A 66-year-old man presented to his cardiologist with a 3-month history of feeling tired, a 6.8 Kg weight loss, and occasional night sweats. He had a remote 17–pack-year history of smoking. Eighteen months previously, he had undergone an aortic valve replacement for symptomatic aortic valve stenosis. His examination revealed a normal temperature, a heart rate of 95 bpm, a blood pressure of 140/90 mm Hg, a soft aortic ejection flow murmur without a detectable diastolic murmur, and no clinical evidence of heart failure. He was noted to have painless bilateral finger clubbing without evidence of palpable splenomegaly or peripheral embolic phenomena. His optic fundi were normal. In addition to the history of weight loss, fatigue, and occasional night sweats, the presence of finger clubbing leads one to consider its major causes.1

Digital clubbing was first described by Hippocrates in 400 bc in a patient with empyema. This unique examination finding can provide an immediate clue that a serious underlying condition may exist. In 1938, Lovibond2 described the “profile” sign (Figure), which, if >180°, indicates true clubbing of the fingers. (The normal angle between the nail bed and the proximal nail fold is 160°.) In addition, there is periungual edema and a softening of the nail bed.2 Digital clubbing may occur alone or can be part of a syndrome of joint pain and swelling associated with periostosis of tubular bones (hypertrophic osteoarthropathy [HOA]). In 1944, Paul Dudley White said,

Clubbing of the fingers and toes associated with cyanosis is found in certain congenital cardiovascular defects (the morbus caeruleus). Clubbing without cyanosis is found in subacute bacterial endocarditis. However, it must be remembered that clubbed fingers are often found with noncardiac conditions, most commonly of all in pulmonary diseases; even ulcerative colitis may be the underlying cause, and a familial type of unknown etiology has been described.4

These comments reflect the spectrum of disease of his time.

The major causes to consider include the following:

1. Pulmonary malignancy. Primary lung cancer, lymphoma, pleural mesothelioma, and secondary pulmonary malignancies can all be accompanied by clubbing. Primary lung and plural tumors may also exhibit pulmonary HOA. In 1956, Flavell5 described 5 patients with pulmonary malignancies (some inoperable) and significant, at times incapacitating, pain and swelling of the wrists, elbows, knees, or ankles that was relieved within hours or weeks by division of the vagus nerve. Tumor resection can also abate or abolish both clubbing and the associated painful osteoarthropathy. More recently, video-assisted left truncal vagotomy provided relief within hours to a patient with inoperable lung cancer who had suffered incapacitating joint symptoms.6 Painful clubbing is more likely in patients with bronchogenic carcinoma, lung abscess, and bronchiectasis.7

2. Chronic infection (or inflammation). Digital clubbing has classically been associated with chronic infections such as bronchiectasis, lung abscess, empyema, pulmonary tuberculosis, and infective endocarditis.8 Both inflammatory bowel disease (Crohn disease more than ulcerative colitis) and chronic liver disease have been associated with clubbing. Furthermore, clubbing has been seen with HIV and chronic parasitic infections with Trichuris...
trichuria (whipworm) and schistosomal colonic polyposis.
3. Cyanotic congenital heart disease.
4. Primary HOA. This is a rare familial condition. Homozygous individuals have chronically elevated prostaglandin E, levels and prominent clubbing. Mutations were first reported in 2008 in the 15-hydroxyprostaglandin dehydrogenase (HPGD) gene encoding the major prostaglandin catabolizing enzyme (prostaglandin E,). Heterozygotes show milder manifestations. In individuals with autosomal-recessive primary HOA, a mutation in the prostaglandin transporter SLCO2A1 has been described. In patients with liver disease treated with prostaglandins, clubbing and cortical hyperostosis resembling HOA developed and then reversed when therapy was completed. In patients with primary HOA, plasma levels of vascular endothelial growth factor (VEGF) are higher than in control subjects.

Pathophysiology
Knowledge of the pathophysiology of clubbing is incomplete. The case report of a 24-year-old woman with reversed shunting through a patent ductus arteriosus and oxygen saturations >90% in her arms and 63% in her femoral artery with clubbing and cyanosis only of her toes (and HOA of her lower extremities) suggests that hypoxia plays a role. Patients with acquired clubbing have a distinctive, abnormal capillary growth pattern, with plexus formation at right angles to the normally vertically oriented capillary loops, arborized loops with branches budding from the tips, and splayed afferent and efferent limbs of the capillary loop. Platelet clusters aggregating in the distal vasculature of the digits may mediate the morphological changes of clubbing. Furthermore, human megakaryocytes within bone marrow produce and secrete VEGF in an inducible manner. VEGF delivered to sites of vascular injury by activated platelets may initiate angiogenesis. In normal neonates, plasma VEGF levels are elevated but within 3 months fall rapidly. In cyanotic children, VEGF levels remain elevated and are inversely related to oxygen saturation, and the functional capacities of circulating endothelial progenitor cells (proliferation, migration, and adhesion) are augmented. That resection of the vagus nerve can abate or abolish both clubbing and pulmonary osteoarthropathy led to the theory that the vagus nerve may be a key signaling pathway. In patients with bronchogenic carcinoma and unequivocal clubbing, both VEGF and platelet-derived growth factor, which are released with platelet aggregation and are hypoxically regulated, are increased in the digits that contain platelet clusters compared with control subjects. In patients with lung cancer, plasma levels of VEGF are significantly higher than in control subjects, and VEGF is known to be a predominant angiogenic tumor growth factor. Removal of a pulmonary large-cell adenocarcinoma in a female patient with digital clubbing and primary HOA dramatically reduced abnormally high plasma and serum VEGF levels. Her bone pain and clubbing deformities regressed and were absent a year after surgery. The resected lung tumor showed 45% greater VEGF mRNA expression than normal lung.

Clubbing is more prevalent with active inflammatory bowel disease, especially when macroscopic disease is confined to the area of the gut innervated by the vagus nerve (ie, the small and large intestine as far as the midtransverse colon). Mucosa with active disease shows higher spontaneous VEGF production than normal mucosa, and the expression of VEGF-A and its receptor, VEGFR-2, are increased in inflamed bowel. Thus, VEGF appears to be a promoter of angiogenesis and inflammation in bowel disease and, when overexpressed in a mouse colitis model, worsens the condition. Most patients with end-stage chronic liver disease undergoing evaluation for transplantation have intrapulmonary shunts (especially those with Child-Pugh classification C), and they can have lower resting PaO, levels. Substantial right-to-left shunting in the lungs in association with cirrhosis, cyanosis, and clubbing was described by Rodman et al, who later documented minor degrees of arterial desaturation and increased venous admixture attributed to intrapulmonary shunting in cirrhotic patients. In patients with cirrhosis, there are increased numbers of small, dilated blood vessels in the alveolar walls (especially vessels <35 μm), with some vessels just beneath the pleural surface having the appearance of spider nevi. In rodent studies of cirrhosis, with the progression of fibrosis, there is hepatocellular hypoxia and increased expression of VEGF and VEGF receptors, which correlate with the density of new microvessels. After successful liver transplantation in a cirrhotic patient with cyanosis, clubbing, oxygen desaturation, and right-to-left shunting...
(demonstrated by perfusion scanning), all of these abnormalities resolved.\textsuperscript{33} In the pathogenesis of digital clubbing, local hypoxia, platelet activation, release of signal proteins such as VEGF, and stimulation of angiogenesis and other cellular activities are probably contributory.

In our patient, routine blood tests and blood cultures were unremarkable. An echocardiogram revealed a normally functioning aortic valve without evidence of vegetations, valve regurgitation, or abscess formation. A computed tomography of the chest revealed a lung tumor near the periphery of the lung. Fine-needle biopsy of the mass led to the diagnosis of adenocarcinoma. There was no evidence of lymphadenopathy. A lobectomy was performed. Within weeks, the finger clubbing disappeared. When new-onset digital clubbing is observed in the absence of overt pathology, a screening chest computed tomography seems warranted.

Acknowledgments

Dr Samuel Goldhaber invited me to write this update when he heard my interest had been stimulated by self-diagnosed clubbing. The case history bears only a faint resemblance to my condition.

Sources of Funding

Dr Rutherford is supported by the Jonsson-Rogers Chair in Cardiology.

Disclosures

None.

References


Digital Clubbing
John D. Rutherford

doi: 10.1161/CIRCULATIONAHA.112.000163
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2013 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/127/19/1997

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org/subscriptions/