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REVIEW

Hand disorders associated with diabetes : a review

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The diabetes may cause damage many structures and organs of a human body and predispose to secondary disorders, including involvement of the hand. Carpal tunnel syndrome, trigger finger or Dupuytren's disease occur more frequently in diabetic patients as well as other, poorer recognized conditions such as limited joint mobility, or hand weakness. The paper presents these disorders, emphasizes differences in clinical presentation, methods and outcomes of treatment, comparing to the non-diabetic patients. Although there are not call complications, some evidence suggests that they may be, as their prevalence is related to the duration of the diabetes, poor metabolic control and occurrence of other disorders such as retino- and nephropathy.

Keywords : Diabetes mellitus complications ; Diabetic hand ; Microvascular disease.

INTRODUCTION

Systemic diseases frequently affect function of many organs and systems. Diabetes is the the classical example of the disease of multiorgan involvement, including extremities : the foot and the hand. Diabetes is a systemic disease characterizing by increased level of blood glucose (hyperglycemia) due to insufficient insulin secretion or its abnormal assimilation/metabolism in target tissues. Chronic hyperglycemia affects many structures and systems within human body. Vascular complications are particularly dangerous due to endothelium damage in small- and microarteries resulting in degeneration and ischemia. This mechanism is responsible for diabetic complications occurring in nerves, kidneys, eyes and extremities.

Human hand is a complex strucure which dexterity (competency) is related to an undisturbed function of many components and therefore may be affected by systemic diseases. The term "diabetic hand" exists in the literature, encompassing

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disorders involving hands in diabetic patients : trigger finger, carpal tunnel syndrome, limited joint mobility etc. These conditions occur in general popualtion as well, but may differ in terms of the incidence, natural course and treatment efficacy (*4,13*). In contrast, a similar term "diabetic foot" means mostly infectious and ischemic complications involving feet in diabetics. This review aims to present the diseases and disorders of the hand associated with diabetes.

1. Limited joint mobility (diabetic cherioarthropathy)

Limited joint mobility is characterized by incomplete extension of fingers in the interphalangeal joints. The patient is unable to fully flatten the hands against each other (prayer sign). Similar finding is observed when hand is placed flatly on the table with the digits spread. The little and ring finger is most frequently involved what can be sometimes misinterpreted as Dupuytren's contracture. However, there is no nodules or chords on the palm in this disorder. Limited joint mobility affects both hands symmetrically and may be associated with thicker and tighter skin in the palm, what may mimic scleroderma. Some patients report slight pain and paresthesia in early stages of the condition (*13*). Stiffness is more pronounced in the morning and tends to disappear after use of the hand, but in long lasting disease the deformity is settled. The prevalence of limited joint mobility in diabetes is variable, ranging from 8% to 50% ; it occurs significantly more frequently in juvenile, insulin-dependent, long-lasting and poorly-controlled diabetes (*1,13*). Limited joint mobility is frequently overlooked by clinicians or considered not a complication of the diabetes.

The pathophysiology of this phenomenon is unclear. It is suspected that soft tissues damage in the diabetes may be due to interaction of end-products of glycolisation with collagen molecules, followed by changes in structure and biological properties of the collagen, resulting in poorer elasticity. Connective tissue is particularly susceptible to this changes. Glycolisation metabolites may as well activate surface-receptors in cells' membrane, thus initiating oxidation and inflammation pathways (*1*) ; the polyol pathway is the process resulting in increased intracellular water accumulation and cellular oedema (*3*). Microangiopathy is also considered to be pathogenetic mechanism in limited joint mobility : its incidence is higher among patients with diabetic retinopathy (*7*). Surgeons are rahther infrequently faced with this disorder : in authors institution no one patient has been identified presenting this pathology. Likewise, reporting this pathology in the surgical literature is very rare ; this may indicate that it may be underestimated and overlooked in our clinical practice.

There is no effective treatment for advanced limited joint mobility. Physiotherapy to increase finger movement is recommended with use of corrective splints in the night. The adequate diabetes control is fundamental to prevent development of serious condition (*1,13*).

2. Carpal tunnel syndrome

It is the commonest peripheral neuropathy, affecting about 6% women population aged over 40. Idiopathic syndrome is the most frequent, however several factors have been identified predisposing to CTS, such as hypothyroidism, rheumatoid arthritis, post-traumatic wrist deformation, renal failure and diabetes (*24,25*).

The prevalence of CTS in diabetes has been reported as between 11 and 25% and it is estimated that CTS occurs three times fold more frequently among diabetics than in general population (3-6%). Conversely, 5-8% CTS patients may have diabetes (*4,20*). In authors' institution, of 386 patients operated on for CTS, 41 (11%) suffered from diabetes. Eleven of 41 patients (27%) had type 1 and 30 (73%) had type 2 diabetes lasting a mean of eight years. Sixteen patients (39%) received insulin and 25 took oral anti-diabetic medication. None of the diabetic patients showed distinct features of diabetic polyneuropathy requiring specific treatment (*25*).

In is not clear why diabetes facilitates development of CTS. There are two concepts indicating the possible mechanisms. Median nerve neuropathy may be a component of systemic polyneuropathy, which is a fairly common complication in diabetes. It is caused by axonal damage (resulting in loss of

myelinated nerve fibers) and ischemia of the nerve due to microangiopathy (*19*). Similar pathogenetic mechanism is postulated in carpal tunnel syndrome, with additional involvement of venous congestion and nerve oedema due to compression. It is suspected that in diabetes, median nerve might be more susceptible (sensitive) to least compression, which in non-diabetic person would not produce symptoms.

Another mechanism involves thickening and stiffness of the flexor retinaculum and surrounding tissues caused by glycolisation of the connective tissue collagen (mentioned earlier) (*1*). Histological examination of the soft tissues in an idiopathic CTS revealed thickening of the collagen fibers in the flexor tendons' fibrous sheath and flexor retinaculum, as well as atherosclerotic angiopathy in arterioles supplying connective tissues around the carpal tunnel (*10*). As diabetes augments these pathologic mechanisms, this may additionally elucidate more frequent development of median nerve neuropathy in this disease.

Carpal tunnel syndrome presents with similar symptoms and signs in diabetic and non-diabetic patients. It was suggested that coexistence of diabetes might impede the diagnosis and worsen the outcomes of surgical treatment of CTS. Results of the study from authors' institution showed pre- and post-operative significant (although clinically not relevant) poorer perception of touch among diabetics, perhaps explained by co-existent diabetic peripheral neuropathy. Post-operatively diabetics had also slightly weaker grip and pinch strength (*25*). However general outcomes from this and other studies show that clinical benefit from surgical decompression of the median nerve was the same in diabetic and non-diabetic patients (*12,19*). Likewise, steroid injections show similar efficacy in both groups (*9*).

3. Dupuytren's disease

Dupuytren's disease (DD) is caused by excessive proliferation of myofibroblasts in the palmar aponeurosis, resulting in formation of nodules and chords followed by finger contractures. A familial occurrence may be confirmed in about 1/3 of cases (*6,18*).

The prevalence of DD in diabetics ranges from 3-32%, comparing to 1-7% in general European population and to 13% in non-diabetics (*3,13,18*). These data have been questioned in retrospective analysis by Loos *et al* (2007), who found diabetes in 321 of 2919 DD patients (11%) operated on in single institution over a period of 50 years (*8*). This data show only slightly higher prevalence of diabetes among patients than in general population. Observations from authors' institution are similar : diabetics constituted an average 10% of DD patients undergoing fasciectomy (*22*).

The underlying pathogenetic mechanism of the relationship between DD and diabetes is unclear. It is hypothesized that it may be similar mechanism to described earlier for limited joint mobility. Other theory emphasizes role of toxic free radical production which increases with age as a result of localised hypoxia, gradual restriction of capillaries, smoking and other environmental factors. It is suggested that diabetes (likewise down-regulation of the some genes, i.e. dihidriol dehydrogenase *DHDH* gene) may reduce the ability of fibroblasts to detoxify various oxidative stress molecules, including superoxide and hydroxyl radicals., which may induce their transformation into myofibroblasts and proliferation (*13,21*).

Clinical presentation of DD differs in diabetics vs general population. The middle and ring fingers are more frequently involved, as opposed to non-diabetics, which more commonly involves the ring and little fingers. The disease is generally milder and less frequently require operation (*4,13*). Interestingly, in general population DD is more common in men, but in diabetics the sex ratio is equal (*6*). Opinions on the relationship between diabetes duration, poor metabolic control and presence of microvascular complications and the severity of finger contractures are inconsistent : some authors confirm, but some deny this correlation (*6,13*). Outcomes of surgery for Dupuytren's disease in diabetic and non-diabetic patients are similar, likewise rate of complications (including infections) and recurrence rates (*6*).

4. Trigger finger/digit (stenosing tenosynovitis)

The condition usually presents with triggering and tenderness in the A_1 pulley region of the affected digit. The nature of the disease is not inflammatory as it is commonly believed. An additional internal layer of the A_1 pulley was found with a considerable amount of chondroid-metaplasia present in this layer (*17*). The disease affects more frequently women than men, is associated with rheumatoid arthritis and diabetes.

The prevalence of trigger finger in diabetes has been reported as between 10 and 20%, comparing to 1-2% in general population. Conversely, about 25% patients with trigger digits suffer from diabetes. Multiply finger and bilateral involvement is significantly more frequent in diabetics as well as coexistence with carpal tunnel syndrome (*4,13*). Diabetes duration, metabolic poor control and presence of microvascular complications are considered significant contributing factors. Likewise in earlier mentioned hand complications, pathological mechanism may include glycolisation of the collagen, followed by its accumulation in the affected tendon sheath. It is not known, however, why this process is activated just in A_1 pulley.

Treatment of trigger finger includes several methods : physiotherapy, steroid injections and A_1 pulley release. Data from the literature show conservative measures to be less effective in diabetics in terms of higher non-responsiveness and recurrence rates (*11*). Other authors suggest that, presence of diabetes negatively influences outcomes of treatment, regardless the method used (*4,14*). Results of our study showed that five of 95 patients (5%) had diabetes and that results of the treatment of these patients by percutaneous A_1 pulley release or steroid injection did not differ from non-diabetics (*23*).

5. Cubital tunnel syndrome

It is second common peripheral neuropathy in the upper limb. It presents typically with paresthesia in two ulnar fingers, weakness and reduction of the dexterity of the hand. Atrophy of the intrinsic muscles in the hand may occur in proportion of patients. The etiology of the syndrome is unknown in most cases (idiopathic), but in some may involve post-traumatic epicondylar deformity of the distal humerus, presence of osteophytes around the elbow or hypertrophy of the synovium in the course of rheumatoid arthritis. The relationship between diabetes and the cubital tunnel syndrome has not been consistently confirmed, however there is some evidence that it occurs more frequently in long-lasting and poorly controlled disease in elderly patients (*20*).

6. Hand infections

Hyperglycemia is a well-known factor increasing the risk of infection in the soft tissue in the diabetic population. Unlike in the "diabetic foot" in which the infection is associated and predisposed by the ischemia, within the hand the infections are at less degree related to microvascular compromise, but rather to reduced cell-mediated immunity and phagocyte function in diabetics (*4*). Reports from the literature show significantly higher risk of hand infections in diabetics in tropical regions. The term "tropical diabetic hand syndrome" was even coined for this reason (*5*). Typically the disease presents in older patients, predominantly women having long-lasting poorly-controlled type 2 diabetes. Infection is in most cases antecedent by a mild trauma such as skin abrasion, laceration or insect bite (*13*). Staphylococus aureus is the most commonly cultured organism, however mixed bacterial contamination is also reported. Other risk factors in tropical diabetic hand syndrome are shown such as low socio-economic status, delayed presentation after mild trauma, inadequate primary treatment (herbal remedies) and ambient local humidity (*13*).

Hand infections in general diabetic population are also more common than in non-diabetic, but the difference is not significant. They may be not related to the antecedent trauma (spontaneous onset) and caused by mixed organisms infection. Several case-series show this relationship and emphasize caution in diagnosing and treatment of trivial hand infections in diabetics (*4*).

7. Hand weakness and reduced dexterity

Hand weakness and reduced dexterity have been recently recognized as a complication in diabetic

patients, independently of the disorders described previously (*15,16*). It is obvious that occurrence of limited joint mobility, Dupuytren's disease or carpal tunnel syndrome may affect both hand strength and function, however, hand weakness was observed in diabetic patients presenting with none of these complications. Similar findings were observed in lower extremities (*16*). A possible etiology assumes that diabetes may negatively influence contractile characteristics and endurance of muscles ; other concept suggests neuropathy of the nerves supplying muscles to be responsible for this phenomenon (*4,15*). Investigation of the hand function and grip strength in diabetics is considered to be potentially useful for better understanding diabetes consequences for the locomotor system and early prediction of other complications (*16*).

8. Other pathologies

There are some other, rarely occurring dermatological lesions, that may present within hands in diabetic patients. They include diabetic blisters, granuloma annulare, Huntley papules and necrobiosis lipoidica diabeticorum. These pathologies are uncommonly seen by hand surgeons, because they involve mostly the skin, are usually painless and do not affect hand function. Typically are diagnosed and treated (if necessary) by dermatologists (*4*).

9. The effect of single dose of steroid on blood glucose concentration

Local steroid injections are commonly used as a first-line treatment in many hand disorders, including trigger finger, carpal tunnel syndrome or de Quervain disease. Concern appears to be logical whether this treatment does not cause significant elevation of the blood glucose level in diabetics. Catalano et al., reported the results of the examination of the daily glucose profile in 23 diabetic patients who received single injection of 1 ml of triamcinolone for common hand disorders : CTS, trigger finger or de Quervain disease (*2*). Daily glucose concentration was examined and recorded over a period of one week before (baseline values) and four weeks after steroid injection. Comparing to baseline, an average glucose concentration increased of 14 mg/dl at the day of injection, 10 mg/dl at 5th day and of 32 mg/dl at 6th day. These values were statistically significantly higher comparing to the baseline, but were clinically irrelevant and did not require additional anti-diabetic medication. In the other days of the follow-up, glucose levels were lower than above mentioned and statistically not significantly different from baseline. Single episodes of significant hyperglycemia were recorded during the follow-up, but they were related mostly to the meals that patients had and they were similarly frequent as in the week before steroid injection (baseline). Results of this study show that a single dose of long-lasting steroid elevates blood glucose concentration in diabetics, but it is clinically irrelevant and does not need changing of standard diabetes control (*2*).

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