



Role of Preoperative Imaging in Hand Tumors Comparative Analysis of Clinical and Radiological Prediagnosis with Histological Results in 121 Consecutive Patients

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Abstract

Background: Tumors of the hand and wrist differ from tumors located elsewhere in the body. Preoperative radiologic imaging is frequently requested in hand tumors, mostly with an aim to contribute to preoperative diagnosis and define tumor extent. The purpose of our study was to perform an analysis of primary tumors of the hand in 121 patients and assess the role of preoperative radiological imaging in hand tumors.

Methods: Between 2007 and 2011, we operated 112 patients due to primary soft tissue and bone tumors of the hand. Patient demographics, tumor location, affected side (right or left), clinical prediagnosis, requested radiologic examinations and radiologic prediagnosis, treatment protocol, recurrences during the postoperative follow up period were recorded. Pathology reports were analyzed and compared with the preoperative diagnosis based on radiologic studies and clinical diagnosis.

Results: Ganglion cysts were the most common tumor type, constituting 25% (n=30) of the tumors, followed by giant-cell tumors of tendon sheath (GCTTS) and lipomas with rates 13% (n=16), and 12% (n=15), respectively. Among these patients, the most frequently requested radiological methods were MRI in 84% (n=69), USG in 13.4%, and CT in 2.4%. Comparison according to tumor type showed that MRI was 84.6% sensitive for lipoma, 62.5% for ganglion cyst, 57.1% for giant-cell tumor of tendon sheath, and 55.6% for hemangioma. Accuracy of clinical prediagnosis without any radiological imaging was 76.8%.

Conclusion: The result of the present study suggest that although preoperative imaging methods are useful for predicting local extension of tumor and tumor size, they are inferior to clinical examination in the diagnosis of hand tumors.

Keywords: Hand; Neoplasms; Connective tissue; Radiographic image interpretation

Introduction

Tumors of the hand are seen commonly in hand surgery practice. Any structures including bones, connective tissues, neural and vascular structures may give rise to these lesions. Swelling, limitation of movement and localized tenderness are the most common presenting symptoms. The keys to effective management are meticulous examination and accurate prediagnosis prior to definitive treatment. The history and location of a lesion are helpful in differentiating between benign and malignant processes, however histological examination is necessary for a definitive diagnosis. Although a comprehensive history, physical examination, and plain x-rays are may be adequate for preoperative diagnosis, especially inexperienced surgeons use multiple radiologic imaging methods for an accurate diagnosis [1]. Imaging methods are unable to differentiate between benignity and malignancy, but in many circumstances a specific diagnosis may be achieved by taking into account the location and the extension of the lesion within the hand or wrist.

Plain radiographs, computed tomography (CT), ultrasound (US) and magnetic resonance imaging (MRI) are currently the most commonly used modalities in the evaluation of hand tumors

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Received Date: 06 Jun 2017

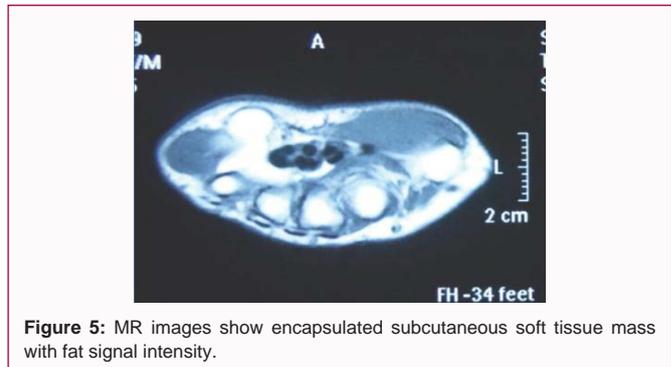
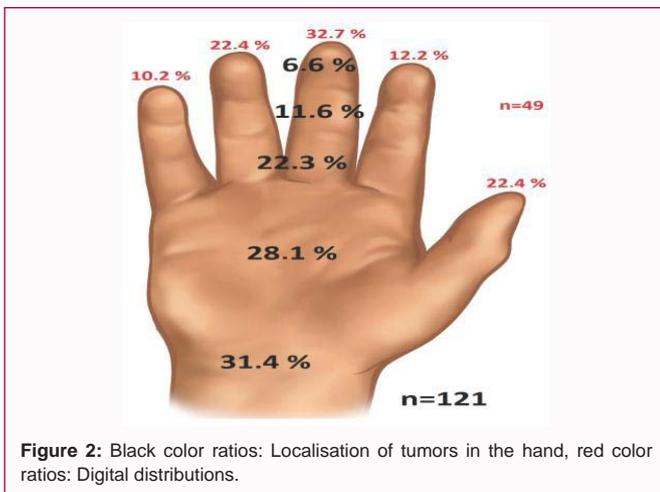
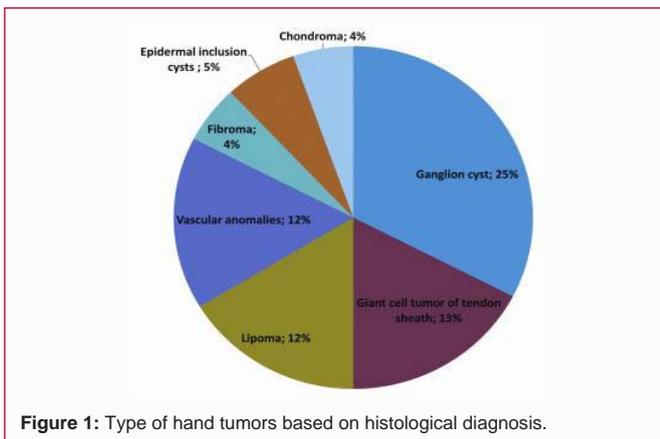
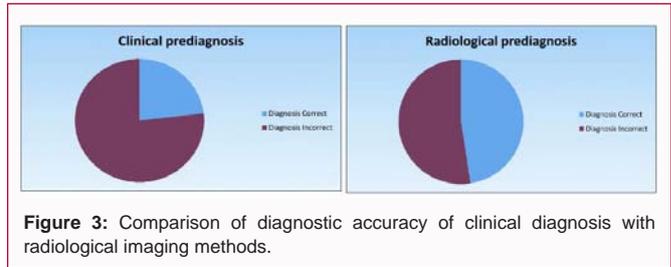
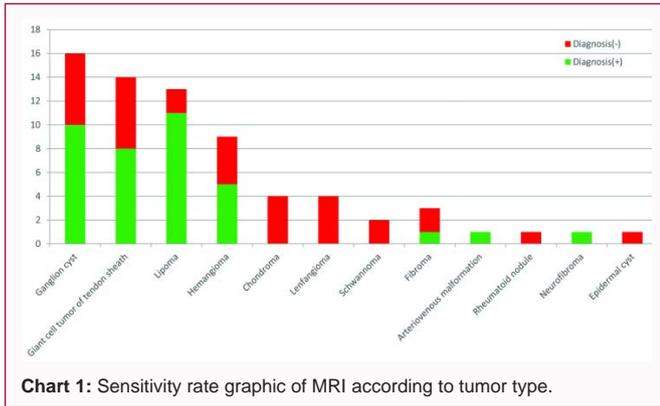
Accepted Date: 07 Aug 2017

Published Date: 21 Aug 2017

Citation:

Özkaya Ö, Sahin AE, Aksan T, Keskiner F. Role of Preoperative Imaging in Hand Tumors Comparative Analysis of Clinical and Radiological Prediagnosis with Histological Results in 121 Consecutive Patients. *Clin Surg*. 2017; 2: 1594.

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[2]. Plain radiographs and computer tomography (CT) are sensitive for soft tissue calcifications, bone involvement and ossification, all which can assist with characterization. However, they have limitations in the detection or evaluation of most soft-tissue lesions in the hand, and other imaging techniques may be required [3]. Ultrasound (USG) is useful in localizing the lesions and differentiating cystic from solid [4]. MRI has become the primary method for identifying and staging soft tissue masses within the hand or wrist. MRI also describes the main features, specifically the signal characteristic and location, of the soft tissue masses [5]. The majority of soft tissue tumors of the hand are benign tumors. Preoperative clinic diagnosis according to patient’s history and physical examination findings often might be enough for planning. The purpose of our study was to perform an analysis of primary tumors of the hand in 121 patients and 1) establish

lesion distribution patterns and common histological diagnosis, 2) describe the radiologic imaging features of primary tumors of the hand, 3) comparative analysis of preoperative clinical prediagnosis and radiologic prediagnosis with postoperative histological results, 4) assess the role of preoperative radiological imaging in hand tumors.

Patients and Methods

All patients operated in our department between January of 2007 and June of 2011 for the removal of benign bone or soft tissue tumors of the hand were retrospectively analyzed. Patient demographics, tumor location, affected side (right or left), clinical prediagnosis, requested radiologic examinations and radiologic prediagnosis, treatment protocol, recurrences during the postoperative follow up period were recorded. Pathology reports were analyzed for all patients and compared with the preoperative diagnosis based on radiologic studies and clinical diagnosis. Radiological diagnosis sensitivity was calculated by dividing the number of true positive results (TP) to the sum of true positive (TP) and the false negative (FN) results, where sensitivity (%)=[TP/(TP+FN)] × 100.

Statistical analysis

Ratio and frequency values were used for complementary statistics of data. Analysis of ratio data was performed with the chi square test using the SPSS 20.0 software.

Results

During the four year period, 121 patients were operated. Forty seven were male, and 74 were female. Mean age was 39 years (range: 4-80 years). Fifty four percent of the tumors were on the right hand, and 46% were on the left. Tumor dimensions ranged from 0.25 cm² to 27 cm². Ganglion cysts were the most common tumor type, constituting 25% (n=30) of the tumors, followed by giant-cell tumors of tendon sheath (GCTTS) and lipomas with rates 13% (n=16), and 12% (n=15), respectively. Except of one malignant soft tissue sarcoma case (0.8%) all tumors was benign. Chart 1 and Figure 1 shows type of hand tumors. Thirty-one percent of the tumors were located in the wrist, 28.1% in the palmer area, and 22.3% in the proximal phalangeal level (Figure 2). Mean follow up period was 2.1 years (11 months to 4 years). A radiograph was taken preoperatively in all patients, and at least one other radiologic imaging method was used addition to direct radiography in 82 patients (68%). Additional radiological imaging prompted by our clinic in only 14, 8 percent (n=18) of the patients. Other patients were referred with radiological imaging by first or second degree health care institutions for surgery. Among these patients, the most frequently requested radiological methods were MRI in 84% (n=69), USG in 13.4%, and CT in 2.4%. The tumors were excised taking into consideration their location, size and characteristics. The long term follow up performed with hand examination. Total recurrence rate after surgery was 4.1% (n=5), and they occurred after excision of GCTTS in 3 patients, and aspiration of ganglion cysts in 2 patients. Patients with recurrences underwent excision. Results of examination were compared with the preoperative clinical diagnosis and radiological examination for each patient. Of the 121 patients with a clinical prediagnosis of hand tumors 76.8% were confirmed with histopathologic results. The clinical diagnosis had an accuracy of 96.6 % for ganglion cysts, 81.2 % for GCTS, 86.6% for lipoma, and 60% for vascular anomalies and 58.6% for others. Accuracy rate found 52.4% in all of 82 patients who underwent radiographic imaging. Diagnostic accuracy of clinical diagnosis was significantly ($p=0.000<0.001$) higher in comparison with radiological imaging methods (Figure 3). When we examine radiological imaging separately, MRI was found to be 53.6% sensitive for all types of hand tumors. Comparison according to tumor type showed that MRI was 84.6% sensitive for lipoma, 62.5% for ganglion cyst, 57.1% for giant-cell tumor of tendon sheath, and 55.6% for hemangioma (Figure 4). Examples of the preoperative, preoperative photographs of the patients with the imaging studies for different type hand tumors are shown in Figure 5-12. USG was used in eleven patients with tumors on the wrist. Pathology revealed ganglion cysts in all of these patients, and USG was 54.5% sensitive for the diagnosis. The difference between the sensitivity of USG and MRI was not significant ($p>0.05$). CT was used in 2 patients with bone tumors of the fingers, and it failed to diagnose enchondroma in both patients.

Discussion

Tumors of the hand and wrist differ from tumors located elsewhere in the body with respect to their frequency, variability, and clinical, diagnostic and therapeutic properties. Because of the majority of soft tissue tumors of the hand are benign tumors, preoperative patient's history and physical examination findings are usually enough for surgical planning. Except of the common type of tumors, in complicated cases, preoperative imaging could be useful for the surgeon. In this situation, it is therefore important that the surgeon knows which imaging method has a greater sensitivity



Figure 6: Intraoperative photograph demonstrate yellowish nodular mass lesion (lipoma).



Figure 7: Preoperative photograph demonstrates soft tissue mass at the dorsum of the hand, adjacent to fifth metacarpophalangeal joint.



Figure 8: MRI findings of patient in figure 7: Lobulated, well-demarcated enhancing mass lateral to the extensor tendon of the fifth finger at the level of metacarpophalangeal joint.



Figure 9: Intraoperative photograph of the tumor (giant cell tumor of the tendon sheath).

for different types of tumors. The sensitivity of a test refers to how many cases of a disease a particular test can find. Normally, all patients should evaluate with the same imaging method and should be reported by the same experienced radiologist to investigate the sensitivity of any imaging method. However, the starting point of our work is retrospective evaluation of the patients who randomly referred us for operation from other clinics with different imaging methods in their hand. Ganglions are the most common benign soft

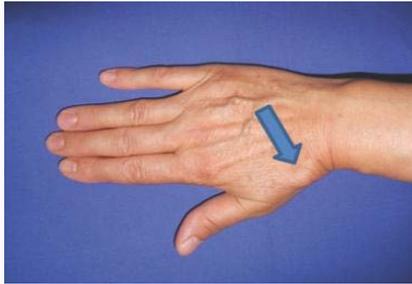


Figure 10: Preoperative photograph demonstrates soft tissue mass of the hand.



Figure 11: MR image shows well-demarcated, contrast enhanced subcutaneous nodular mass adjacent to first carpometacarpal joint.



Figure 12: Intraoperative photograph demonstrates the nodular yellowish mass adjacent to radial cutaneous nerve branches (Shwannoma) carpal joint.

tissue tumors of the hand and wrist, forming 50% to 60% of all soft tissue tumors of the hand. In our study, although the most common benign soft tissue tumors were ganglions, their frequency was 25%, which was lower than the rates reported in the literature. The most common site is the dorsal aspect of the wrist (60%), where they arise from the scapholunate joint or ligament [6]. Diagnosis of ganglia is made by a triple test which includes history, physical examination and transillumination. Triple test is 90% specific for the diagnosis of ganglion cysts. In our study triple test was 96.6% specific for ganglion cysts. It should be noted that solid benign peripheral nerve tumors of the hand can transilluminate and be mistaken for ganglionic cysts [7]. USG and MRI are useful in the diagnosis. USG shows an anechoic or hypoechoic, well defined, round or oval mass, and MRI shows a unilocular or multilocular, rounded or lobular mass with a fluid signal and adjacent to a joint or tendon sheath [5,8,9]. In our study although there was no significant difference between the sensitivities of MRI and USG in the diagnosis of ganglion cysts, clinical prediagnosis were more accurate than both imaging methods with significant difference. Although Anderson et al. [10] found that the sensitivity of MRI is 89% for diagnosis of ganglia, this ratio was 62.5% in our study. We believe that this significant difference in our study is dependent

on the radiologist. Anderson's study was performed with two experienced radiologists and using a standard protocol. In our study however, the MRI examinations were performed at various centers and evaluated by different radiologists. The main treatment options in ganglion cysts are aspiration and surgical excision. Aspiration of the ganglion is associated with a high recurrence rate up to 58%. In our study, two patients had already undergone aspiration for alleviation of symptoms, and both had a recurrence. Surgery remains the most effective treatment in the management of ganglia, and has the highest levels of patient satisfaction. Careful excision of the entire lesion, which includes a portion of the joint capsule or ligament, has a local recurrence rate of 5%. In the literature, giant cell tumor of the tendon sheath (GCTTS) is often reported as the second most common benign tumor of the hand. GCTTS was the third most common tumor in our study, preceded by lipomas. GCTTS is a benign tumor with local aggressive behavior in some cases, and can recur in 5% to 50% of patients following surgery [11]. The recurrence rate of GCTTS was 18.7% in our study. These tumors present as firm, nontender nodules most commonly found on the volar surface of the fingers or hand. Clinically, they are slow growing lesions, and unlike ganglia, do not fluctuate in size. They do not transilluminate. Radiographs are important because they can show abnormal features either in the form of cortical compression or intraosseous involvement [11,12]. MRI is the most conclusive preoperative tool because GCTTS shows characteristic features, including low signal intensity on both T1- and T2-weighted images equal to that of skeletal muscle [12,13]. Recently, Kitagawa et al. [14] stated that MR imaging could depict the characteristic internal signal of GCTTS. Moreover, it could accurately assess the tumor size and degree of extension around the phalanx, which can affect the type of surgical approach. On ultrasonography, GCTTS appears as a solid homogeneous hypoechoic mass. Ultrasound is very useful in the distinction between a ganglion and GCTTS [15]. Ultrasonography also provides useful information about the tumor vascularity, size and its relationship with the surrounding tissues. In our study clinical prediagnosis accuracy was 81.2% for GCTTS, which is statistically significant higher than imaging methods.

Lipomas were the second most common tumor of the hand in our study, in contrast with the literature [16]. They are slow growing, non-tender masses that do not transilluminate. Imaging methods due to differential diagnosis are not necessary except of symptomatic neurologic complications due to extension of carpal or guyan tunnel. In these cases MRI is most useful imaging method. Plain radiographs are sensitive for soft tissue calcification and ossification which can assist with characterization. On plain radiographs, lipomas may demonstrate the so-called Bufalini sign. This is a relatively radiolucent area within the tissue and signifies rarefaction of the tissue via fatty tumor presence. An MRI characteristically shows a well-circumscribed mass that mirrors the appearance of the normal mature fat on both T1 and T2 images. In our study there were no significant statistical difference to diagnosis of lipoma between MRI and clinical prediagnosis. Primary malignant soft tissue tumor of the hand is uncommon and of all tumors in the hand, 1% to 2% is malignant. In our study malignant tumor ratio was 0.8. An optimal imaging technique should include proper positioning, Specific protocols for the suspected abnormalities and dedicated surface coils for MRI [17].

Conclusion

The findings of our study showed that radiologic studies were

inferior to clinical examination in the diagnosis of hand tumors. Although they were useful in determining the location and extent of the tumor, they did not change the type of operation. Characterization of hand tumors by radiologic studies is radiologist dependent, therefore the sensitivity and cost-effectiveness of these studies should always be considered prior to their request.

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