Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Acinar Filling After Secretin Stimulation: Association with Pancreatic Dysfunction and Structural Damage in Secretin-Enhanced MRCP

Gennaro Restaino

gennaro.restaino@responsible.hospital

Responsible Research Hospital

Eleonora Cucci

Responsible Research Hospital

Massimiliano Missere

Responsible Research Hospital

Giuseppina Maselli

Responsible Research Hospital

Mariavittoria Occhionero

ASReM Campobasso

Research Article

Keywords: Magnetic resonance cholangiopancreatography, Secretin, Pancreas, Acinar filling, Pancreatic function, Sphincter of Oddi dysfunction

Posted Date: March 4th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8957116/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Acinar Filling After Secretin Stimulation: Association with Pancreatic Dysfunction and Structural Damage in Secretin-Enhanced MRCP

Abstract

Purpose: To investigate the clinical significance of acinar filling observed during secretin-enhanced magnetic resonance cholangiopancreatography (s-MRCP) in patients undergoing pancreatic evaluation.

Materials and Methods: This retrospective study analyzed 1,283 consecutive s-MRCP examinations performed between 2005-2018. Acinar filling was defined as parenchymal T2 hyperintensity developing during secretin stimulation. Clinical, functional, and morphological parameters were compared between patients with and without acinar filling using univariate analysis and multivariate logistic regression. Exocrine function was assessed using duodenal filling grade (Matos score 0-3).

Results: Acinar filling was present in 67/1,283 patients (5.2%). In multivariate analysis, independent predictors included Cambridge grade (OR=1.71, 95% CI 1.42-2.06, p0.001), age (OR=1.68 per SD, 95% CI 1.27-2.22, p0.001), sphincter of Oddi dysfunction (SOD) (OR=2.07, 95% CI 1.00-4.29, p=0.050), and hyperenzymemia (OR=1.75, 95% CI 1.01-3.05, p=0.047). Importantly, acinar filling occurred predominantly in patients with preserved exocrine function (Matos score 2.8±0.5, with 85% demonstrating complete duodenal filling), suggesting a functional-obstructive mechanism. The multivariate model achieved acceptable discriminative ability (AUC=0.744). Among patients with morphologically normal pancreas (Cambridge 0), acinar filling remained associated with SOD (11.8% vs 2.7%, p=0.006).

Conclusion: Acinar filling during s-MRCP is independently associated with SOD, hyperenzymemia, structural pancreatic damage, and older age. The occurrence of acinar filling predominantly in patients with preserved exocrine function supports a functional-obstructive mechanism wherein adequate

pancreatic secretion accumulates in acinar spaces under conditions of relative ductal obstruction. This finding may represent a pathological marker warranting clinical attention.

Keywords: Magnetic resonance cholangiopancreatography; Secretin; Pancreas; Acinar filling; Pancreatic function; Sphincter of Oddi dysfunction

---

Introduction

Secretin-enhanced magnetic resonance cholangiopancreatography (s-MRCP) has become an established non-invasive technique for evaluating pancreatic ductal anatomy and exocrine function.[1][2] Secretin stimulates pancreatic secretion, allowing visualization of the main pancreatic duct (MPD) and side branches, assessment of ductal compliance, and evaluation of exocrine reserve.[3] The technique has proven valuable in diagnosing chronic pancreatitis, pancreas divisum, and other pancreatic ductal abnormalities.[4][5]

During s-MRCP, some patients exhibit acinar filling—a phenomenon where secretin-stimulated pancreatic juice accumulates in the acinar spaces, producing a characteristic parenchymal T2 hyperintensity pattern. While this finding has been occasionally reported in the literature, its clinical significance remains incompletely understood. Sandrasegaran et al. described "acinarization" or "parenchymal blush" in 8.5% of patients undergoing s-MRCP and found associations with pancreas divisum, elevated basal pancreatic sphincter pressure, and recurrent acute pancreatitis.[6] They hypothesized that acinar filling requires preserved exocrine function to generate secretions that accumulate under conditions of ductal obstruction.

However, systematic analysis of the clinical, functional, and morphological correlates of acinar filling in a large patient cohort has been lacking. Furthermore, the relationship between acinar filling and pancreatic exocrine function has not been definitively established. Understanding whether acinar filling represents a marker of pancreatic pathology or a benign variant has important clinical implications for patient management and follow-up.

The aim of this study was to investigate the clinical, functional, and morphological correlates of acinar filling in a large consecutive series of patients undergoing s-MRCP, with particular emphasis on the relationship between acinar filling and pancreatic exocrine function.

Materials and Methods

Study Population

This retrospective study included all consecutive s-MRCP examinations performed at our institution between January 2005 and December 2018. A total of 1,283 patients with complete secretin-enhanced studies were included. The study was approved by the institutional review board, and the requirement for informed consent was waived given the retrospective nature of the analysis.

MRCP Technique

All examinations were performed on a 1.5T MR scanner (GE Healthcare, Milwaukee, WI) using a phased-array body coil. Patients fasted for at least 6 hours prior to the examination. The s-MRCP protocol included:

1. Baseline T2-weighted sequences (fast recovery fast spin-echo [FRFSE], single-shot fast spin-echo [SSFSE], fast imaging employing steady-state acquisition [FIESTA])

2. Two-dimensional and three-dimensional cholangiopancreatography

3. Dynamic sequential imaging after intravenous secretin administration (1 clinical unit/kg, Secrelux - Sanochemia)

4. Three-phase contrast-enhanced 3D liver acquisition with volume acceleration (LAVA) sequences

Sequential coronal thick-slab heavily T2-weighted images were acquired at 30-seconds intervals for 12 minutes following secretin injection to assess ductal dynamics and duodenal filling.[2][7]

Image Analysis

All images were reviewed by experienced abdominal radiologists as part of routine clinical practice. For this retrospective analysis, imaging reports were systematically reviewed for the presence of specific findings.

Acinar filling was defined as diffuse or focal parenchymal T2 hyperintensity developing during secretin stimulation, representing accumulation of pancreatic juice in acinar spaces.[6] This finding was assessed qualitatively as present or absent.

Cambridge classification was assigned based on ductal findings according to established criteria:[4][5][8]

- Grade 0: Normal pancreatic ducts

- Grade 1: Equivocal changes

- Grade 2: Mild chronic pancreatitis (fewer than 3 abnormal side branches)

- Grade 3: Moderate chronic pancreatitis (3 or more abnormal side branches)

- Grade 4: Severe chronic pancreatitis (changes of grade 3 plus main duct abnormalities including dilation, irregularity, or filling defects)

When Cambridge classification was not explicitly mentioned but the report described chronic pancreatitis severity (mild, moderate, or severe), the corresponding Cambridge grade was assigned (grade 2, 3, or 4 respectively).

Exocrine function was evaluated based on duodenal filling using a modified Matos score (0-3):[9][10]

- Grade 0: No duodenal filling

- Grade 1: Filling to duodenal bulb only

- Grade 2: Filling beyond duodenal bulb but not beyond inferior duodenal flexure

- Grade 3: Filling beyond inferior duodenal flexure (complete filling)

Sphincter of Oddi dysfunction (SOD) was diagnosed based on imaging findings suggestive of impaired pancreatic outflow, including delayed duodenal filling or persistent main pancreatic duct dilation without anatomic obstruction on dynamic post-secretin images.[11][12][13]

Clinical Data

Clinical indications for s-MRCP were extracted from medical records and imaging requisitions, including:

- Recurrent acute pancreatitis (RAP)

- Pancreatic hyperenzymemia (elevated serum amylase or lipase on at least one occasion)

- Chronic pancreatitis

- Pancreatic cystic lesions

- Other pancreatic pathology

Statistical Analysis

Continuous variables were summarized as mean ± standard deviation and compared using Student's t-test or Mann-Whitney U test based on normality assessment (Shapiro-Wilk test). Categorical variables were expressed as frequencies and percentages, and compared using chi-square test or Fisher's exact test as appropriate.

Variables with p0.20 in univariate analysis were included in multivariate logistic regression modeling acinar filling as the binary outcome. Collinearity was assessed using correlation matrices; all pairwise correlations were 0.3, indicating no multicollinearity concerns. Adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated. Age was standardized (per 1 SD = 15.8 years) for interpretability.

Stratified analyses assessed whether associations between SOD and acinar filling differed by Cambridge grade. Exocrine function (Matos score) was compared between groups using Mann-Whitney U test. Model discriminative ability was quantified using receiver operating characteristic (ROC) analysis, with area under the curve (AUC) >0.70 considered acceptable and >0.75 considered good.

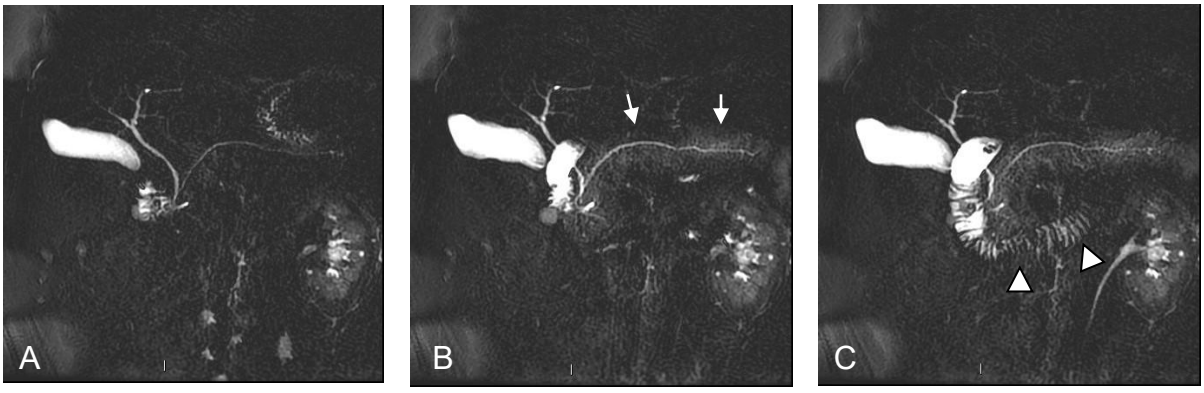
Sensitivity analyses excluded patients with chronic pancreatitis (Cambridge ≥2) and cystic lesions to assess robustness. Missing data were minimal (8%) and handled by complete case analysis. Statistical significance was set at p0.05 (two-tailed). All analyses were performed using Python (SciPy version 1.11.0).

Results

Study Population and Prevalence

The study included 1,283 patients (mean age 51.8±15.8 years; 46.6% female) who underwent s-MRCP. Acinar filling was identified in 67 patients (5.2%) (Figure 1)

Figure 1: Representative Images of Acinar Filling During Secretin-Enhanced MRCP



Sequential coronal-oblique T2-weighted images obtained during secretin-enhanced MRCP in a 62-year-old patient with recurrent acute pancreatitis. (A) Baseline image before secretin administration shows normal pancreatic parenchyma. (B) At 3 minutes post-secretin, diffuse parenchymal T2 hyperintensity develops (arrows), representing

acinar filling. (C) At 12 minutes, acinar filling persists with concurrent preserved duodenal filling (arrowhead), indicating intact exocrine function (Matos score 3).

Clinical indications for s-MRCP included recurrent acute pancreatitis (11.5%), pancreatic hyperenzymemia (21.9%), chronic pancreatitis (12.3%), and cystic lesions (10.3%) (Table 1)

Table 1 Baseline characteristics of study population stratified by acinar filling status

Characteristic	Total (n=1,283)	AF Present (n=67)	AF Absent (n=1,216)	p-value
Demographics				
Age, years	51.8±15.8	58.7±10.1	51.3±16.0	0.0002
Female sex	598 (46.6)	23 (39.0)	575 (51.1)	0.092
Clinical Indications				
Recurrent acute pancreatitis	148 (11.5)	4 (6.0)	144 (11.8)	0.171
Pancreatic hyperenzymemia	281 (21.9)	26 (38.8)	255 (21.0)	0.001
Chronic pancreatitis	158 (12.3)	12 (17.9)	146 (12.0)	0.215
Cystic formation	132 (10.3)	6 (9.0)	126 (10.4)	0.871
Morphological Findings				
Pancreas divisum	137 (10.7)	5 (7.5)	132 (10.9)	0.502
Main duct dilatation	229 (17.8)	10 (14.9)	219 (18.0)	0.633
Cambridge grade	0.43±0.97	1.27±1.34	0.39±0.92	<0.001
Functional Findings				
SOD	60 (4.7)	11 (16.4)	49 (4.0)	<0.001
Matos score	2.66±0.70	2.81±0.50	2.65±0.71	0.131

Data are presented as mean±SD or n (%). AF acinar filling, SOD sphincter of Oddi. Statistical tests: Mann-Whitney U test for continuous variables, chi-square or Fisher exact test for categorical variables

.

Univariate Analysis

Patients with acinar filling were significantly older than those without (58.7±10.1 vs 51.3±16.0 years, p=0.0002). There was a trend toward male predominance in the acinar filling group (61.0% vs 48.9% male), but this did not reach statistical significance (p=0.092).

Pancreatic hyperenzymemia was significantly more frequent in patients with acinar filling (38.8% vs 21.0%, OR=2.39, 95% CI 1.43-3.98, p=0.001). **Sphincter of Oddi dysfunction** showed a strong association with acinar filling (16.4% vs 4.0%, OR=4.68, 95% CI 2.31-9.48, p0.001).

Cambridge classification was significantly elevated in the acinar filling group (mean 1.27±1.34 vs 0.39±0.92, p0.001). The distribution of Cambridge grades differed markedly between groups: 49.3% of patients with acinar filling showed morphological evidence of chronic pancreatitis (Cambridge ≥2), compared to only 16.1% without acinar filling (Table 2).

Table 2 Distribution of Cambridge classification grades by acinar filling status

Cambridge Grade	AF Present (n=67)	AF Absent (n=1,216)	p-value
Grade 0 (Normal)	34 (50.7)	1,020 (83.9)	
Grade 2 (Mild CP)	14 (20.9)	133 (10.9)	
Grade 3 (Moderate CP)	19 (28.4)	47 (3.9)	
Grade 4 (Severe CP)	0 (0.0)	16 (1.3)	
Any CP (Grade ≥2)	33 (49.3)	196 (16.1)	<0.001

Data are n (%). AF acinar filling, CP chronic pancreatitis. Cambridge grade 1 (equivocal) was not observed. p-value from Mann-Whitney U test comparing mean Cambridge grades (1.27±1.34 vs 0.39±0.92)

Multivariate Logistic Regression

Complete data for multivariate analysis were available for 1,102 patients (65 with acinar filling, 1,037 without). (Table 3)

Table 3 Multivariate logistic regression analysis: independent predictors of acinar filling

Predictor	Adjusted OR	95% CI	p-value
Cambridge grade (per unit)	1.71	1.42-2.06	<0.001
Age (per SD)	1.68	1.27-2.22	<0.001
SOD	2.07	1.00-4.29	0.050
Hyperenzymemia	1.75	1.01-3.05	0.047
Recurrent acute pancreatitis	0.47	0.17-1.30	0.146

OR odds ratio, CI confidence interval, SD standard deviation (15.8 years), SOD sphincter of Oddi. Model includes age, hyperenzymemia, SOD, Cambridge grade, and recurrent acute pancreatitis. AUC=0.744

Four variables emerged as independent predictors of acinar filling (Fig 2):

1. **Cambridge grade:** OR=1.71 (95% CI 1.42-2.06, p0.001) per unit increase

2. **Age:** OR=1.68 (95% CI 1.27-2.22, p0.001) per standard deviation (15.8 years)

3. **SOD:** OR=2.07 (95% CI 1.00-4.29, p=0.050)

4. **Hyperenzymemia:** OR=1.75 (95% CI 1.01-3.05, p=0.047)

Recurrent acute pancreatitis was not independently associated with acinar filling after adjustment for other variables (OR=0.47, 95% CI 0.17-1.30, p=0.146).

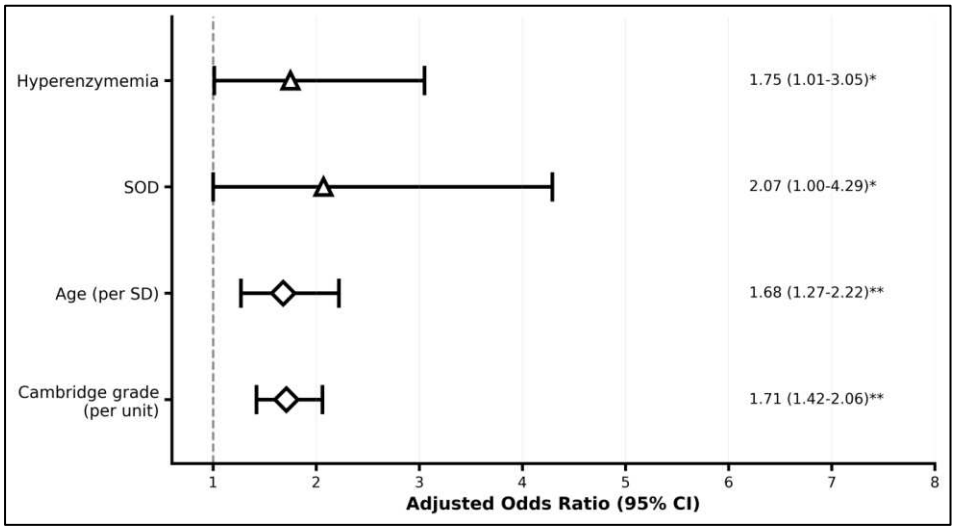


Figure 2: Forest Plot of Multivariate Logistic Regression Results

Forest plot displaying adjusted odds ratios (OR) with 95% confidence intervals for independent predictors of acinar filling. Cambridge grade (OR=1.71, p<0.001), age per standard deviation (OR=1.68, p<0.001), SOD (OR=2.07, p=0.050), and hyperenzymemia (OR=1.75, p=0.047) were independently associated with acinar filling. Recurrent acute pancreatitis was not significant after adjustment (OR=0.47, p=0.146). The vertical dashed line indicates OR=1.0 (no association).

Exocrine Function Analysis

Pancreatic exocrine function, assessed by duodenal filling after secretin stimulation (Matos score), did not differ significantly between patients with and without acinar filling (mean 2.8±0.5 vs 2.7±0.7, p=0.131). (Table 4)

Table 4 Exocrine function (Matos score) by acinar filling status

Matos Score	AF Present (n=67)	AF Absent (n=1,138)	p-value
Mean±SD	2.81±0.50	2.65±0.71	0.131
Median [IQR]	3.0 [3.0-3.0]	3.0 [3.0-3.0]	
Distribution:			
Score 0 (no filling)	0 (0.0)	2 (0.2)	
Score 1 (to bulb)	3 (4.5)	147 (12.1)	
Score 2 (beyond bulb)	7 (10.4)	74 (6.1)	

Score 3 (complete)	57 (85.1)	890 (73.2)	

Data are mean±SD, median [interquartile range], or n (%). AF acinar filling, IQR interquartile range. Matos score: 0=no duodenal filling, 1=filling to bulb, 2=filling beyond bulb, 3=filling to inferior duodenal flexure. p-value from Mann-Whitney U test

Notably, 85.1% of patients with acinar filling demonstrated complete duodenal filling (Matos score 3), compared to 73.2% without acinar filling. Only 4.5% of patients with acinar filling had impaired exocrine function (Matos score ≤1), indicating that acinar filling occurs predominantly in the context of preserved secretory capacity.

Stratified Analysis by Pancreatic Morphology

To assess whether associations differed by disease stage, we performed stratified analysis by Cambridge grade (Table 5).

Table 5 Stratified analysis: association of SOD with acinar filling by Cambridge grade

Cambridge Grade	n	AF with SOD (%)	AF without SOD (%)	OR	95% CI	p-value
Grade 0 (Normal)	1,054	2/28 (7.1)	32/1,026 (3.1)	2.39	0.54-10.50	0.227
Grade ≥2 (CP)	229	9/32 (28.1)	24/197 (12.2)	2.82	1.17-6.81	0.035
Interaction						NS

AF acinar filling, SOD sphincter of Oddi dysfunction, CP chronic pancreatitis, OR odds ratio, CI confidence interval, NS not significant (p>0.10). Ratio of ORs=0.85, indicating no significant interaction between SOD effect and Cambridge grade

Among patients with morphologically normal pancreas (Cambridge 0, n=1,054), acinar filling (3.2%) remained associated with SOD (11.8% vs 2.7%, p=0.006) and older age (58.1±10.5 vs 51.1±16.2 years, p=0.007). In patients with established chronic pancreatitis (Cambridge ≥2, n=229), SOD was also significantly associated with acinar filling (OR=2.82, 95% CI 1.17-6.81, p=0.035). The similar magnitude of associations across morphological categories suggests that SOD-related mechanisms operate throughout the disease spectrum.

Model Performance

The multivariate prediction model (age, hyperenzymemia, SOD, Cambridge grade) (Figure 3) achieved an area under the ROC curve of 0.744, indicating acceptable discriminative ability and representing improvement over individual predictors (AUC range 0.56-0.67). At the optimal threshold (predicted probability ≥0.075), the model achieved 58.5% sensitivity and 81.5% specificity for identifying acinar filling.

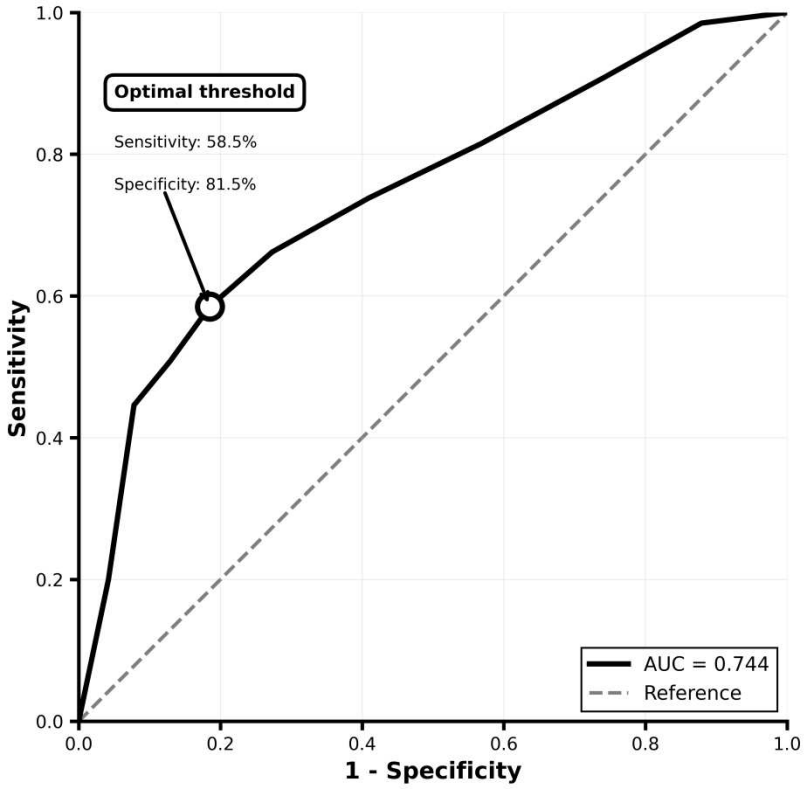


Figure 3: Receiver Operating Characteristic Curve for Multivariate Prediction Model

Receiver operating characteristic (ROC) curve for the multivariate prediction model (age, hyperenzymemia, SOD dysfunction, Cambridge grade) for identifying acinar filling. The model achieved an area under the curve (AUC) of 0.744, indicating acceptable discriminative ability. The optimal operating point (sensitivity 58.5%, specificity 81.5%) is indicated by the circle.

Sensitivity Analyses

Results remained robust when excluding patients with chronic pancreatitis (Cambridge ≥2) or cystic lesions. In the subgroup of 580 patients who underwent CT on the same day as MRCP, pancreatic calcifications were associated with SOD (p=0.039) and higher Cambridge grade (p=0.019) but not

directly with acinar filling (p=0.318), suggesting calcifications represent advanced structural damage while acinar filling may reflect earlier functional obstruction.

Discussion

Principal Findings

This study demonstrates that acinar filling during s-MRCP is independently associated with both functional pancreatic abnormalities (SOD, hyperenzymemia) and structural damage (elevated Cambridge classification). Importantly, acinar filling occurs predominantly in patients with preserved exocrine function, supporting a functional-obstructive pathophysiological mechanism. These findings suggest that acinar filling represents a pathological marker rather than an incidental or benign variant.

Pathophysiological Mechanisms and Clinical Significance

Our findings support a **functional-obstructive model** of acinar filling. The independent association with SOD (OR=2.07) combined with preserved exocrine function (85% with Matos score 3) suggests that acinar filling results from adequate pancreatic secretion under conditions of relative ductal obstruction. SOD creates increased resistance at the papilla, elevating intraductal pressure and potentially causing retrograde flow of pancreatic secretions into acinar spaces.[6][11]

The finding that 85% of patients with acinar filling demonstrated complete duodenal filling (Matos score 3) indicates that acinar filling occurs in the context of **preserved exocrine secretory capacity**. This supports the pathophysiological model proposed by Sandrasegaran et al., wherein acinar filling requires intact pancreatic secretion to generate fluid that accumulates in acinar spaces under conditions of relative ductal obstruction.[6] This distinguishes acinar filling from advanced chronic pancreatitis with acinar atrophy and exocrine insufficiency, where diminished secretory capacity would preclude significant fluid accumulation. The combination of preserved exocrine function (high

Matos score) with evidence of obstruction (SOD, OR=2.07) suggests acinar filling represents a **functional-obstructive phenomenon** rather than a marker of pancreatic failure.

The association with structural damage (Cambridge grade OR=1.71) likely reflects two mechanisms: (1) chronic obstruction leading to progressive parenchymal injury, and (2) inflammation-induced alterations in ductal permeability. Importantly, the persistence of SOD-acinar filling associations across morphological categories (Cambridge 0 and ≥2) suggests that obstructive mechanisms operate throughout the disease continuum rather than being confined to specific stages.

While SOD was significantly associated with acinar filling in patients with established chronic pancreatitis (Cambridge ≥2: OR=2.82, p=0.035), the association in morphologically normal patients (Cambridge 0: OR=2.39, p=0.227) did not reach statistical significance, likely reflecting smaller sample size in this subgroup and wide confidence intervals (0.54-10.50) due to small cell counts. However, when analyzed using chi-square test, SOD remained significantly associated with acinar filling in Cambridge 0 patients (11.8% vs 2.7%, p=0.006), supporting the concept that obstructive mechanisms contribute to acinar filling even before structural changes become apparent.

The independent association with age (OR=1.68 per 16 years) may reflect age-related changes in sphincter of Oddi function or cumulative subclinical pancreatic injury. This finding aligns with epidemiological data showing increasing chronic pancreatitis prevalence with age.[3]

Comparison with Literature

Sandrasegaran et al. reported acinarization in 8.5% of patients undergoing s-MRCP and found associations with pancreas divisum, elevated basal pancreatic sphincter pressure, and recurrent acute pancreatitis.[6] Our prevalence of 5.2% is somewhat lower, possibly reflecting differences in patient populations or detection criteria. However, our findings corroborate and extend their observations by demonstrating independent associations with SOD and structural damage in a larger cohort, and by providing the first systematic evaluation of exocrine function in patients with acinar filling.

The requirement for preserved exocrine function distinguishes acinar filling from advanced chronic pancreatitis with acinar atrophy. In late-stage disease, diminished secretory capacity precludes significant fluid accumulation despite potential ductal obstruction. This explains why acinar filling is relatively uncommon (5.2% prevalence) and may represent a **transitional state** between functional obstruction and established structural damage.

Clinical Implications and Risk Stratification

The multivariate model (AUC=0.744) demonstrates acceptable ability to identify patients at risk for acinar filling based on readily available clinical and imaging parameters. While not sufficiently accurate for definitive diagnosis, the model may facilitate risk stratification in clinical practice. Patients with multiple risk factors (older age, hyperenzymemia, SOD, elevated Cambridge grade) warrant careful evaluation for acinar filling during s-MRCP.

The clinical significance of acinar filling remains incompletely defined. Our cross-sectional data demonstrate associations with both functional abnormalities and structural damage, but cannot establish temporal relationships or prognostic implications. The association with SOD is particularly relevant given evolving perspectives on this diagnosis. Recent Rome V criteria have become more restrictive about SOD diagnosis, and the role of sphincterotomy in idiopathic recurrent pancreatitis attributed to SOD remains controversial.[14] Whether identification of acinar filling helps select patients who might benefit from intervention requires prospective study.

Longitudinal studies are critically needed to determine whether acinar filling predicts progression to chronic pancreatitis, which would have implications for surveillance strategies and potential early intervention in high-risk patients. If acinar filling represents an early marker of pancreatic injury, it could potentially identify patients who would benefit from risk factor modification (smoking cessation, alcohol abstinence) or closer monitoring.

Limitations

This retrospective study has some limitations. First, the study population consisted of patients undergoing clinical s-MRCP, which may introduce selection bias toward those with suspected pancreatic pathology.

Second, small cell counts in stratified analyses (particularly Cambridge 0 with SOD, n=4) resulted in wide confidence intervals and limited statistical power to detect effect modification. Larger studies are needed to definitively assess whether SOD-acinar filling associations differ by disease stage. Fifth, the multivariate model achieved acceptable but not excellent discriminative ability (AUC=0.744), suggesting that unmeasured factors (e.g., quantitative duct compliance, direct sphincter pressure measurements, genetic susceptibility) contribute to acinar filling risk. Future studies incorporating these variables may improve predictive accuracy.

Third, temporal relationships cannot be established from cross-sectional data. We cannot determine whether acinar filling precedes structural damage or occurs concurrently. Longitudinal studies with serial imaging are needed to determine the natural history. Finally, follow-up data were not available to determine the prognostic significance of acinar filling or response to therapeutic interventions.

Future Directions

Prospective studies are needed to:

1. Establish standardized criteria for acinar filling detection and grading with assessment of interobserver reliability

2. Determine the natural history and prognostic implications through longitudinal follow-up

3. Investigate whether acinar filling predicts future development of chronic pancreatitis or exocrine insufficiency

4. Evaluate therapeutic interventions (e.g., SOD sphincterotomy, risk factor modification) in selected cases

5. Correlate imaging findings with direct measurements of sphincter pressure and pancreatic secretory function

6. Develop quantitative imaging biomarkers to improve detection and characterization of acinar filling

---

Conclusion

Acinar filling observed during secretin-enhanced MRCP is independently associated with sphincter of Oddi dysfunction, hyperenzymemia, structural pancreatic damage, and older age. Importantly, acinar filling occurs predominantly in patients with preserved exocrine function (85% with complete duodenal filling), supporting a functional-obstructive mechanism wherein adequate pancreatic secretion accumulates in acinar spaces under conditions of relative ductal obstruction. These findings suggest acinar filling represents a pathological marker warranting clinical attention. The combination of preserved exocrine function with evidence of obstruction distinguishes acinar filling from advanced chronic pancreatitis with exocrine insufficiency and suggests it may represent a transitional functional-obstructive state. Longitudinal studies are needed to determine whether acinar filling has prognostic implications and whether early identification could guide therapeutic interventions.

Acknowledgments

The authors thank the radiology technologists and support staff who performed the MRCP examinations included in this study.

Conflict of Interest: The authors declare no conflicts of interest.

Funding: This research received no specific grant from any funding agency.

References

1. Manfredi R, Pozzi Mucelli R. Secretin-enhanced MR imaging of the pancreas. *Radiology*. 2016;279(1):29–43. https://doi.org/10.1148/radiol.2015140622

2. Swensson J, Zaheer A, Conwell D, et al. Secretin-enhanced MRCP: how and why—AJR expert panel narrative review. *AJR Am J Roentgenol*. 2021;216(5):1139–1149. https://doi.org/10.2214/AJR.20.24857

3. Singh VK, Yadav D, Garg PK. Diagnosis and management of chronic pancreatitis: a review. *JAMA*. 2019;322(24):2422–2434. https://doi.org/10.1001/jama.2019.19411

4. Conwell DL, Lee LS, Yadav D, et al. American Pancreatic Association practice guidelines in chronic pancreatitis: evidence-based report on diagnostic guidelines. *Pancreas*. 2014;43(8):1143–1162. https://doi.org/10.1097/MPA.0000000000000237

5. Tirkes T, Shah ZK, Takahashi N, et al. Reporting standards for chronic pancreatitis by using CT, MRI, and MR cholangiopancreatography: the Consortium for the Study of Chronic Pancreatitis, Diabetes, and Pancreatic Cancer. *Radiology*. 2019;290(1):207–215. https://doi.org/10.1148/radiol.2018181353

6. Sandrasegaran K, Bodanapally U, Cote GA, et al. Acinarization (parenchymal blush) observed during secretin-enhanced MRCP: clinical implications. *AJR Am J Roentgenol*. 2014;203(3):607–614. https://doi.org/10.2214/AJR.13.11414

7. Tirkes T, Sandrasegaran K, Sanyal R, et al. Secretin-enhanced MR cholangiopancreatography: spectrum of findings. *Radiographics*. 2013;33(7):1889–1906. https://doi.org/10.1148/rg.337125014

8. Swensson J, Akisik F, Collins D, et al. Is Cambridge scoring in chronic pancreatitis the same using ERCP and MRCP? A need for revision of standards. *Abdom Radiol (NY)*. 2021;46(2):647–654. https://doi.org/10.1007/s00261-020-02685-2

9. Cappeliez O, Delhaye M, Devière J, et al. Chronic pancreatitis: evaluation of pancreatic exocrine function with MR pancreatography after secretin stimulation. *Radiology*. 2000;215(2):358–364. https://doi.org/10.1148/radiology.215.2.r00ma10358

10. Mensel B, Messner P, Mayerle J, et al. Secretin-stimulated MRCP in volunteers: assessment of safety, duct visualization, and pancreatic exocrine function. *AJR Am J Roentgenol*. 2014;202(1):102–108. https://doi.org/10.2214/AJR.12.10271

11. Pereira SP, Gillams A, Sgouros SN, Webster GJ, Hatfield AR. Prospective comparison of secretin-stimulated magnetic resonance cholangiopancreatography with manometry in the diagnosis of sphincter of Oddi dysfunction types II and III. *Gut*. 2007;56(6):809–813. https://doi.org/10.1136/gut.2006.099267

12. Testoni PA, Mariani A, Curioni S, Zanello A, Masci E. MRCP-secretin test-guided management of idiopathic recurrent pancreatitis: long-term outcomes. *Gastrointest Endosc*. 2008;67(7):1028–1034. https://doi.org/10.1016/j.gie.2007.09.007

13. Mariani A, Curioni S, Zanello A, et al. Secretin MRCP and endoscopic pancreatic manometry in the evaluation of sphincter of Oddi function: a comparative pilot study in patients with idiopathic recurrent pancreatitis. *Gastrointest Endosc*. 2003;58(6):847–852. https://doi.org/10.1016/s0016-5107(03)02303-4

14. Elmunzer BJ, Winslow E, De Giorgio R, et al. Gallbladder and sphincter of Oddi disorders. *Gastroenterology*. 2026. https://doi.org/10.1053/j.gastro.2026.01.035