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The accuracy of diagnostic palpation: the comparison of soft tissue findings with random blood sugar in diabetic patients

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It has been said that certain early osteopathic physicians could estimate random blood sugar by touch. This questionable statement was put to test with a simple protocol. Forty diabetic patients were evaluated for tissue texture change by palpation. The degree of subcutaneous tissue texture change was quantified subjectively and compared with the level of concomitantly obtained random blood sugar. Statistical analysis revealed a Pearson correlation value of 0.210 ($p = .097$), a Kendal correlation value of 0.215 ($p = .042$), and a Spearman correlation value of 0.269 ($p = .047$). These results suggest that palpatory findings of tissue texture change associated with diabetes can be quantified, thus validating a distinctive osteopathic contribution to physical diagnosis.

Introduction

In 1971, a recently graduated osteopathic physician was told by his then boss and mentor that "Harrison Fryette could estimate random blood sugar by touch."[1] This comment was met with shock and an incredulous response, something to the effect that it was such outlandish statements that gave the rest of the medical world the inclination to question the validity of osteopathic medicine. The disbelieving youngster was taken to a hospital room containing two patients, one of whom was diabetic, and told to comparatively palpate the posterior cervical soft tissues in both patients. After a brief period, he was asked if he could discern a difference. There was, indeed, a palpable difference. The diabetic patient's soft tissues possessed a distinct tissue texture change not present in the tissues of the nondiabetic roommate. The tissues felt fuller; they felt "puffy."

A year or so later, that same young physician had an encounter with a new patient who was complaining of cervico-thoracic pain. After obtaining a history of the chief complaint, he impetuously proceeded to the musculoskeletal examination and was surprised to feel that same subcutaneous fullness previously palpated in the diabetic patient's tissues. A surreptitiously introduced inquiry into the patient's current medications revealed that he was indeed an insulin-dependent diabetic.

So, if there was an observable subcutaneous finding in diabetic patients, from the clinical diagnostic perspective it was then necessary to demonstrate that this palpable difference was consistently present. To this end, a simple protocol

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eventually was developed in which two groups of patients were blindly palpated to determine whether diabetic patients could be consistently differentiated from nondiabetic patients. Of 17 individuals palpated blindly (7 diabetics and 10 nondiabetics), tissue texture change was identified in 100% of the diabetics and was absent in 80% of the nondiabetics. These "results suggest(ed) that palpatory findings may be useful in distinguishing chronically hyperglycemic individuals from normoglycemic individuals."[2]

With the demonstration that there is indeed a discernable palpatory difference that identifies the diabetic patient, the question arises: How well may such a difference be quantified? If quantification proves to be possible, then the statement referring to Fryette's diagnostic skills is not as outlandish as it initially appears to be upon cursory examination.

Subsequently, the following protocol was developed to determine whether a statistical correlation exists between subjectively quantified palpatory changes in tissue texture and the easily measurable independent variable of random blood sugar.

Materials and methods

Patients ($n = 40$) were recruited from the outpatient Family Medicine Clinic of the Chicago Osteopathic Medical Center and assigned sequential numeric identifiers to ensure anonymity of the patient-physician encounter. All were established diabetics. Patients meeting these criteria, with no exclusions, were enrolled and examined in the order that they presented to the clinic for routine follow-up visits. All patients who were asked to participate in the protocol did so without hesitation. This process was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experimentation involving humans (Midwestern University Institutional Review Board approved).

Following standard-of-care procedures, patients' random blood glucose levels (mg/dL) were assessed using the One-Touch (Life Scan, Inc., Milpitas, CA) blood glucose assessment system immediately before the physician-patient encounter. After the blood glucose analysis, musculoskeletal examinations were performed in 2 × 3-M examination rooms as part of the routine osteopathic physician-patient encounter. This segment of the protocol was performed at the very beginning of the encounter and before the physician's review of the patient's chart, blinding the examining physician to the blood glucose test results and before the acquisition of any verbal interim history, thereby reducing any other cues that might bias the examination. There were two examining physicians.

The palpatory examination

Patients were examined in the supine position on a standard adjustable-height bench-type examination/manipulative-treatment table. The examining physician was seated at the head of the table. The patient's posterior cervical soft tissues were palpated for tissue texture change by using a combination of skin rolling,[3,4] Beal's compression test,[5,6] and layer palpation.[3,4,7] Briefly, the examining physician grasped the skin and subcutaneous tissue of the patient's posterior cervical region bilaterally between the thumbs and index fingers with sufficient digital pressure to focus attention on subcutaneous tissue. Special attention was given to the posterior paraspinal tissues over the midcervical transverse processes. The degree of subcutaneous tissue texture turgidity (nonpitting or brawny edema) was quantified on a five-point scale (ordinal data) from 0, indicating no palpable tissue texture change, to 4, indicating severe tissue texture change (Table 1). This portion of the protocol required one to two minutes.

Table 1 Five-point scale for assessing the severity of palpable posterior cervical subcutaneous tissue texture change in diabetic patients

Assessment value	Palpable finding description
0	None
1	Just detectable
2	Mildly present
3	Moderately present
4	Severely present

Statistical analysis

Ordinal data frequencies, descriptive statistics, and correlations (Pearson [zero-order] correlation, and Kendal and Spearman rank-order nonparametric correlations) of blood sugar levels with palpatory assessment were computed using the SPSS 10.1 statistical package (SPSS, Inc., Chicago, IL).[8]

Results

Of the 40 patients enrolled, eight exhibited blood sugars ranging from 61 to 108 mg/dL, and 32 exhibited blood sugars >110 mg/dL (Table 2). Of these 32 patients, the blood sugars of 22 ranged from 110 to 199 mg/dL, six ranged from 200 to 299 mg/dL, two ranged from 300 to 399 mg/dL, and two were >400 mg/dL. Palpable tissue texture changes were exhibited by 27 of the 40 enrolled patients.

For each patient, the numeric quantification for the palpably assessed intensity of posterior cervical subcutaneous tissue texture change (Table 1) was recorded for comparison with the One-Touch blood glucose analysis (Table 3). No patient exhibited a tissue texture change value greater than 3 (moderate tissue texture change). Computation of three statistical correlation tests (Pearson, Kendal, and Spearman) resulted in the following findings: a Pearson correlation value of 0.210, with a probability of .097; a Kendal corre-

lation value of 0.215, with a probability of .042; and a Spearman correlation value of 0.269, with a probability of .047 (Table 4).

Discussion

First, let it be said that the statistical strength of this study is limited by the relatively small cohort size, making it more appropriately considered a pilot study. The results also are limited by the weakness of the correlation. This having been said, the subject being addressed is quite relevant to the definition of osteopathic distinctiveness, and a statistical trend appears to be present, in that the *p*-values of two of the three statistical correlations used (Kendal and Spearman) are less than .05.

Considering the literature, the significance of tissue texture changes in association with diabetes mellitus has been recognized in the osteopathic literature.[2,9] Most of these reports look at diagnostic findings and the somatovisceral impact of osteopathic manipulative treatment.[10,11]

The continual improvement of refined palpatory skills is at the heart of the uniquely developed osteopathic approach to physical diagnosis.[3-5,7] Although the knowledge of diabetes as we currently understand it was unavailable to clinicians like H. H. Fryette, the physician's sense of touch and the physiology of the diabetic patients they palpated were not different from today. The lack of technological diagnostics at the time, furthermore, required that they focus on physical diagnosis to correctly identify disease.

Although we typically refer to blood or serum glucose, the term "glycemia" is actually misleading. Glucose is elevated in diabetic patients throughout the extracellular compartment. The elevated presence of the glucose exerts an osmotic effect upon the intracellular compartment causing water to be pulled from the cells. The fluid shift is directly proportionate to the elevation of glucose, resulting in palpable swelling of the soft tissues that is in turn also proportionate. This edema is most readily palpable in the subcutaneous tissues and is, with a discerning sense of touch, quantifiable.

Table 2 Incidence of palpatory subcutaneous tissue findings obtained during the musculoskeletal examination compared with the One-Touch blood glucose level obtained immediately before the patient's physical examination

Blood glucose (mg/dL)	Palpatory findings	No palpatory findings
<110	6	2
110-199	14	8
200-299	5	1
300-399	0	2
>399	2	0
Sum	27	13

Table 3 Patient data; blood sugar and tissue texture change

Patient no.	Blood sugar (mg/dL)	Tissue texture change
1	112	0
2	101	0
3	209	2
4	204	2
5	121	0
6	487	2
7	125	0
8	461	2
9	108	0
10	167	1
11	169	1
12	223	3
13	99	1
14	397	0
15	196	2
16	235	1
17	129	1
18	175	2
19	167	1
20	160	0
21	277	2
22	168	0
23	129	2
24	146	0
25	61	1
26	144	1
27	199	2
28	199	2
29	127	0
30	315	0
31	163	2
32	86	1
33	187	1
34	106	1
35	196	1
36	186	2
37	185	0
38	98	2
39	93	2
40	241	0

This exercise may seem to be nothing more than a clinically irrelevant "parlor trick." What difference does it make if one can crudely quantify diabetic glycemia by palpation? Contemporary technology has produced pocket-

Table 4 Computed correlations between blood glucose and subcutaneous tissue texture change findings using three statistical correlation measures

Correlation statistic	Statistic value	Probability
Pearson	0.210	.097
Kendal	0.215	.042
Spearman	0.269	.047

sized devices, for little cost, that provide precise glycemic readings. Furthermore, the statistical power of this study is weak, but one must remember that H. H. Fryette practiced in the first half of the 20th century. Insulin was not discovered until the early 1920s, so for Fryette the descriptors "mild," "moderate," and "severe," when applied to diabetic patients, probably applied more closely to glucose levels of 400, 800, and 1200 mg/dL.

It must be recognized that the data presented herein is internally biased by the fact that all patients examined were diabetic and, therefore, diabetic tissue texture change was to be anticipated in each individual examined. This bias is overcome by the ordinal nature of the data. It is further strengthened by the participation of two examiners using the same palpatory methods (Procedure Appendix) to evaluate patients with relatively controlled diabetes (range 61-487 mg/dL, Table 3) when compared with diabetic management in the early 20th century.

What this study does show, however, is (1) that palpatory discrimination exists for levels of tissue texture change that in turn mirror systemic physiology, and (2) that claims made about the early practices of osteopathic medicine should not be so quickly dismissed. The osteopathic profession has a rich tradition of distinctive palpatory physical diagnosis in an area where very few others have ventured—the quantification of physical changes that constitute somatic dysfunction. Physical diagnosis is by far the most *cost-effective* diagnostic method available. It does not replace technological diagnostics, but as has been said repeatedly in the past, technological diagnostics should be reserved for the purpose of confirming the conclusions drawn from a thorough history and physical examination, not as a *replacement* for the history and physical. The acquisition of a thorough history, the performance of a careful osteopathic physical examination, and the mental process of synthesizing a prioritized differential diagnosis list is, in fact, that which differentiates a physician from a technician.

Physical findings, identifiable by traditionally osteopathic diagnostic practices, are present that can alert the astute clinician to underlying systemic illness, in this case diabetes. But diabetes is not the only systemic condition mirrored by generalized tissue texture changes. The hypothyroid state is associated with myxedema. Systemic infections result in a generalized soft tissue response. Renal failure results in osmotically induced fluid shifts that mirror the feel of diabetes to the extent that, in the previous diabetes palpation study,[2] the two nondiabetic individuals incorrectly identified as diabetics were actually renal failure patients.

Conclusion

The osteopathic profession needs to further delineate the extent of its palpatory diagnostics. The quantification of the palpatory experience helps to validate our distinctive osteopathic approach and contribution to physical diagnosis. Our oral tradition is full of references to palpable findings associated with mechanical and reflex somatic dysfunction, as well as with systemic illness, which are worthy of further study.

Procedure Appendix

Note: The development of discerning touch, which allows the examiner to appreciate subcutaneous tissue texture, is of paramount importance in the diagnosis of somatic changes:

- found in association with systemic illness
- for the determination of the intensity of viscerosomatic reflexes
- for the differentiation between acute and chronic somatic dysfunction

The following diagnostic procedures are descriptions of the procedures as they were performed in the above protocol. As such, they were performed to evaluate systemic changes in the posterior cervical subcutaneous tissue texture, with the patient lying supine and the physician seated at the head of the examination table.

These procedures, however, may also be performed to assess for (mechanical or viscerosomatic reflex) segmental somatic dysfunction by comparing the soft tissues at each vertebral level with those of the segment above and below. Furthermore, they may be used to evaluate any spinal area by modifying the position of the patient, or that of the examining physician.

Palpation for tissue texture abnormality (layer palpation)

Procedure

1. Slide both hands, palms up, beneath the patient's cervical spine.
2. Using the lightest touch, contact the skin on either side of the spine and palpate cutaneous temperature and texture.
3. Apply slightly more palpatory pressure, enough to palpate through the skin but not enough to appreciate the paravertebral muscles and their fascia. Evaluate the subcutaneous tissue by palpating for interstitial turgidity.
4. Assess the superficial fascial tension in the region with slightly greater pressure by introducing movement in different directions and identifying in which direction the movement is most free and in which it is the tightest.
5. Applying more pressure, sense the deep fascia. Palpate for areas of thickening involving the fascia that surrounds the paravertebral musculature.
6. Finally, palpate through the deep fascia to evaluate the underlying muscles. Identify individual muscle fibers and the direction in which they run. This will allow you to differentiate the superficial muscles that are oriented

cranio-caudally from the deeper muscles oriented more medio-laterally. Note areas of increased musculature tension.

Skin rolling

Procedure

1. Slide both hands, palms up, beneath the patient's cervical spine.
2. On either side, with each hand, symmetrically grasp a fold of posterior-cervical skin between the pads of the thumbs and index fingers.
3. Gently pull the skin away from the underlying deep fascia and paravertebral musculature.
4. Using the principles of layer palpation described before compress the grasped tissue to appreciate the turgidity of the skin and subcutaneous tissues.

Beal's compression test

Procedure

1. Slide both hands, palms up, beneath the patient's cervical spine.
2. The pads of the fingers should contact the paravertebral soft tissue on either side of the spine.
3. Using the principles of layer palpation described above, apply gradually increasing pressure directed anteriorly relative to the supine patient, compressing the paravertebral soft tissues to appreciate the turgidity of the skin and subcutaneous tissues.

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