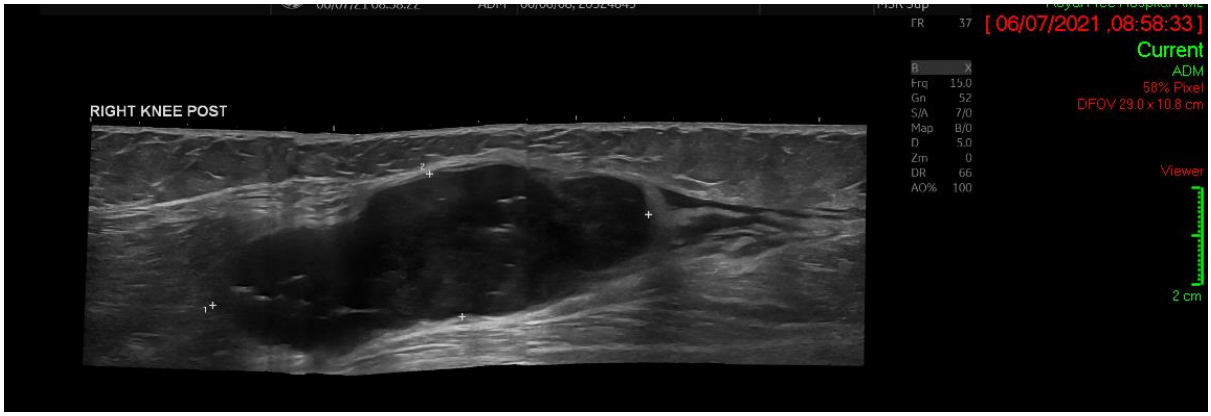

Figure 6: Longitudinal image of the medial aspect of the popliteal fossa shows the Baker cyst. Callipers outline the cyst which is anechoic with hyperechoic foci within.

Figure 7: Longitudinal image of the medial aspect of the popliteal fossa shows the Baker cyst. Power Doppler imaging demonstrates no vascularity.

Patient was referred back to her physician to discuss the results. The results were discussed with Rheumatology and patient was referred back to Ultrasound department for urgent drainage of Baker cyst due to its size and now she was unable to walk and causing too much pain. Patient was not on anticoagulants. Consultant Radiologist performed the scan and reported moderate sized right knee joint effusion with synovial thickening and similar size complex Baker's cyst. The patient was consented for the aspiration and informed about the procedure steps. The injection site and probe were cleaned using “Chloraprep”, a chlorhexidine and isopropyl alcohol solution. Sterile gel was applied to the target area and sterile gloves were donned. Aspiration was performed with the needle in plane with the transducer and the needle was entered from inferior to superior. Following superficial infiltration with 1% lidocaine attempted aspiration was made. Despite of using

19-guage needle no fluid could be aspirated suggested complex inflammatory content and synovial proliferation. Patient well tolerated the procedure. Radiologist recommended a steroid injection for symptom relief if no contraindication with other treatments in her report (see Figure 8)

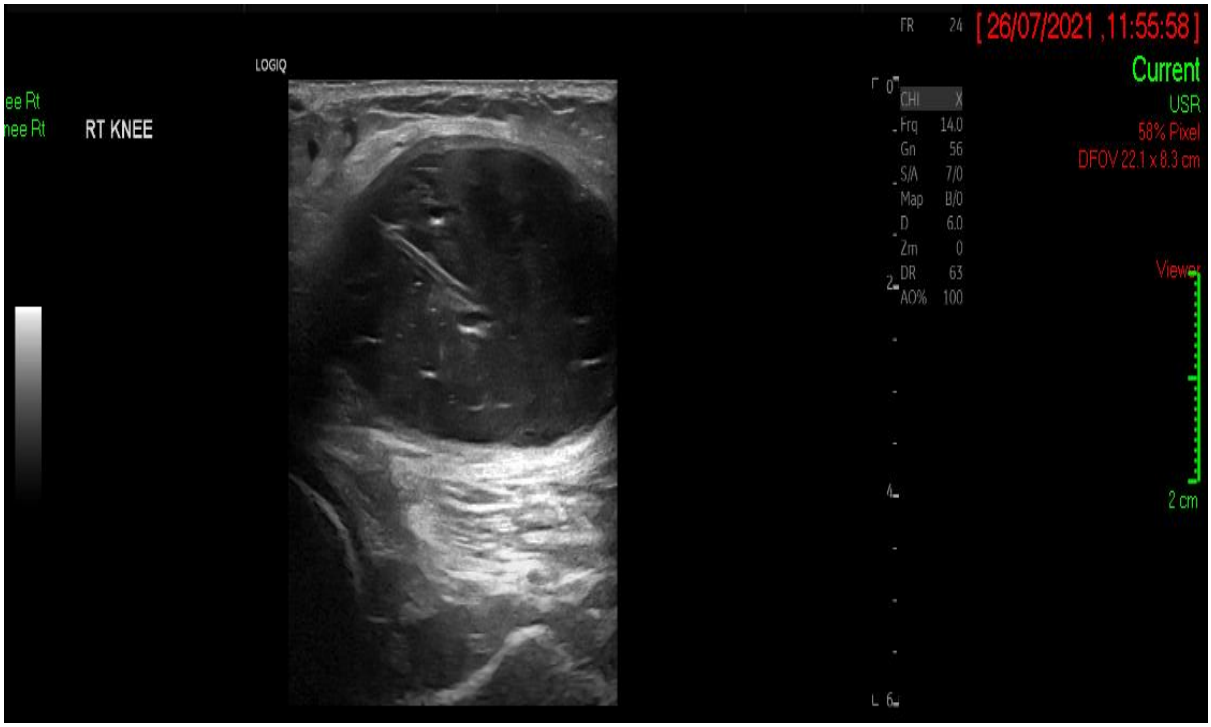

Figure 8: The needle tip during aspiration using an in- plane technique can be visualized within the cyst.

Discussion:

Baker cysts occurrence are common in adults and children, however most commonly in children it is a primary process where cyst arise directly from the gastrocnemius-semimambranosus bursa and do not communicate with the knee joint space. The peak prevalence of Baker cyst in children is from four to seven years of age, often asymptomatic and do not require treatment and resolve completely without treatment. The prevalence in adult increases with the age **(www.uptodate.com, n.d. and Adiyeke et al., 2017).** In adults it's can be associated with degenerative like osteoarthritis, rheumatoid arthritis, infectious arthritis) and history of trauma like cartilage or meniscal tears **(Ryman, 2019).** There are several mechanisms which leads to formation and maintenance of Baker cyst including a) Joint -cyst communication b) There is a valve like effect between the joint space and cyst which leads to sequestration of synovial fluid into the popliteal fossa c) Herniation of the joint capsule into

the popliteal fossa **(Leib et al., 2021)**. Majority of these cysts are asymptomatic and may be miss half of them on physical examination **(Park, Kwon and Kwon, 2020)**. Commonly patient present with sensation of tightness, swelling, pain or stiffness of the knee which aggravate with activity, bulge in the back of the knee and may inhibit full flexion or extension of the knee **(Masci, 2021).** Clinically Foucher's sign is positive i.e., with knee in 45 degrees flexion Baker cyst swelling tend to reduce or disappear due to relief of tension within the cyst **(Maximiliano et al., 2018).** It is useful to differentiate the Baker cyst from other popliteal masses like popliteal artery aneurysm, soft tissue tumours, meniscal cyst, haematoma, abscess, ganglion cyst, lymphadenopathy, lipoma, arteriovenous fistula and deep vein thrombosis (DVT). Patient may present with signs or symptoms of thrombophlebitis. This condition can be seen in large ruptured Baker cyst (**Frush and Noyes, 2015**). Clinically patient should be examined in standing position with knee in full extension and this should make posterior knee mass prominent. Patient should be examined in supine position as well where knee should be adequately examined. Sometimes Baker cyst located more laterally and no changes seen with knee full range of motion, in these cases it will be difficult to diagnose Baker cyst and with no previous history of knee joint pathology **(Leib et al., 2021)**. Baker's cyst can be easily missed at physical examination. Imaging studies are performed in cases where there is diagnostic uncertainty and it is important to diagnose as condition like ruptured Baker cyst if miss can lead to complications like compartment syndrome. In suspected cases of Baker cyst imaging workup include plain radiographs, ultrasound and MRI. It is useful to obtain plain radiograph of knee to detect condition like osteoarthritis, inflammatory arthritis and loose bodies as these can be associated with Baker cyst. Ultrasound has high sensitivity and specificity in Baker cyst diagnosis and interventional treatment as it is non-invasive, easily available, cost effective and absence of radiation **(Serrano, Ferreira and Özçakar, 2020)**. Also, Doppler ultrasound can confirm the absence of vascular flow within the mass to exclude vascular conditions like popliteal artery aneurysm etc. Only disadvantage of ultrasound is, it is highly operator dependent and cannot differentiate from other conditions like meniscal cysts or myxoid tumours and does not adequately visualize other condition in the knee that are associated with these cysts such as meniscal tears. Then in these conditions MRI can differentiate them rather than ultrasound as it allows assessment of the entire spectrum of related disorder such as chondral tears and ligament tears. But the

main disadvantage of MRI is high cost. Therefore, if the evaluation of the intra articular structures is not necessary, Ultrasound should be considered as a screening modality (**Physiopedia, 2018 and Frush and Noyes, 2015**).

On ultrasound examination, Baker cyst appears as a well-defined, anechoic or hypoechoic cystic lesion with posterior acoustic enhancement representing enlargement of the semimembranosus-gastrocnemius bursa. Generally, it has a rounded appearances at its proximal and distal ends but if it ends are sharp indicates rupture of the cyst. Baker cyst can be categorized as simple cysts and complex cyst on ultrasound examination. Simple Baker cyst will be anechoic lesions with smooth and well-defined borders and a thin synovia wall. Complex Baker cyst will have atypical findings like intensive internal echoes, septations, calcifications, synovial thickening or hypertrophy, haemorrhage of loose bodies (**Chen, Lew and Liao, 2012 and Köroğlu et al., 2012**). The complex Baker cyst due to its septations and multilocularity leads to complicate the draining procedure and also hinder corticosteroid entering into every section of the cyst (**Fredericksen and Keil, 2021).**

Asymptomatic Baker cysts found incidentally do not require any treatment. But patient should be advise about small risk of cyst rupture in future and they should seek medical attention if they develop symptoms. Complications related to the presence of popliteal cysts include infection, rupture and neurovascular compression **(Lee et al., 2020)**. Infected Baker cyst is much less common. Aspiration of the knee joint or the Baker cyst in infected cases will show purulent fluid. The most common causative organism is staphylococcus aureus. The initial treatment for symptomatic Baker cyst should be non-operative, rest/activity modification can temper the pain that bursa is causing, taking non-steroidal anti-inflammatory drugs (NSAIDS) to alleviate the pain and ice to the swollen cyst and knee joint. The treatment is based on the principles of R.I.C.E (rest, ice, compression and elevation) **(Physiopedia, 2018).** Synovial osteochondromatosis (SOC) or Baker's dozen is a benign condition may be secondary to Baker cyst characterized by synovial hyperplasia and changes in the cartilage leads to chondromas **(Sheikh and Siau, 2015)**.

Ultrasound guided aspiration of Baker's cyst

For symptomatic relief, a Baker's cyst can be aspirated. All patients should undergo sonographic confirmation of the Baker cyst. Also, a colour Doppler view should be obtained to rule out any vascular lesion. Palpation guided aspiration carries a high risk of puncturing the neurovascular bundles in the

popliteal fossa, whereas needle placement and appropriate drainage will be more accurate with ultrasound guided aspiration. A 18-20 gauge needle should be preferably use because of the content of the cyst, as if it's very viscous difficult to be aspirated. It is good practice to use needles with large tip as large tip will prevent obstruction of the needle pore by debri (**Chen, Lew and Liao, 2012**). Also, aspiration of the the knee joint before aspiration of the Baker cyst in patients older than 50 years is proven to give better results. If knee joint will not be aspirated before Baker cyst, there will be re accumulation of the fluid in the Baker cyst as 50% of the Baker cyst communicate with the knee joint. Several studies have proved that the steroid injection followed by aspiration of Baker cyst led to symptomatic improvement and also reduce the risk of recurrence. Also, similar results with steroid injections in patients with history of knee osteoarthritis **(Jacobson, 2018)**. **Smith et al (2015)** conduct a retrospective cohort study, all the patients enrolled in the study had ultrasound confirmation of the Baker cyst, cyst was aspirated using in-plane approach, once cyst was completely aspirated cyst peripheral walls were fenestrated using the needle tip. The fenestration with the needle tip was done in 6 different locations within the wall of the cyst. Then followed by injection of mixture of 0.5 % bupivacaine and 40 mg/ml of triamcinolone with in the cyst remnant cavity. Post procedure all the patients had knee compression for 2 weeks with an elastic bandage. They found that in addition to cyst wall fenestration, use of knee compression for 2 weeks post procedure was the key factor in positive outcome of the treatment. Patients had significant clinical improvement. Cyst wall fenestration and elastic bandage prevent recurrent synovial fluid imbibition between the cyst walls and promote adherence. Hence, the recurrence cyst rate was lower with this treatment. **Köroğlu et al (2012)** in his prospective study followed 32 patients with symptomatic Baker cyst and known history of osteoarthritis with Baker cyst aspiration and corticosteroid injection. All patients were advised to wear compression bandage post procedure 1 week. This is the first study in which they classify Baker cyst into simple and complex cyst. All the cases were followed up after the treatment and showed decrease in the volume of Baker cyst and also clinically as well there was improvement in their symptoms. They didn't find any recurrence of cyst in simple Baker cyst cases however complex Baker cyst's relapsed and need more closely follow up for any repeat treatment. Their results indicate that Baker cyst secondary to osteoarthritis can be treated with percutaneous aspiration and steroid injection as the first

line of treatment. Also, they confirm in the study that ultrasound guided aspiration is a safe procedure as they didn't record any adverse outcome. Similarly, **Fredericksen and Keil (2021)** described the efficacy of a bed side procedure where ultrasound guided aspiration of Baker cyst and steroid injection was performed in patient with knee osteoarthritis in Emergency room. He explained that many patients in emergency present with symptomatic knee pain have already tried pain relief such as topical and oral anti-inflammatory drugs. Other patient's category present in emergency cannot take some pain killers patient like patient with chronic kidney disease or history of gastrointestinal bleeding. This emergency bed side procedure can be considered as effective treatment for symptomatic Baker cyst who have not responded to pain medication (non-opiate). Rupture Baker cyst is rare but the most often complication seen with this condition and it's very important to accurately diagnose it and rule out other conditions like thrombophlebitis or deep venous thrombosis (DVT) to avoid unnecessary medical treatment like anticoagulants. Also, early management of ruptured Baker cyst cases allow complete recovery and also reduce risk of complications like compartmental syndrome. Patient present with severe pain which simulates muscle rupture and also it can produce bruising which involve posterior calf area down to the ankle. **Mortada, Amer and Zaghlol (2020)** did a retrospective observational study which is the first study to check the efficacy and safety of ultrasound guided aspiration plus corticosteroid injections of ruptured Baker cysts. All 42 cases in the study had ultrasound confirmation of the Baker cyst. Baker cyst were classified as simple (thin cyst wall and smooth borders) and complex (echogenic bodies, septations, internal synovitis). The rupture Baker cyst has the pointed configuration of the distal edge and fluid extension to the lower calf. Under ultrasound guidance Baker cyst was aspirated using 18-gauge needle, the cyst content was diluted with 1% lidocaine to help with complete evacuation of the cyst. In cases where there was complex Baker cyst with internal septations, the cyst was aspirated from different points until the cyst was completely decompressed and then 40 mg triamcinolone acetonide was injected into the cyst once or twice with one week apart according to the study criteria. All the patients were advised to wear compression bandage post procedure for one week. This will help chance to reduce the recurrence as compression will help to promote adhesions of the evacuated cyst walls. Follow up results showed a significant improvement clinically. Recurrence rate

was higher in complex type and concluded that followed procedure is highly effective in treating both simple and complex Baker cyst.

Çağlayan et al (2016) did a controlled clinical trial study to check in patients with Baker cyst whether ultrasound imaging can be used to provide visual biofeedback and it effect on treatment outcome. For this study, 52 patients were enrolled with symptomatic Baker cyst. Patients were divided in two groups: one group during the procedure of aspiration and steroid injection did not observe the ultrasound screen and other group did and were explained the images. The exact mechanism of action of this visual biofeedback is not known. But it has been reported that direct visualization will decrease the pain intensity.

As discussed, earlier management of symptomatic Baker cyst is conservative but surgical excision may be required if the cyst remains symptomatic with pain and significant functional impairment even with the intraarticular steroid injections. Arthroscopic drainage of and cystectomy of Baker's cyst has several benefits like it is minimally invasive, less traumatic, faster recovery and recurrence rate is low as cyst wall can also be arthroscopically resected **(Jiang and Ni, 2017) and (Wu et al., 2017).** Similarly, a systemic review on treatment methods of popliteal cysts also suggested arthroscopic debridement of the cyst wall is an effective method with least recurrences **(Van Nest et al., 2020)**. A study, done on total 102 patients with osteoarthritis found the size of the Baker's cyst decreased significantly after total knee arthroplasty (**Hommel, 2017)**. Results of open Baker cyst excision, often are not good as there is high rate of recurrence as a result of recurrent effusion due to underlying presence of intraarticular pathology and also prolonged period of recovery **(Saylik and Gökkuş, 2016)**. Recently in the treatment options of Baker's cyst specially in the setting of the pot traumatic osteoarthritis, there are cases reported using of Leucocyte -rich platelet rich plasma may be considered as a treatment option as it helps in reduction of cyst size and pain. But additional studies and research are needed to check its efficacy in treating the condition **(Song, Yeh and Jayaram, 2020)**.

Conclusion:

In conclusion for Baker cyst, ultrasound diagnosis, ultrasound guided aspiration followed by corticosteroid injection can be considered as safe and cost-effective method for management of Baker cyst. Baker cyst should be classified as simple and complex before the treatment. Complex group need more close

monitoring for early and proper management. It is very important to treat underlying joint disorder as this will reduce the accumulation of the synovial fluid and cyst size. Surgical excision is not a definitive treatment as recurrence of cyst is high after surgery due to underlying joint disorder.

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