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Short Commentary

Bone and Soft Tissue Tumours of the Foot and Ankle

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Epidemiological Considerations

Overall, tumours of the foot and ankle regions are rare. Whereas only 3 – 6 % of all osseous tumours found in the human body are confined to the pedal area, there are numbers of 5 % of all benign soft tissue tumours and at least 8 % of all malignant soft tissue tumours, resp., which are encountered in the foot and ankle [1].

Regarding pedal bone tumours, there is a strong preponderance of benign entities, reaching roughly 84 %. In contradistinction, only 50 % of all soft tissue pedal masses turn out to be benign [2].

The frequency (excluding ganglion cysts) of occurence of pedal tumours is divided into two peaks: the first peak falls into the first decade of life whereas the the second (smaller) peak lies within the 8th decade [3]. There is no overt difference in sex and race.

Local Distribution of Pedal Tumours

Considering bony tumours of the foot and ankle, the vast majority of these tumours are arising in the hindfoot and ankle, resp. Metatarsal bones as well as phalangeal bones are much less frequently affected. This is quite different in comparison to soft tissue tumours where the forefoot is the foremost afflicted site of such tumours [1].

Signs and Symptoms of Pedal Tumours

One major problem in identifying pedal tumours is confined to the fact that foot pain is a common feature due to daily mechanical stress, which can masquerade tumour-induced pain. Another problem is given by the fact that pedal tumours are often outside of a physician´s scope because of their rarity and are therefore not taken into account.

Although „lumps and bumps“ are readily detected by clinical investigation due to shallow soft tissue layers, covering the foot, diagnosis is nevertheless considerably delayed (2- to 3-fold compared to other body regions) [4]. This delay in establishing a timely diagnosis has usually to do with an underestimating these tumours as they are appearing as small masses. Small, well-demarcated and rounded soft tissue masses are erroneously considered as being simply benign or harmless, resp [5]. As a consequence, this assumption may lead to misdiagnosis and treatment failure. Fortunately, both delayed diagnosis and treatment do not deteriorate prognosis and overall survival because of the very slow pedal tumour growth rate (10 – 20-fold reduced growth rate compared to the rest of the body) and the overall small tumour size [6].

Special Anatomical Situation of the Foot and Ankle

Compartimental anatomy of foot and ankle is quite different compared to other body regions. Whereas the plantar soft tissue of the foot can be divided into distinct compartments, the dorsal aspect of the foot is mainly unseparated and therefore considered extra-compartimental. The same applies to the ankle region which is also considered extra-compartimental due to thin and perforated septae, allowing free tumour spreading. Furthermore, close relationship of some tumours to plantar neurovascular bundles may cause severe functional deficits in the case of foot-sparing resective procedures. Proper knowledge of unique compartmental anatomy is therefore of particular importance for surgical plannings [7].

Tumours smaller than 3 cm should be subject to excision biopsies if safely possible. Tumours larger than 3 cm should be diagnosed by open excision biopsy or by percutaneous core biopsy, using closed coaxial biopsy systems alternatively. No matter which biopsy strategy comes into operation, compartmental anatomy has to be respected otherwise the entire extremity is threatened to be lost due to compartimental contamination.

Imaging Diagnostic Work-Up

Plain Radiography: X-ray examination should be the first imaging modality if a mass lesion of the foot is present because of at least three reasons: 1, to get an overview about the osseous situation of the entire pedal skeleton; 2, to localize and characterize bony lesions if present; 3, to detect calcifications or ossifications within the mass lesion (the so-called tumour matrix).

Ultrasonography: Ultrasound examination plays an important role in the work-up of any palpable mass lesion in the foot. Because ganglion cysts are frequently encountered in the ankle and forefoot areas, ultrasonography is capable to clearly identify pure cystic lesions, thus they can be excluded from further clearing. If there are cyst-like lesions which are not clearly referred to as pure cysts or if there are solid soft tissue masses present, they all should be further evaluated, using MRI.

Computed Tomography: CT comes into play in such cases where bony abnormalities or osseous tumours, resp., should be further evaluated. CT proves to be helpful with the pedal skeleton because of its complex anatomy to image all bony components without superposition. Furthermore, CT is most sensitive if (even subtle) calcifications are looked for. Evidence of soft tissue calcificatons

or ossifications, resp., turns out to be of paramount importance for differential diagnostic considerations (e.g., crystal depositions, phleboliths, ossifying myositis, chondrogenic calcifications, calcifications in synovial cell sarcoma).

Magnetic Resonance Imaging: MRI is the most powerful diagnostic modality within the diagnostic approach to pedal tumours. Superior soft tissue contrast helps to delineate and to differentiate both soft tissue masses and bone tumours, particularely for staging purposes (Enneking staging system, AJCC staging system). Contrast-enhanced techniques are able to distinguish viable and cystic or necrotic areas within the masses which is in particular helpful as a guidance for biopsy or resection plannings, resp.

Other Imaging Modalities: such as nuclear medicine techniques (bone scintigraphy, positron-emission-tomography) and digital subtraction angiography are all of minor importance in the routine diagnostic work-up of pedal tumours.

Tumours and Tumour-Like Lesions of the Foot and Ankle

In general, commonly encountered bone and soft tissue tumours of the human body can all be found in the foot and ankle, too. However, there are some special issues with such pedal tumours.

The majority of pedal osseous tumours are benign, comprising osteomas, osteochondromas, osteoid osteomas, as well as osteoblastomas, chondroblastomas, and enchondromas. Furthermore, there are also lytic bony lesions, including cysts (e.g., intraosseous ganglia, geodes, ABC), and giant cell tumours. There is a peculiar trabecular-poor area within the calcaneal body (stress-shielded region) which often develops intraosseous lipomas (vicarious lipoma). Those lipomas in turn may render liquid or they become calcified due to fat cell necrosis [8].

Malignant bone tumours of the foot are – as said earlier – very rare and constitutes of osteo- and chondrosarcomas as well as Ewing sarcomas. Although they are rare, they carry the same potential of both local recurrence and metastastic spreading as similar tumours somewhere else in the human body [9].

Considering soft tissue tumours, the pedal situation is somewhat different: cysts, ganglia, and bursae are frequently encountered because of the excusively joint- and tendon-rich anatomcial conditions alongside the entire foot and ankle. Leaving them out, there are a lot of benign solid tumours which are found in the foot: plantar fibromatosis, tenosynovial giant cell tumour, lipoma, neurogenic tumours, as well as hemangiomas and vascular malformations. In the forefoot, there is an unique tumour-mimicking entity, the so-called Morton´s neuroma. Being actually a misnomer, Morton´s neuroma is not a true neoplasia but rather a perineural reactive fibrosis. In contradistinction, to pedal bony tumours, there is a significant number of malignant soft tissue tumours, comprising synovial cell sarcoma, clear cell sarcoma, and epitheloid sarcoma [10]. While rarely encountered elsewhere in the human body, these malignant tumours are relatively typical for pedal soft tissue malignancies. Moreover, some of these soft tissue sarcomas are able to metastasize, using lymphatic pathways.

Although soft tissue sarcomas of the foot are – in general – less aggressive when compared to other body regions, the risk of local tumour recurrence is high because of the unique compartimental situation at the foot and ankle. For this reason, expectative procedural approach in the case of potentially malignant pedal tumours is highly questionable and amputations remain a mainstay in the curative therapy of these tumours [11].

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