This month’s feature highlights four articles that appear in the current issue of Mayo Clinic Proceedings. These articles are also featured on the Mayo Clinic Proceedings’ YouTube Channel (https://youtu.be/NlkJn4Ea5zg).

BARRIERS TO BETTER BLOOD PRESSURE CONTROL
Systemic hypertension is appropriately publicized as a dominant, generally tractable risk factor for cardiovascular disease. As nonpharmacologic and pharmacologic approaches in the management of hypertension are steadily improving, one would anticipate that trends in the prevalence and outcomes of hypertension would be encouraging. This, however, is not the case: general awareness of hypertension and its adverse effects is decreasing in the population of the United States where the prevalence of hypertension in adults is now approaching 50%; the level of blood pressure (BP) control is declining in individuals treated for hypertension; and, notably, mortality from hypertension-related cardiovascular disease is on the rise. Thus, the question arises why are there these quite troubling trends for a condition that is a known harbinger for cardiovascular disease and one for which management is continually being refined. An important insight regarding this issue is provided in the article by Milani et al in the present issue of Mayo Clinic Proceedings. Milani et al undertook a retrospective cohort analysis of 3305 patients with hypertension enrolled by their physician into a hypertension digital medicine program and followed for up to 1 year. Enrollment required the patient having a smartphone and purchasing a BP unit compatible with the smartphone. Interaction and follow-up occurred through the patient portal. Data relevant to hypertension and its risk factors and management were obtained, blood pressure readings were charted weekly, and doctoral pharmacists and health coaches interacted regularly with enrolled patients. Barriers to health care were itemized as three main issues - health literacy, patient activation, and financial strain — all of which were assessed for each patient. The primary outcome was the proportion of patients with a BP < 140/90 mm Hg at 1 year. The findings demonstrate that health care barriers were generally more prevalent in Blacks as compared with Whites, and that BP control at 1 year, compared with individuals with no health care barriers, was lower in individuals with 1 barrier, and especially so for individuals with 2+ barriers. Notably, for individuals with 2+ barriers, BP control was entirely comparable for Blacks and Whites. The latter findings, as the authors discerningly speculate, suggest that overarching socioeconomic disparities per se, rather than intrinsic resistance to BP management, may be responsible for less effective BP control often reported in Blacks. This timely study by Milani et al thus uncovers the impact of social determinants of health and race on BP control, and one which is quite relevant to these disturbing trends in the prevalence and consequence of hypertension. Additionally, informing these findings of Milani et al is a broadly relevant concept: for any prevalent disease to be effectively treated, messaging regarding its significance and risks must be clearly communicated; individuals with the
condition need to be successfully and intimately engaged and activated in patient-centric management with health care providers; and socioeconomic conditions that impede access to health care, restrict medication affordability, and disincentivize patient activation all need to be addressed.


THE PROGNOSTIC POWER OF ARTIFICIAL INTELLIGENCE

Two contributions in the current issue of Mayo Clinic Proceedings illustrate the considerable and growing impact of artificial intelligence in health care. The artificial intelligence enhanced electrocardiogram (AI ECG) has been shown to reliably detect several cardiac diseases, and, using an illustrative case, Harmon et al demonstrate how age predicted by an AI ECG may align with or diverge from a patient’s chronologic age. In this case study, an obese patient without any cardiac history had an AI ECG-predicted age that exceeded the patient’s chronologic age by 5 years. Following regular exercise and an altered diet and weight reduction of 40 lb over a 6-month period, the age predicted by an AI ECG decreased and aligned with the patient’s chronologic age. In essence, the AI ECG-predicted age reflected improved cardiovascular and general fitness attendant upon healthy lifestyle choices and weight loss. This issue of Mayo Clinic Proceedings also includes the study by de Souza e Silva et al which used machine learning to predict mortality in 13,362 patients with coronary artery disease (CAD) referred for cardiac rehabilitation from 1995 to 2016. In this analysis, 25 features were assessed which pertained to demographic characteristics, comorbidities, indications for coronary angiography, number of diseased vessels, left ventricular ejection fraction (LVEF), exercise testing, and management strategy. Of these features, age and peak metabolic equivalents emerged as the most significant ones in predicting mortality, outstripping, for example, diabetes, current smoking, indications for coronary angiography, number of diseased vessels, or LVEF. Based on these two features, a survival tree analysis (a tree-based machine learning model) accurately predicted mortality, thereby providing a novel and simple prediction model for survival in patients with CAD. These two contributions attest to the power, potential, and promise of AI in medical practice: Harmon et al demonstrate how AI may refine a simple tool — the ECG — into one that assesses general fitness and cardiovascular health, or the lack thereof, while de Souza e Silva et al demonstrate the use of machine learning in predicting mortality in CAD, underscoring, once again, the importance of regular exercise as a determinant of outcomes in cardiovascular disease.


A SENTINEL BLEED WARNING OF A FEARED COMPLICATION

Vascular access provides a lifeline for hemodialysis, and of the available accesses, the arteriovenous fistula (AVF) is the most favored. Yet this preferred vascular access is susceptible to numerous complications including, among others, the complete failure to mature into a functional access, the need for interventions to promote maturation, and the occurrence of venous stenosis, thrombosis, hematoma/seroma formation, and infection. In the upper extremity, the creation of an AVF may cause a vascular steal syndrome and, rarely, ischemic monomelic neuropathy. The venous wall of an AVF is constantly exposed to vascular stress: intermittent needle puncture for hemodialysis and pathologic shear stress imposed by the heightened blood pressures and flows
conveyed by the arterial inflow to the AVF. In time, and especially if subjected to proximal venous stenosis, the venous wall may become aneurysmal and progressively weaker, attenuated, and ulcerated to the point that bleeding and rupture may occur — this is the most exigent of all AVF complications because if such hemorrhage is not expeditiously stanched, exsanguination can occur. The remarkable observations of Cirillo-Penn et al document by video a sentinel bleed from a dialysis AVF that spontaneously occurred during dialysis. The AVF was 12 years old (average life span of functional AVFs is 5 years) and was complicated by central venous stenosis and the need for stent placement and venoplasties. Physical examination revealed two significant aneurysms, skin attenuation and breakdown, the eddying of blood beneath the broken skin, and the likelihood of incipient hemorrhage. Cirillo-Penn et al expeditiously repaired the fistula, noting that in the more proximal aneurysm it was just an overlying thrombus that averted frank rupture and bleeding. Two months after the surgical procedure, the repaired fistula was once more used for dialysis. This remarkable case of Cirillo-Penn is instructive for several reasons: First, it provides one of the very few video documentations of a sentinel bleed from an AVF, one which may presage torrential and life-threatening hemorrhage; second, it demonstrates how timely intervention by and the expertise of vascular surgery can prevent such a feared complication as well as salvage and repair the fistula such that it can, once more, be used for intermittent hemodialysis; and, third, it underscores the clinical acumen and attentiveness of dialysis providers in recognizing the significance of this early sign, in instituting temporizing measures, and in expeditiously obtaining definitive management by vascular surgery.


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