Clinical Commentary

Treatment of osseous cyst-like lesions

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Osseous cyst-like lesions (OCLL) are focal, radiolucent areas with a sclerotic rim and a dome, conical or spherical shape typically located within the epiphyseal trabecular bone adjacent to a weight-bearing area of the articular surface (Jeffcott et al. 1983; von Rechenberg et al. 1998; Sherlock and Mair 2011; Denoix et al. 2013; Balducci et al. 2019; Bonilla 2019). Most OCLLs communicate with the joint through tracts of varying sizes. The uni- or multi-loculated cystic cavities have a distinct fibrous lining and are filled with fibrous tissue, gelatinous fluid and in some instances fibrocartilage which may be partially mineralised and occasionally contain necrotic bone (Jeffcott et al. 1983; von Rechenberg et al. 1998; Sherlock and Mair 2011). The fibrous tissue within the cyst produces interleukin-1 β, interleukin-6, nitric oxide, prostaglandin E2 and neutral metalloproteinases, which may contribute to the maintenance, poor endogenous healing and expansion of the cystic lesions (von Rechenberg et al. 2000).

Osseous cyst-like lesions, which were traditionally called subchondral bone cysts, are the most common of the three types of bone cysts recognised in the horse, which also include the rarely reported aneurysmal and unicameral bone cysts (von Rechenberg et al. 1998; Sherlock and Mair 2011; Denoix et al. 2013; Stöcker et al. 2017; Balducci et al. 2019; Bonilla 2019). While aneurysmal and unicameral cysts are true bone cysts, which are defined as closed cavities lined by epithelium, OCLLs lack an epithelial lining and usually have articular communication and thus are more appropriately termed osseous/subchondral cyst-like lesions (Sherlock and Mair 2011; Bonilla 2019). Osseous cyst-like lesions in horses are most commonly found in males (62%) in the medial condyle of the femur (45.8%), followed by phalanges (26.2%), carpal bones (7.1%), metacarpal and metatarsal bones (6%), fibia (4.4%), radius (3%), talus, sesamoid bones, patella, scapula and tarsal bones (von Rechenberg et al. 1998). They can be an incidental finding but often are associated with variable degrees of lameness ranging from mild to severe with an insidious or acute onset (Bonilla 2019).

A significant body of evidence supports a multifactorial aetiology of OCLLs, including environmental (dietary imbalance and biomechanical factors), physiological (growth, conformation and hormonal imbalance) and genetic factors, and their classification into two broad categories, developmental/juvenile and acquired OCLLs (Jeffcott et al. 1983; Ray et al. 1996; Sherlock and Mair 2011; Walker et al. 2016; Naccache et al. 2018; Balducci et al. 2019). While developmental OCLLs are a manifestation of osteochondrosis and are typically diagnosed in young horses commencing training, acquired OCLLs are a sequela of acute or chronic trauma or overloading of the articular cartilage and its supporting subchondral bone and can occur in all age groups (Jeffcott et al. 1983; Sherlock and Mair 2011; Balducci et al. 2019). Regarding the pathogenesis of OCLLs, the two main postulated theories are the synovial fluid intrusion and bony contusion theories (Kaspiris et al. 2013; Chen et al. 2015), which also may operate together (Gorbachova et al. 2018). These hypotheses are in part supported by experimental studies, that demonstrated the ability to induce OCLL formation by damaging both the articular cartilage and the underlying subchondral bone, while injury to the articular cartilage alone did not result in OCLL development (Ray et al. 1996; von Rechenberg et al. 2003; Williams and Santschi 2017). Secondary synovial fluid invasion, inflammation and osteoclastic bone resorption initiated by contact of mononuclear cells in synovial fluid with subchondral bone may further contribute to the development of OCLLs (Williams and Santschi 2017). Although there is not much evidence indicating that the pressure of the invading synovial fluid damages the trabecular bone directly, the pressurised fluid may alter loading conditions of the surrounding bone and induce a mechanoregulated bone adaptation response (Cox et al. 2011). In contrast to the prevailing hypothesis that the fluid pressure would increase the load, a finite element model of bone microarchitecture has recently demonstrated that pressurised fluid decreased the load on the surrounding bone by stress-shielding, thereby leading to net bone resorption and growth of the cavity (Cox et al. 2011).

The OCLL described in the accompanying case report ‘Treatment of a subchondral cystic-like lesion in the distal scapula with a translesional bone screw in a horse’ by C. Corraretti et al. (2020), in a 2-year-old French Warmblood not yet in training, with no history of trauma, can likely be categorised as a developmental lesion arising secondary to osteochondrosis. Osteochondrosis, defined as a focal disturbance of endochondral ossification leading to the development of osteoarticular lesions (osteochondrosis dissecans or OCLLs) at specific predilection sites of predisposed joints, affects 10–30% of the equine population as well as other species such as pigs, dogs, cattle, sheep, poultry and also humans (Rejnö and Strömberg 1978; Desjardin et al. 2014; Naccache et al. 2018). While for asymptomatic lesions, conservative treatment is recommended, conservative treatment of clinically significant OCLLs in any location with stall rest, systemic nonsteroidal anti-inflammatory drugs and intra-articular medications has generally yielded unsatisfactory outcomes. Therefore, several surgical treatment approaches have been developed with reported success rates ranging from approximately 50–85% (Howard et al. 1995; Hogan et al. 1997; Bodo et al. 2004; Fuerst et al. 2007; Wallis et al. 2008; McIlwraith 2013; Santschi et al. 2015; Golonka et al. 2018; Jackson et al. 2018; Jackson et al. 2019).

The trans-cystic screw employed in the case report by Corraretti et al. (2020) is a recent popular addition to the
surgical treatment repertoire and is based on the ability of trabecular bone to adjust and realign to the peak loading direction and the hypothesis that the screw returns trabecular bone strain to the interior of the OCLL. By altering the biomechanical environment of OCLLs, the screw is expected to promote bone healing and thus provide a foundation for attachment of remaining hyaline cartilage, prevention of contact of joint fluid with damaged bone, and load transfer (Santschi et al. 2015; Frazer et al. 2019a, 2019b; Frazer et al. 2020). Finite element analysis demonstrated that increasing screw compression enhances total bone surface area, providing evidence that drilling a forage hole or placing a screw without compression is less effective in stimulating bone formation (Frazer et al. 2019a, 2019b; Frazer et al. 2020). In preliminary studies inserting screws in lag fashion across medial femoral condylar OCLLs, an increase in OCLL density and resolution of lameness in 75% of horses was achieved (Santschi et al. 2015). Similarly, treatment of subchondral lucencies in the medial proximal radius with a bone screw yielded promising results (Roquet et al. 2017).

A recent metanalysis (O’Brien 2019) compared conservative treatment with ultrasound-guided intraleisional injection (Plevin and McLellan 2014) and 6 surgical treatment options for medial femoral condylar OCLLs: debridement via arthrotomy ± cancellous bone graft (Kold and Hickman 1984; White et al. 2010), arthroscopic debridement ± chondrocytes/IGF-1 graft (Howard et al. 1995; Ortved et al. 2012), arthroscopically guided injection of the OCLL with corticosteroids (Wallis et al. 2008) and transcondylar screws (Santschi et al. 2015). Based on the reported success rate, speed of return to function and cost, they concluded that arthroscopic intraleisional corticosteroid injection seems to be the initial treatment of choice in most cases and lag screwing appears to be the most suitable second-line treatment should the former fail (O’Brien 2019). Since older animals (>3 years) have been shown to be less likely to return to soundness or to work than younger horses (Smith et al. 2010), initiation of treatment should not be delayed beyond the individual joints’ window for regression and resolution of osteochondral abnormalities, which closes at 5 months for the tarsus and at 8 months for the stifle (Dik et al. 1999). For the shoulder, that time frame has yet to be established.

The 2-year-old French Warmblood stallion described in the associated case report (Corraretti et al. 2020) showed intermittent 2/5 (AAEP scale) left forelimb lameness with a shortened cranial phase of the stride and was diagnosed with an OCLL in the caudal half of the glenoid cavity of the scapula with no other radiographic abnormalities of the scapulohumeral joint. Osteochondrosis of the scapulohumeral joint (SHJ) is considered to be the most severely debilitating form of osteochondrosis in the horse, due to the constant loading of the majority of the glenoid articular cartilage (Nyack et al. 1981; Jenner et al. 2008). The scapulohumeral joint is a diarthrodial ball-and-socket joint with 3 degrees-of-freedom but the primary movement is flexion-extension (Harrison et al. 2012). In addition, the scapula is exposed to mediolateral bending that causes high strains at the junction of the spine and the neck and tension of the biceps brachii muscle-tendon unit on the supraglenoid tubercle and cranial aspect of the neck (Vallance et al. 2011).

Osseous cyst-like lesions of the scapula are rare with only 4/703 reported cysts being located in the scapula (Nyack et al. 1981; von Rechenberg et al. 1998). Accordingly, there is little experimental or clinical data to base treatment decisions on. In the accompanying case report, Corraretti et al. (2020) decided to treat the OCLL with a unicortical, trans-cystic 4.5 mm (50 mm long) self-tapping cortical screw placed in neutral fashion in a lateromedial direction across the OCLL without drilling through the axial trans cortex of the scapula to avoid iatrogenic damage to the brachial plexus and axillary artery and vein, with the intention to stabilise the cystic area and to promote bone healing. Given the reported poor holding strength of screws placed in the scapula (Ahern et al. 2017), the narrow dimension of the scapula in a lateral to medial plane and the comparatively large size of the cyst (19 × 28 mm), the screw could only engage limited bone stock on the far side of the cyst, raising doubt whether biomechanical stabilisation of the cyst could contribute much to the successful outcome of this case. Based on biomechanical considerations, the possibility of pathological fractures through OCLLs described in other OCLL locations (Williams and Santschi 2017) and the reported scapula fracture configuration in racehorses, with 93% of fractures extending intra-articularly to the glenoid in the frontal plane (Vallance et al. 2011), a cranio-caudally placed screw would be biomechanically superior but complicated by the biceps tendon and the caudal location of the cyst. The treatment success in this case invites further studies into the mechanism of action of trans-cystic screws in addition to biomechanical cyst stabilisation and the induction of a mechanoregulated bone adaptation response, such as providing access to blood vessels and mesenchymal stem cells, and/or decompression of the cyst and removal of the stress-shielding effect of the pressurised cyst contents as has been reported in human patients (Pretell-Mazzini et al. 2014; Noordin et al. 2018). Should cyst decompression indeed significantly contribute to the healing response, use of a cannulated screw might enhance the therapeutic effect (Pretell-Mazzini et al. 2014; Noordin et al. 2018). The interesting case report by Corraretti et al. (2020) introduces another treatment option for management of this rare condition, which to date has been associated with a poor prognosis for return to full athletic function.

Author’s declaration of interests
No conflicts of interest have been declared.

Ethical animal research
Not applicable to this clinical commentary.

Source of funding
None.

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