

The Opportunistic Finger Prick: Point-of-Care Hemoglobin A1C Testing in the Hand Surgeon's Office to Screen Patients for Undiagnosed Diabetes Mellitus

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INTRODUCTION: Diabetes mellitus (DM) is a multi-systemic disease with a prevalence estimated to increase to nearly 55 million people in the United States by 2030. Nearly one quarter of patient with DM will still be undiagnosed in this estimate and not receive necessary treatment.¹ Hyperglycemia may cause functional and structural impairment of nerves and blood vessels, potentially leading to severe adverse outcomes, including issues in wound healing among others.² Due in part to this, untreated DM is a significant concern in preoperative decision-making and postoperative care for surgical patients. The prevalence of upper extremity disease in patients with DM, such as flexor tenosynovitis in 10-15% of patients with DM, presents a promising avenue for targeted screening of patients in the hand orthopedic office.³ Modern point-of-care hemoglobin A1C (HbA1C) testing requires only a minute volume of blood collected from a finger prick to provide a HbA1C measurement, a 2-3 month average of blood sugar levels, in under 6 minutes. If elevated, the results of this rapid test can be confirmed with a standard blood test. This study aimed to determine how the diagnosis of upper extremity conditions - including carpal tunnel syndrome, flexor tenosynovitis, Dupuytren's contracture, and De Quervain's tenosynovitis- can be used to identify patients with undiagnosed DM, allowing surgeons to counsel patients to receive appropriate care, avert surgery cancellations, and reduce complications in surgical wound healing.

METHODS: We screened all patients (≥18 years and <75 years) at a hand orthopedic surgery practice with a diagnosis of carpal tunnel syndrome, flexor tenosynovitis, Dupuytren's disease, or De Quervain's tenosynovitis. We excluded patients who had a known history of DM, were pregnant at the time of screening, or were unable to give informed consent. A total of 100 eligible patients were enrolled and underwent a point-of-care hemoglobin A1C (HbA1C) test using the Siemens DCA Vantage machine. Fourteen enrolled patients had an error reading of out-of-range hemoglobin levels and could not be used. Patient demographics (sex, age, BMI, insurance) and disease characteristics (bilateral symptoms, presence of other upper extremity pathology) were abstracted from electronic medical records. Prediabetes was defined as a HbA1C ≥5.7 and <6.5, and type 2 DM (T2DM) was defined as a HbA1C ≥6.5. All patients were informed of their results, and patients with a HbA1C ≥5.7 were counseled to speak to their primary care provider (PCP) regarding care and further testing. Patients without a PCP were aided in making an appointment. Descriptive statistics were performed to characterize the cohort. Chi-squared tests were performed to compare categorical variables between patients with and without pre-diabetes or T2DM. Binary logistic regression analysis was performed to examine the association between DM status and patient demographics, insurance, record of PCP appointments, insurance status, and disease characteristics while controlling for age and sex. Significance was p<0.05. Institutional IRB approval was obtained for this study.

RESULTS: In our cohort of 84 patients with measured HbA1C levels, we identified a total of 49 patients (58.3%) with levels in the range of prediabetes and 4 (4.8%) in the range of T2DM (Figure 1). The most prevalent race in our cohort was White (56.0%), and the average age of patients with prediabetes or T2DM was 65.9 and 65.0 years, respectively (Table 1). The most prevalent condition in patients with prediabetes/T2DM (77.3%) and without T2DM (80.6%) was tenosynovitis (Figure 2). Notably, only 32.1% of patients with prediabetes/diabetes had a PCP appointment within 1 year of their HbA1C test at the hand orthopedic surgery practice, and 43.4% of these patients did not have a PCP. There was a significant difference in the presence of bilateral symptoms between patients with and without prediabetes/T2DM (p=0.037), and patients with prediabetes/T2DM had 70% lower odds of presenting with bilateral symptoms (OR=0.30, CI: [0.10, 0.88], p=0.028). Sex was also significantly associated with diabetes status (p=0.008), and female patients with upper extremity conditions in our cohort had significantly higher odds of prediabetes/T2DM than male patients (OR=0.28 for males, CI: 0.11, 0.72).

DISCUSSION: We identified 53 patients (63.1% of our cohort) with an elevated HbA1C indicative of prediabetes or T2DM in a hand orthopedic surgery practice. The prevalence of prediabetes in our cohort was markedly higher than the 12.6% of adults diagnosed with prediabetes in our county in 2018, which may reflect a gap in screening awareness and/or accessibility. This may be supported by our finding that most patients with prediabetes/T2DM had not visited a PCP within the year prior to their HbA1C test and nearly half did not have a PCP, which highlights the critical role of the hand surgeon in identifying and screening high-risk patients. Patients may present to the hand surgeon office with upper extremity conditions, particularly when affecting their activities of daily living or ability to work, when they otherwise may be unwilling or unable to seek care from their PCP. Those who present with unilateral symptoms, as observed in our study, as well as other traditional risk factors and comorbidities in DM can then be rapidly and efficiently screened by their hand surgeon to catch the disease before it progresses and has a high burden. The hand surgery practice therefore presents an early checkpoint and unique "safety net" to identify patients with unknown prediabetes/T2DM, and counsel patients to seek care early in the disease process.

SIGNIFICANCE: Hand surgeons may successfully identify patients with elevated HbA1C, particularly in the range of a diagnosis of prediabetes where the disease state is more reversible. Screening by hand surgeons may allow for earlier treatment for elevated blood sugar, avoiding long-term complications. Additionally, patients with these upper extremity conditions may require surgical intervention for their hand condition, and elevated blood sugar may place patient at increased risk of infection and delayed wound healing. Our study supports that point-of-care HbA1C testing can be incorporated into a hand practice as a low-cost and rapid way to provide invaluable care for patients beyond the upper extremity.

REFERENCES:

- Rowley WR, Bezold C, Arikan Y, et al. Diabetes 2030: Insights from Yesterday, Today, and Future Trends. *Pop Health Man.* 2017;20(1):6-12.
- Lotfy M, Adeghate J, Kalasz H, et al. Chronic Complications of Diabetes Mellitus: A Mini Review. *Curr Diabetes Rev.* 2017;13(1):3-10.
- Papanas N, Maltezos E. The diabetic hand: a forgotten complication? *Journal of Diabetes and its Complications.* 2010;24(3):154.

Table 1. Characteristics of the cohort

Variable	Normal HbA1C (n=31)	Elevated HbA1C	
		Prediabetes (n=49)	T2DM (n=4)
Age (mean [SD])	64.4 [11.8]	65.9 [11.2]	65.0 [16.4]
Sex			
Female	13 (41.9%)	35 (71.4%)	3 (75.0%)
Male	18 (58.1%)	14 (28.6%)	1 (25.0%)
Race			
White	19 (61.3%)	25 (51.0%)	3 (75.0%)
Black or African American	4 (12.9%)	7 (14.3%)	0 (0.0%)
Asian	3 (9.7%)	3 (6.1%)	1 (25.0%)
Other	3 (9.7%)	10 (20.4%)	0 (0.0%)
Declined or Unknown	2 (6.5%)	4 (8.2%)	0 (0.0%)
BMI (mean [SD])*	27.6 [4.6] (n=30)	29.6 [5.8] (n=41)	28.3 [3.3]
Upper Extremity Condition(s)**			
Carpal tunnel syndrome	21 (67.7%)	30 (61.2%)	3 (75.0%)
Flexor tenosynovitis	25 (80.6%)	38 (77.6%)	3 (75.0%)
De Quervain's tenosynovitis	0 (0.0%)	3 (6.1%)	0 (0.0%)
Dupuytren's contracture	0 (0.0%)	3 (6.1%)	0 (0.0%)
Multiple Upper Extremity Conditions	11 (35.5%)	14 (28.6%)	1 (25.0%)
Bilateral Symptoms	24 (77.4%)	27 (55.1%)	2 (50.0%)
Medicare Insurance	12 (38.7%)	23 (46.9%)	2 (50.0%)
Has a PCP	19 (61.3%)	27 (55.1%)	3 (75.0%)
PCP Appointment within 12 Months of HbA1C Test	13 (41.9%)	15 (30.6%)	2 (50.0%)

*BMI was not collected for all patients.
**Patients may have more than one upper extremity condition.
PCP, primary care provider

Figure 1. HbA1C Levels of the Cohort

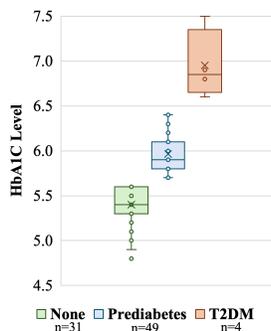


Figure 2. HbA1C Level Stratified by Upper Extremity Condition

