Research Square

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Glucose on-site evaluation (GOSE) during endoscopic ultrasound-guided pancreatic cyst fluid aspiration: real-world agreement with laboratory glucose measurement

Edgardo Amaya-Fragoso
dr.edgardo.amayafr@gmail.com
Instituto Nacional de Cancerología
Beatriz Alejandra Sánchez-Jiménez
Instituto Nacional de Cancerología
Patricia González-Ballesteros
Instituto Nacional de Cancerología
Daniel Martín Escobedo-Paredes
Hospital Angeles del Carmen
Katia Picazo-Ferrera
Centro Médico ABC
José Guillermo de la Mora-Levy
Instituto Nacional de Cancerología
Wilmer Daniel Torrecilla-Ramírez
Instituto Nacional de Cancerología
Uriel Isaías Flores-Martín
Instituto Nacional de Cancerología
Juan Octavio Alonso-Lárraga
Instituto Nacional de Cancerología
Mauro Eduardo Ramírez-Solís
Instituto Nacional de Cancerología
Angélica Hernández-Guerrero
Instituto Nacional de Cancerología

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Abstract

Background

Differentiation of pancreatic cysts is essential for management. Intracystic glucose analysis is currently the most sensitive and available biomarker for this purpose; however, sending aspirate to the laboratory for glucometry consumes volume that could be used for additional biomarkers. Glucose on-site evaluation (GOSE) could eliminate this limitation.

Aims

To evaluate the analytical interchangeability between GOSE and laboratory glucometry in pancreatic cyst fluid aspirated by EUS-FNA/B.

Methods

Pancreatic cysts that underwent EUS-FNA/B for diagnostic evaluation were retrospectively enrolled. A drop of aspirate was used for GOSE; the remainder was used for laboratory glucometry. Cysts were classified as mucinous (definitive, probable, or compatible) or non-mucinous. Interchangeability was assessed using the Bland-Altman analysis, intraclass correlation coefficient (ICC), and linear regression. Diagnostic performance was compared using ROC curve analysis with DeLong test.

Results

117 patients were included. Median glucose values were 44 mg/dl for laboratory glucometry and 43 mg/dl for GOSE; 58 pancreatic cysts were categorized as mucinous, and 59 as non-mucinous. Pearson's R^2 was 0.95 ($p < 0.001$). The Bland-Altman analysis demonstrated a mean bias of + 1.3 mg/dl (95%CI -0.5 to + 3.1), with LoA of -18.2 to + 20.7 mg/dl and 98.3% of pairs within the LoA. Agreement was consistent across mucinous and non-mucinous subtypes. ICC was 0.98 (95%CI 0.97–0.98).

Conclusion

GOSE demonstrates excellent analytical interchangeability with laboratory glucometry (ICC 0.98, bias + 1.3 mg/dl) and equivalent diagnostic performance at the standard 50 mg/dl threshold. These findings support using GOSE as the sole measurement method while preserving cyst fluid for additional biomarker analysis.

Introduction

Pancreatic cysts are often found incidentally on abdominal imaging performed for other reasons, as they are mostly asymptomatic lesions[1]. The prevalence has been estimated to range from 2.4% to 13.5% in the general population, increasing with age (some reports as high as 45%), and there is no difference between sexes[2,3].

Pancreatic cysts represent a clinical challenge because their prognosis can range from a totally benign lesion (which will not even require surveillance) to premalignant or even pancreatic ductal adenocarcinoma (PDAC) with cystic degeneration[4]. Imaging studies, such as computed tomography (CT) or magnetic resonance imaging (MRI), can lead to a diagnostic approach by identifying certain features suggestive of some type of pancreatic cysts, as if it is connected to the pancreatic duct or not, or its morphology (oligocystic or multicystic); however, in some other cases, they might be insufficient to differentiate the types of pancreatic cysts[5].

Besides morphology, and since biopsy and/or resection are uncommon in real-world practice, pancreatic intracystic biomarkers play a predominant role in diagnosis, as they can further categorize pancreatic cysts as mucinous or non-mucinous and guide decision-making[6]. Endoscopic ultrasound-guided fine-needle aspiration/biopsy (EUS-FNA/B) not only evaluates pancreatic cysts' morphologic features in real time and provides comparative outcomes with MRI, but also enables aspiration of fluid to analyze intracystic biomarkers[7]. Current guidelines on the diagnosis and management of pancreatic cysts recognize that tissue acquisition and resection are limited by surgical morbidity weighed against an uncertain prognosis, and agree that diagnosis should be established using a combination of clinical, biochemical, and imaging features, rather than solely on histopathological analysis[1,2,8] Surgery should be reserved for mucinous cysts with high-risk features, such as main pancreatic duct dilatation above 10 mm, obstructive jaundice, and mural-enhancing nodes larger than 5 mm[9].

Glucose and carcinoembryonic antigen (CEA) are the most studied biomarkers measured in fluid; levels below 50 mg/dl and above 192 ng/ml are suggestive of mucinous cysts[10,11]. Previous studies have established that glucose is more sensitive than CEA for diagnosing mucinous cysts, whereas CEA is more specific. Glucose and CEA are complementary biomarkers, not exclusive, so analyzing both is mandatory for a correct diagnostic approach and differential diagnosis[12]. For adequate laboratory measurement of glucose and CEA, a fluid aspirate of at least 2 ml is required (1 ml per biomarker), which may be difficult given the aspirate's viscosity[13]. Furthermore, a larger sample might be necessary if other biomarkers are analyzed (i.e., amylase, lactate)[14].

Glucose on-site evaluation (GOSE) using a point-of-care glucometer is an alternative for measuring glucose in pancreatic cysts, offering benefits such as wide availability, reproducibility, low cost, and faster results than laboratory testing, thereby enabling preliminary diagnosis during the procedure[10,15]. The main limitation of this practice is that glucometers are not designed for fluids other than blood, and the expected variability when blood glucose is < 100 mg/dl should be within ± 15 mg/dl[16]. Furthermore, the interchangeability between methods has not been evaluated.

A study validated GOSE against laboratory glucometry in pancreatic cyst fluid samples, reporting a mean bias of 7.2 mg/dl[13]. External validation of these findings in independent cohorts, with interchangeability as the primary objective, remains lacking. The aim of this study was to evaluate the analytical interchangeability between GOSE and laboratory glucose measurement in pancreatic cyst fluid aspirated by EUS-FNA/B.

Material and methods

This was a multicenter, retrospective, observational study. Patients from three Mexican centers were included for analysis. Most patients were retrospectively recruited from the Instituto Nacional de Cancerología. Patients older than 18 years who underwent EUS for the diagnosis of pancreatic cysts and had an EUS-guided FNA/B aspiration of pancreatic cyst fluid for biochemical analysis, as well as on-site glucometry, between January 2019 and June 2025, were included. Patients with incomplete data, contraindications for FNA/B (platelet count < 50,000 or INR > 1.5), or non-cystic pancreatic lesions were excluded. STROBE guidelines were followed as recommended for retrospective and observational studies. This study was authorized by the local ethics committee with registration number 1247/2022.

Procedures

All EUS-guided FNA/B fluid aspiration from pancreatic cysts was performed by experienced endoscopists. All of the EUS-guided FNA/B fluid aspirations from pancreatic cysts were performed using linear echoendoscopes (UCT-180, Olympus Medical Systems, Tokyo, Japan) and an EU-M2 processor (Olympus Medical Systems, Tokyo, Japan). EUS-guided FNA/B was performed with different brands and models of needles (EchoTip, Cook Medical, Ireland; Acquire, Boston Scientific, Marlborough, USA; Trident, Microtech, Nanjing, China; EZ Shot, Olympus Medical Systems, Tokyo, Japan), as well as their calibers (22G or 19G), according to the endoscopist's criteria. Once the pancreatic cyst was located and punctured under ultrasonographic visualization, fluid was aspirated with either active or passive suction until it appeared in the syringe. At least 2 ml were obtained from each patient. A drop of aspirate was placed on a reagent strip inserted into a glucometer (ACCU-CHEK Active, Roche, Switzerland) for GOSE. If a valid numeric result was obtained, the rest of the aspirate was sent in a dry, sterile tube for further biochemical testing, including laboratory glucometry and the quantification of CEA, amylase, and CA19-9. If insufficient fluid was aspirated to perform all biochemical tests, laboratory glucometry and CEA were prioritized. If a solid component of the pancreatic cyst was observed during EUS inspection, it was biopsied and sent for histopathological analysis. Patients received either intravenous ceftriaxone 1 g or ciprofloxacin 400 mg, based on the endoscopist's criteria and the patient's allergy history.

Definitions

In real-world practice, histopathological confirmation of pancreatic cysts is not routinely available or recommended, so diagnoses are established based on a combination of clinical, biochemical, and imaging features. Three diagnostic classifications were used for mucinous cysts: "definitive" for cases

when histopathological confirmation was available after surgical resection or EUS-FNB; “probable” if the diagnosis was established according to a combination of intracystic glucose below 50 mg/dl and CEA higher than 192 ng/ml with echoendoscopic features as connection to either main or branch pancreatic ducts and oligocystic morphology; and “compatible” for cases where only one biochemical feature was present, but EUS characteristics were suggestive and mucus was aspirated from the cyst. The following EUS features were suggestive of mucinous cysts: communication with the main/branch pancreatic duct, oligocystic morphology, and pancreatic duct dilation. Any pancreatic cysts that did not meet the latter criteria were classified as non-mucinous. Serous cysts were defined as pancreatic cysts with multicystic morphology on EUS inspection, intracystic glucose higher than 70 mg/dl, and CEA below 192 ng/ml.

GOSE

A drop of aspirated fluid was placed on a glucometer (ACCU-CHEK Active, Roche, Switzerland). The glucose measurement range was from 20 mg/dl to 600 mg/dl. Glucose levels below and above the cutoff points were marked as “Lo” and “Hi,” respectively. “Lo” was set as 20 mg/dl, and “Hi” was set as 600 mg/dl, and these values were used for statistical purposes.

Laboratory glucose quantification

Fluid aspirated from pancreatic cysts was placed in a dry, sterile tube and sent to the laboratory for analysis within 20 minutes of aspiration. The colorimetry method involved centrifuging the sample at 3500 rpm for 10 minutes, followed by glucose oxidase colorimetry at 540 nm for 5 minutes at 98.6°F (Vitros 4600).

CEA quantification

Fluid aspirated from pancreatic cysts was placed in a dry, sterile tube and sent to the laboratory for analysis within 20 minutes of aspiration. Centrifugation was set at 3000 rpm for 10 minutes, followed by the direct chemiluminescence method (ARCHITECT Plus i2000 SR).

Statistical analysis

Descriptive statistics were used to present baseline characteristics. Categorical variables were presented as frequencies and percentages, while quantitative variables were described using measures of central tendency and dispersion. The Shapiro-Wilk test was performed to assess the distribution of quantitative variables, and based on the p-value, the variables were classified as either parametric or non-parametric. For comparison between quantitative, non-parametric variables, the Wilcoxon test was performed. For the primary objective, linear regression with Pearson’s r was performed to assess correlations among glucometry tests, and the Bland-Altman test was used to assess interchangeability. Mean bias and 95% limits of agreement (LoA) were calculated as a mean difference ± 1.96 SD of the paired differences. An intraclass correlation coefficient (ICC) was additionally calculated to assess overall concordance. The ICC was estimated using a two-way mixed-effects model with absolute agreement and single measures; for interpretation, the following thresholds were set: >0.90, excellent;

0.75–0.90, good; 0.50–0.75, moderate; <0.50, poor. The Kruskal-Wallis test was used to compare glucose levels across methods and subgroups. An ROC curve and its area under the curve were calculated to assess the performance of GOSE, laboratory glucometry, and CEA. DeLong test was performed to assess statistical significance. SPSS v24.0 (IBM SPSS Statistics) and JASP v0.19.3 were used for statistical analysis.

Results

One hundred and seventeen patients met the inclusion criteria for analysis and were included between January 2019 and June 2025. Overall, 67.2% were female, and the mean age was 56.2 years. Most pancreatic cysts were anatomically located in the head (59%), followed by the body (23.9%) and the tail (11.1%). Median pancreatic cyst size was 37 mm. Glucose was measured by laboratory glucometry and GOSE for all patients, with median values of 44 mg/dl and 43 mg/dl, respectively. 58 pancreatic cysts were categorized as mucinous, while the rest were considered non-mucinous. Of the 58 mucinous cysts, 18 had a definitive diagnosis, 29.3% were considered probable, and 39.7% were compatible, according to the study definitions. The remaining characteristics are shown in Table 1.

Table 1
Baseline characteristics

Characteristics	**All patients (n = 117)**
Female sex, n (%)	78 (67.2)
Age in years, mean (SD)	56.2 (16.0)
Pancreatic cyst location, n (%)	69 (59.0)
Head	28 (23.9)
Body	13 (11.1)
Tail	7 (6.0)
Multifocal	
Pancreatic cyst size, mm, median (IQR)	37.0 (30.1)
Biomarkers on aspirate fluid	44.0 (188.0)
Laboratory-based glucometry, mg/dl, median (IQR)	43.0 (152.0)
On-site glucometry, mg/dl, median (IQR)	41.6 (231.8)
CEA, ng/ml, median (IQR)	161.3 (6534.7)
Amylase, UI/ml, median (IQR)	
Serum Ca19.9, UI/ml, median (IQR)	45.0 (746.8)
Mucinous cysts, n (%)	58 (100.0)
Definitive	18 (31.0)
Probable	17 (29.3)
Compatible	23 (39.7)
Non-mucinous cysts, n (%)	59 (100.0)
Serous	41 (69.5)
Others	18 (30.5)
Neuroendocrine neoplasms	3 (16.7)
Solid pseudopapillary tumor	5 (27.8)
Pancreatic pseudocyst	10 (55.5)

IQR, interquartile range; SD, standard deviation.

Figure 1 shows the linear correlation between GOSE and laboratory glucose, with a calculated Pearson's R^2 of 0.95 ($p < 0.001$). Interchangeability of glucometry methods was assessed in Table 2, which showed no statistically significant differences among all patients ($p = 0.21$). There were also no differences among mean glucose values measured by laboratory and GOSE between probable (20 mg/dl vs 20 mg/dl, $p = 0.39$) and compatible mucinous cysts (25 mg/dl vs 21 mg/dl, $p = 0.79$), as well as serous (107 mg/dl vs 105 mg/dl, $p = 0.63$) and other cysts (73.5 mg/dl vs 80 mg/dl, $p = 0.75$). The only group showing a statistical difference was the definitive mucinous subgroup (21.5 mg/dl vs 26 mg/dl, $p < 0.005$). Table 3 shows the results of the Bland-Altman analysis of GOSE vs laboratory glucose; mucinous cysts had a mean glucose bias of + 2.7 mg/dl with LoA of -15.6 to + 20.9, and 94.8% of pairs within LoA, and non-mucinous cysts had a mean glucose bias of -0.1 mg/dl with LoA of -20.4 to + 20.2, and all pairs within LoA. The graphical representation of the Bland-Altman analysis is shown in Fig. 2. ICC for mucinous cysts was 0.87 (95% CI 0.81–0.93, $p < 0.001$), 0.96 (95% CI 0.94–0.98, $p < 0.001$) for non-mucinous cysts, and 0.98 (0.97–0.98, $p < 0.001$) overall (Table 4).

Table 2
Glucometry methods interchangeability

		Laboratory (mg/dl)		**GOSE (mg/dl)**		**p-value**
		Median	**IQR**	**Median**	**IQR**	
Total	All patients (n = 117)	44.0	20.0–100.0	43.0	20.0–101.0	0.21
Mucinous	Definitive (n = 18)	21.5	20.0–29.2	26.0	20.0–36.2	< 0.005
	Probable (n = 17)	20.0	17.0–24.0	20.0	20.0–20.0	0.39
	Compatible (n = 23)	25.0	20.0–37.5	21.0	20.0–40.0	0.79
Non-mucinous	Serous (n = 41)	107.0	87.0–129.0	105.0	89.0–123.0	0.63
	Others (n = 18)	73.5	37.2–101.2	80.0	40.0–105.0	0.76

GOSE, glucose on-site evaluation; IQR, interquartile range.

Table 3
Bland-Altman analysis: GOSE vs laboratory glucose

	Total (n = 117)	Mucinous (n = 58)	Non-mucinous (n = 59)
Bias (GOSE – Laboratory glucose)			
Mean bias (mg/dl)	+ 1.3	+ 2.7	-0.1
95% CI	-0.5 to + 3.1	+ 0.3 to + 5.2	-2.8 to + 2.6
SD of differences (mg/dl)	9.9	9.3	10.3
Limits of agreement (± 1.96 SD)			
Upper LoA (mg/dl)	+ 20.7	+ 20.9	+ 20.2
95% CI	+ 17.6 to + 23.9	+ 16.7 to + 25.2	+ 15.5 to + 24.9
Lower LoA (mg/dl)	-18.2	-15.6	-20.4
95%CI	-21.3 to -15.0	-19.8 to -11.3	-25.1 to -15.8
Agreement			
Pairs within LoA, n(%)	115 (98.3)	55 (94.8)	59 (100.0)
Pairs outside LoA, n(%)	2 (1.7)	3 (5.2)	0 (0.0)

GOSE, glucose on-site evaluation; LoA, limits of agreement; SD, standard deviation; CI, confidence interval. Bias is defined as the mean difference between GOSE and laboratory glucose measurements. Limits of agreement calculated as mean bias ± 1.96 SD. 95% CIs estimated using the Bland-Altman method.

Table 4
Intraclass correlation coefficient – GOSE vs laboratory glucose

Subgroup	ICC	95% CI	p-value	Interpretation
All cysts (n = 117)	0.98	0.97–0.98	< 0.001	Excellent
Mucinous (n = 58)	0.87	0.81–0.93	< 0.001	Good
Non-mucinous (n = 59)	0.96	0.94–0.98	< 0.001	Excellent

ICC, intraclass correlation coefficient; GOSE, glucose on-site evaluation; CI, confidence interval.

ROC, receiver operating characteristic curve; GOSE, glucose on-site evaluation; CEA, carcinoembryonic antigen; AUC, area under the curve.

The diagnostic performance of GOSE, laboratory glucose, and CEA showed AUROCs of 0.92, 0.94, and 0.90, respectively, with a p-value of 0.54 (Fig. 3). CEA > 192 ng/ml had the highest specificity for identification of mucinous cysts (98.3%, 95%CI 91.0–99.7), while sensitivity was equal for GOSE and

laboratory glucometry (91.4%, 95%CI 81.4–96.3). The remaining diagnostic characteristics are shown in Table 5.

Table 5
Diagnostic performance of GOSE, laboratory glucose, and CEA for mucinous pancreatic cyst identification

	GOSE (< 50 mg/dl)		Laboratory glucose (< 50 mg/dl)		CEA (> 192 ng/ml)	
	Value	**95% CI**	**Value**	**95% CI**	**Value**	**95% CI**
AUC (95% CI)	0.92	0.86–0.97	0.94	0.90–0.98	0.90	0.84–0.95
Sensitivity (%)	91.4	81.4–96.3	91.4	81.4–96.3	53.4	40.8–65.7
Specificity (%)	86.4	75.5–93.0	86.4	75.5–93.0	98.3	91.0–99.7
PPV (%)	86.9	76.2–93.2	86.9	76.2–93.2	96.9	84.3–99.4
NPV (%)	91.1	80.7–96.1	91.1	80.7–96.1	68.2	57.7–77.2
Accuracy (%)	88.9	81.9–93.4	88.9	81.9–93.4	76.1	67.6–82.9

GOSE, glucose on-site evaluation; CEA, carcinoembryonic antigen; AUC, area under the ROC curve; PPV, positive predictive value; NPV, negative predictive value; CI, confidence interval.

Discussion

We found that GOSE is a feasible, accurate, rapid, inexpensive, and interchangeable method for evaluating glucose in pancreatic cyst fluid aspirates, compared to laboratory glucometry. The primary aim of this study was to validate the analytical interchangeability between GOSE and laboratory glucometry, rather than to establish a definitive diagnostic accuracy study. GOSE and laboratory glucometry measurements show an almost perfect correlation (Pearson's R^2 of 0.95), with no clinically or decision-changing differences between methods when evaluated by type of pancreatic cyst.

Mean glucose values did not differ statistically among groups, and these differences did not alter cyst classification in any patient. Furthermore, the mucinous cysts identified by GOSE had a mean glucose overestimation of 2.7 mg/dl, compared to laboratory glucometry, with LoA of -15.6 mg/dl to + 20.9mg/dl, and 94.8% of pairs within LoA; a glucose overestimation bias of 2.7 mg/dl is hardly clinically relevant with a cutoff set at 50 mg/dl. However, the wide interval of 36.5 mg/dl (-15.6 mg/dl to + 20.9 mg/dl) must be considered when interpreting results, especially when glucose values are close to the cutoff point on a suspected mucinous cyst. Non-mucinous cysts had a lower underestimation bias when identified by GOSE (-0.1 mg/dl), but a wider range (-20.4 mg/dl to + 20.2 mg/dl), with all pairs within LoA. ICC was excellent for overall pancreatic cysts and non-mucinous cysts, while it was graded as good for mucinous cysts.

Multiple studies have already assessed the role of glucose levels in differentiating mucinous from non-mucinous pancreatic cysts. Laboratory glucometry < 50 mg/dL has been reported to have a sensitivity ranging from 93.2% to 100% in diagnosing mucinous cysts[17–19]. Although not widely adopted, other authors have suggested different glucose cutoff values for diagnosis, with similar sensitivity outcomes[13,14,20]. Carr et al. reported in their analysis that blood glucose levels do not affect pancreatic fluid glucose[21]. Our results align with the previously mentioned ranges, with a sensitivity of 91.4% (95% CI 81.4% – 96.3%) when laboratory glucometry was used to diagnose mucinous cysts.

Ribeiro et al. conducted a study evaluating intracystic glucose measurements and comparing laboratory glucometry with GOSE, finding a strong correlation between the methods (0.92). The authors also reported that GOSE values were slightly higher than laboratory glucometry values in 75% of cases, with a median of 9 mg/d[18]. Noia et al. also found an excellent correlation between glucometry methods[15]. Other authors have reported similar outcomes with GOSE, and although glucometry methods tend to yield comparable values, no other official correlation analysis has been reported[19,22,23].

Zamir et al. conducted a single-center prospective study to validate GOSE against laboratory glucometry and identify an optimal cutoff point for glucose values in mucinous cysts. A total of 101 pancreatic cysts were included, and after Bland-Altman analysis, the authors reported a mean glucose difference of 7.2 mg/dl, with a LoA of -22.7 mg/dl to + 8.4 mg/dl, and an overall ICC of 0.97[13]. Our results showed an excellent ICC of 0.98 ($p < 0.001$), similar to Zamir et al.'s findings. We also found that LoA across cyst subtype does not differ widely, and that further classification from mucinous to non-mucinous (or even from probable to compatible) or vice versa was not observed. These results support the idea that glucose differences between GOSE and laboratory glucometry are mild, clinically irrelevant, and do not alter pancreatic cyst classification.

We also found that GOSE, laboratory glucometry, and CEA had good diagnostic performance in identifying mucinous cysts, with an AUROC > 0.90 for each test. A CEA value > 192 ng/ml was the most specific test (98.3%), while GOSE and laboratory glucometry shared the same sensitivity for diagnosing mucinous cysts (91.4%). Zikos et al. compared the diagnostic efficacy of laboratory glucometry, GOSE, and CEA for differentiating mucinous vs non-mucinous cysts, finding sensitivities of 95%, 88%, and 77%, respectively, with AUROCs of 0.84, 0.89, and 0.77, which are also similar to our results[24]. These findings have been consistent across various publications[13,19,20].

The demonstration of interchangeability among glucometry methods allows for a lower fluid aspirate volume for assessing one of the most sensitive biomarkers of mucinous cysts, and for using the remaining aspirate for other diagnostic biomarker analysis. Low intracystic lactate levels (< 0.6 mmol/L) have been associated with a diagnosis of mucinous cyst and have been correlated with intracystic glucose levels (Spearman's rho = 0.64)[14].

Given the absence of histopathological confirmation in most patients and the risk of incorporation bias when cyst type is assigned using cyst-fluid glucose or CEA, the present study should be interpreted

primarily as an analytical agreement study rather than a definitive diagnostic accuracy study.

The use of a composite clinicopathological criteria as a surrogate reference standard is well supported by current international guidelines, and explicitly recognizes that histopathological confirmation is unavailable in the vast majority of non-resected pancreatic cysts, endorsing the combined use of imaging features, cyst fluid glucose, and CEA as the standard diagnostic approach in clinical practice[1,2,9]. The current Kyoto guidelines further validate glucose (< 50 mg/dl) as a diagnostic marker for mucinous cysts, with 93% sensitivity and 89% specificity, without requiring surgical confirmation[9]. Our composite classification is in line with current guidelines.

To date, no published study has demonstrated that GOSE is inaccurate for pancreatic cyst fluid analysis. The main theoretical concern is the use of glucometers in a biological matrix for which they were not originally designed (i.e., fluid rather than blood); however, the present study and prior validation work consistently demonstrate excellent analytical agreement with laboratory measurements, supporting the safety of this practice.

This study has several strengths. Although retrospectively, we present information on more than 100 pancreatic cysts, evaluated using both GOSE and laboratory glucometry, as well as CEA, with the primary objective of assessing the interchangeability of glucometry methods. This is the only study conducted specifically to assess that outcome. Second, we found that GOSE and laboratory glucometry are interchangeable methods for mucinous or non-mucinous cysts, as there are no significant differences in glucose levels by cyst type. Furthermore, our analysis showed consistent agreement between the two glucometry methods across mucinous and non-mucinous cyst subtypes.

Our study has several limitations. First, its retrospective and single-center design poses a risk of bias in data collection. Second, the fact that most of the studied pancreatic cysts lacked histopathological confirmation suggests a possible diagnostic bias, although glucose measurements did not vary widely across methods, regardless of cyst type or subtype. Third, only one type of on-site glucometer was used, so our findings may not generalize to other brands; however, variability among glucometer brands is not expected to be relevant. Fourth, this study did not consider blood contamination of fluid aspirates, and we do not know the impact of such events on glucose levels or measurements, although others have reported that these events do not affect glucose measurement[20]. Fifth, it is still unknown whether hyperglycemia might introduce bias in pancreatic cyst glucose measurements.

Conclusion

GOSE demonstrates excellent analytical interchangeability with laboratory glucometry (ICC 0.98, bias + 1.3 mg/dl) and equivalent diagnostic performance at the standard 50 mg/dl threshold. These findings support the use of GOSE as the sole measurement method, preserving cyst fluid volume for additional biomarker analysis.

Abbreviations

GOSE
glucose on-site evaluation
CT
computed tomography
MRI
magnetic resonance imaging
EUS
endoscopic ultrasound
FNAB
fine needle aspiration/biopsy
CEA
carcinoembryonic antigen
IPMN
intraductal papillary mucinous neoplasm
PDAC
pancreatic ductal adenocarcinoma
MCA
mucinous cystadenoma.

Declarations

Potential competing interests

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Conflict of interest

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Author Contribution

AFE, SJBA, GBP, EPDM, PFK and MLJG study concept and design, acquisition of data, drafting of the manuscript; AFE, SJBA, TRWD and FMUI analysis and interpretation of data, statistical analysis; MLJG, ALJO, RSME and HGAI critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Figures

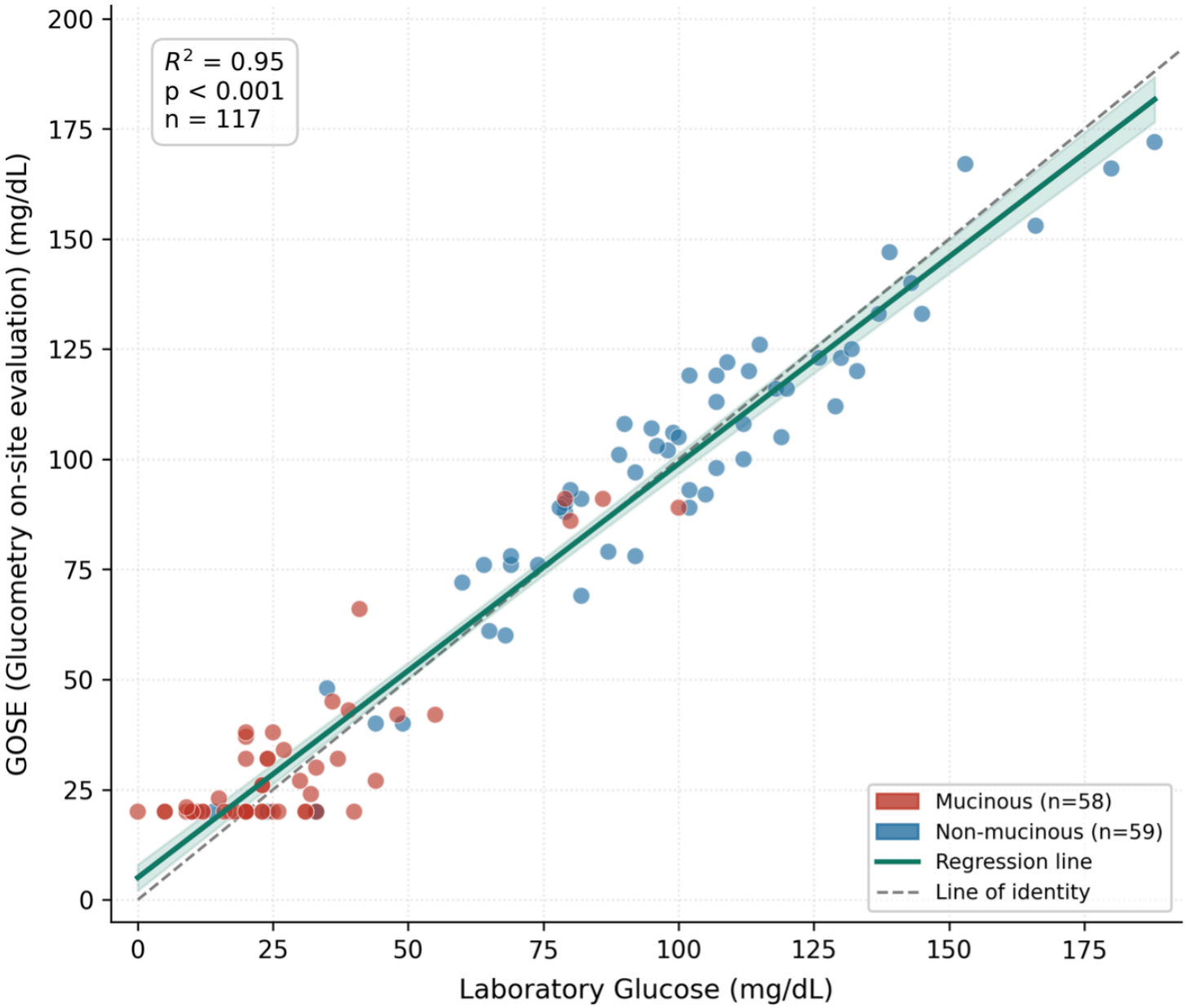


Figure 1

Correlation between laboratory glucometry and GOSE

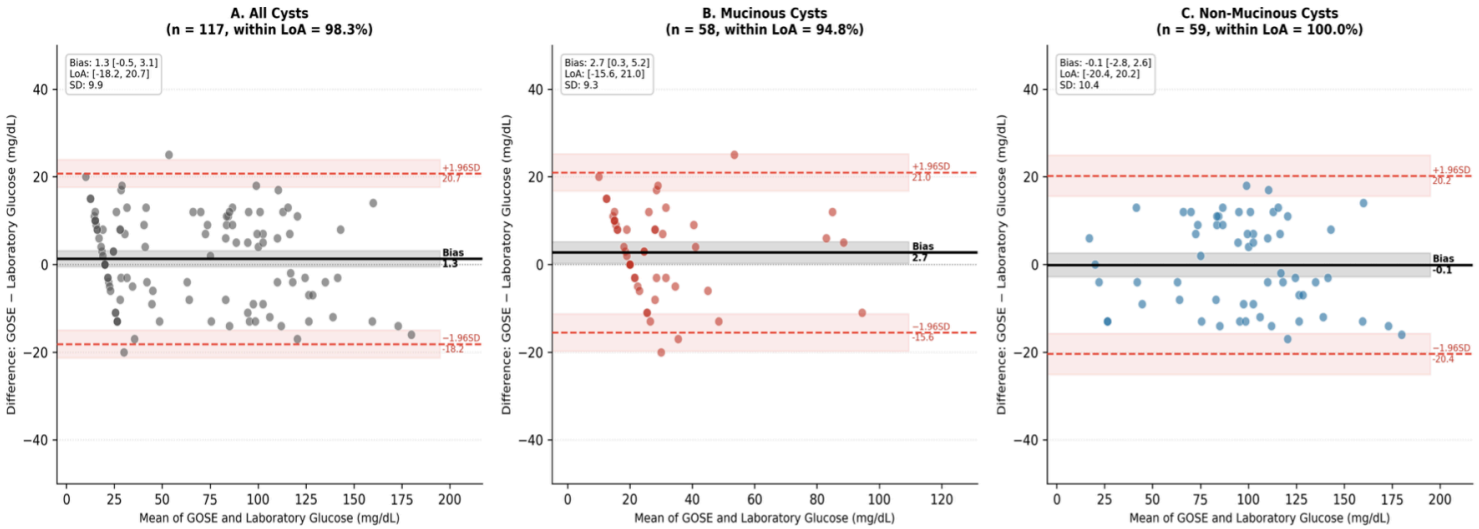


Figure 2

Bland-Altman analysis: GOSE vs laboratory glucose

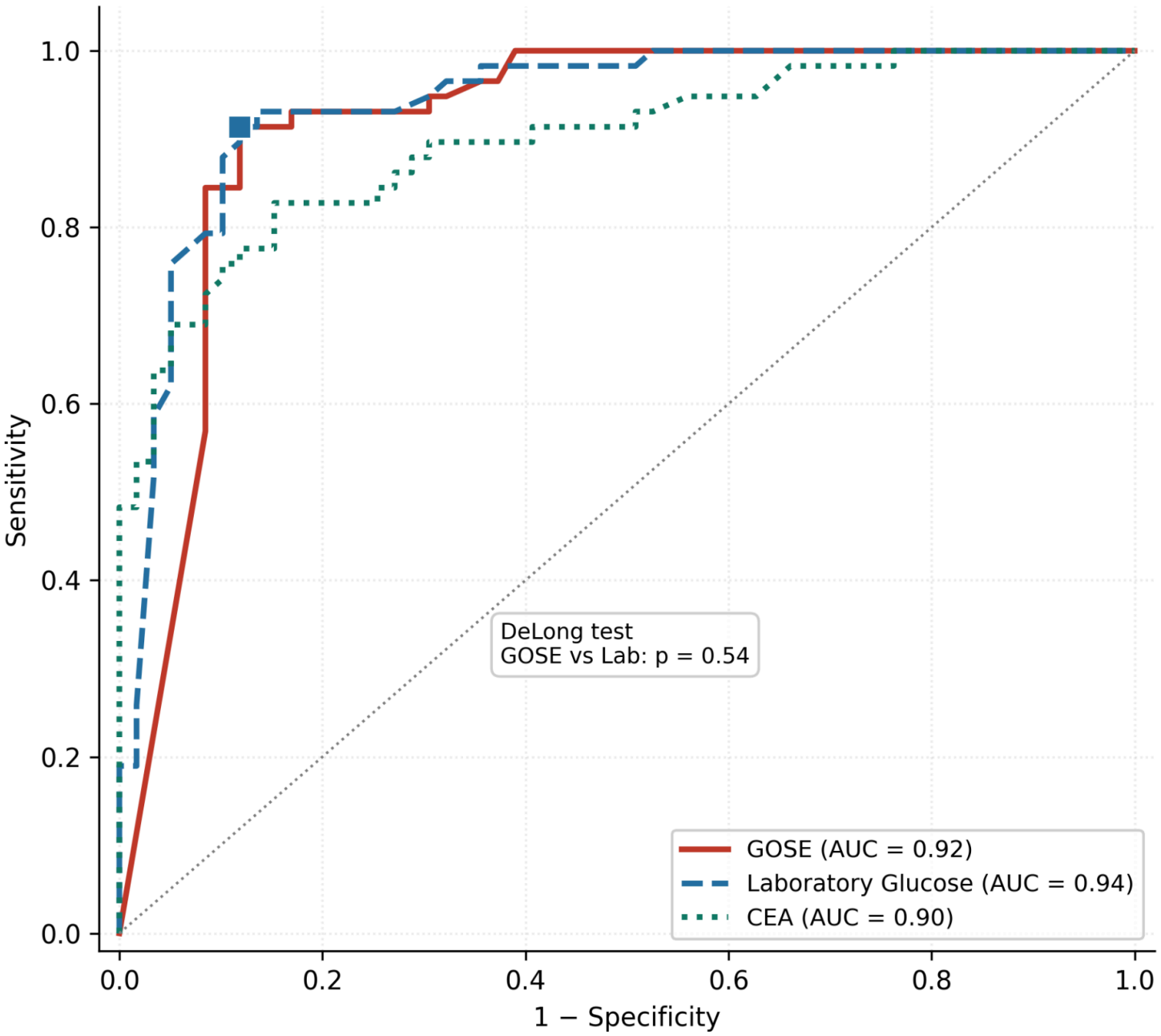


Figure 3

ROC for GOSE, laboratory glucose and CEA