Fluoride Does Not Immediately Preserve Glucose in Sample Tubes

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Glucose testing is essential in diagnosing and monitoring diabetes mellitus, a common chronic and debilitating diseases in the U.S. Clinical laboratories perform the test on samples that are often collected at remote sites and transported for analyses, which may take hours. For many years, Fluoride tubes (NaF) have been used as the sampling tube of choice because of Fluoride's inhibitory effect on glycolysis.

However, studies have shown that Fluoride would not preserve glucose in blood as widely belived.[1-8] Although it effectively stops glycolysis by inhibiting enolase, biochemical reactions upstream to this enzyme may continue for 2 or 3 hours.

We conducted experiments to confirm that glucose in blood tubes would decrease over time, and to investigate the effectiveness of Fluoride in preserving glucose levels.

METHOD

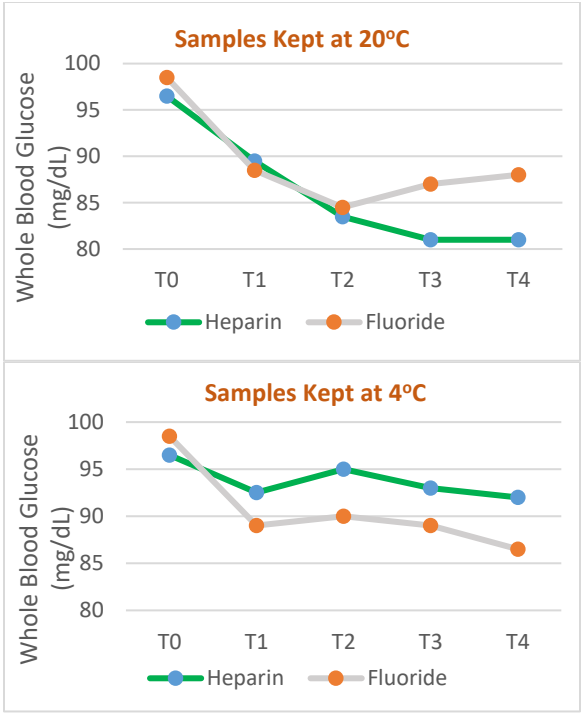
Whole blood samples were collected from a subject by venipuncture in Heparin (green top) and in Fluoride/Oxalate (gray top) tubes. Whole blood glucose concentrations were measured in duplicate using HemoCue Glucose 201 (HemoCue AB, Sweden) immediately after collection (T0). Then one set (green & gray) of samples were left at room temperature (20°C) and another set was refrigerated at 4°C. At one-hour intervals up to hour-four (T4), whole blood glucose measurements were repeated in duplicate on both sets of samples.

HemoCue Glucose 201 is a factory calibrated Point-of-Care device with an internal quality control. It measures glucose by a modified glucose dehydrogenase method using a chromogen and measured at two wavelengths to compensate for turbidity.[9]

RESULTS

Mean glucose concentrations:

	At 20°C (mg/dL)		At 4°C (mg/dL)	
	Heparin	Fluoride	Heparin	Fluoride
T0	96.5	98.5	96.5	98.5
T1	89.5	88.5	92.5	89.0
T2	83.5	84.5	95.0	90.0
T3	81.0	87.0	93.0	89.0
T4	81.0	88.0	92.0	86.5



At room temperature, glucose levels in both Heparin and Fluoride tubes steadily decreased. While glucose level in Heparin tube continued to decrease up to T3 or T4, glucose level in Fluoride tube seemed to stabilize after T1. There was approximately 7% and 11% decrease in glucose at T1 in Heparin and Fluoride tubes, respectively. By T3, glucose level in Heparin tube decreased by 16%. At T3 and T4, glucose in Fluoride tube remained at essentially the same level as in T1.

Stored at 4°C, rate of decrease in glucose levels in both Heparin and Fluoride tubes were clearly lower. Nevertheless, glucose levels steadily decreased in both tubes up to T4. By T4, glucose level in Heparin and Fluoride tubes decreased by approximately 5% and 12%, respectively.

DISCUSSION

Results of our small-scale study was consistent with published reports of Fluoride additive not being effective in preserving blood glucose levels. This was more evident when tubes were left at room temperature; at 20°C, blood glucose levels in Fluoride tube decreased by 10 mg/dL (11% of original concentration) within the first hour (T1). However, glucose level stabilized after the second hour (T2). The rate of decrease was much slower when samples were stored at 4°C, but glucose level in Fluoride tube decreased by 10% of original concentration by hour-three.

Thus, we conclude that Fluoride does not preserve glucose effectively in blood sample. This raises questions about the common practice of collecting Fluoride blood samples at a remote sites and transporting them to the testing labs uncentrifuged. Glucose levels in such samples are likely to be falsely decreased.

The manufacturer of Vacuette Glucomedics (contains NaF, EDTA, and Oxalate; Greiner Bio-One) claims to halt decrease of glucose immediately after the sample is drawn.[10] However, the product is not available in the U.S.[11]

Glucose reference range: 74-100 mg/dL (4.1-5.6 mmol/L)[12]

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