Nasjonalt Senter for
Gastroenterologisk Ultrasonografi
National Centre for Ultrasound in Gastroenterology
Haukeland University Hospital, Bergen, Norway

Ultralyd Pankreas

Bergen 2018

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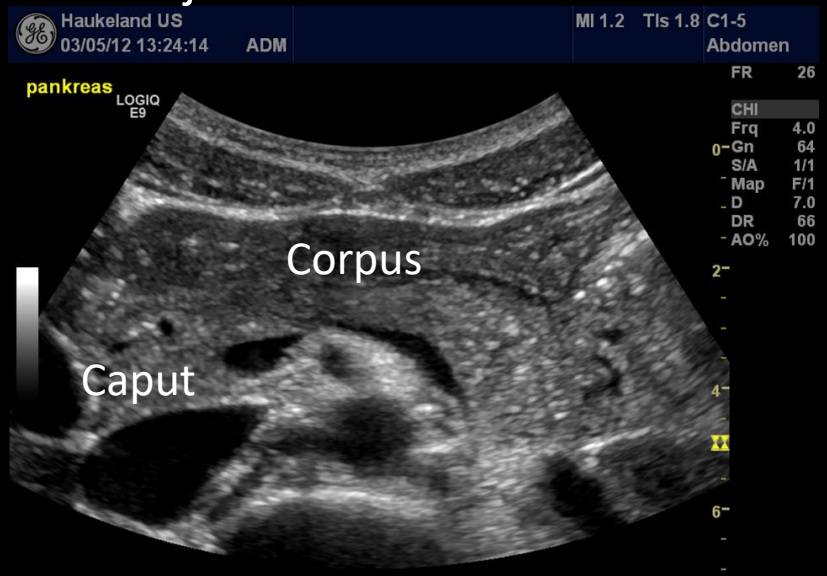
Haukeland Universitetssjukehus
Bergen

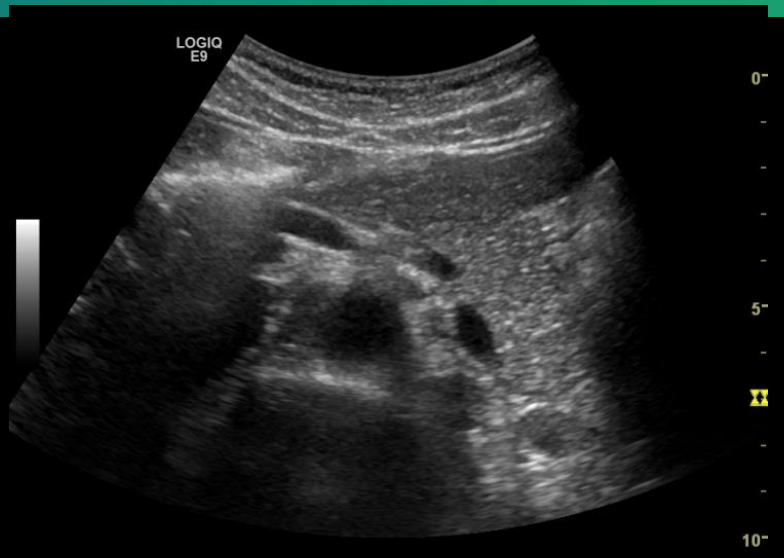
Pankreas-oversikt

- Normal pankreas fremstilling
- Pankreas cancer
- Cystiske pankreaslesjoner
- Pankreatitter
  - Akutte
  - Kroniske
- Annet: Divisum, cystisk fibrose

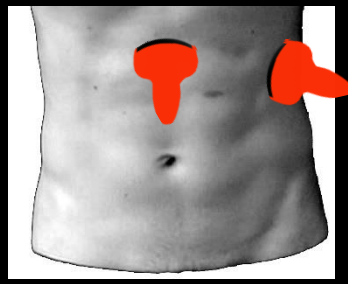
Pankreas- fremstilling

- Stasjon 1 (og 5)
- Innsyn bedres ved ve. Sideleie, dyp inspirasjon eller ved inntak av vann
- Stor variasjon i størrelse og form
- Tiltagende lys ved økende alder (Fett/fibrose)
- Ductus pancreaticus 1-2mm (>3.5 mm→Dilatasjon



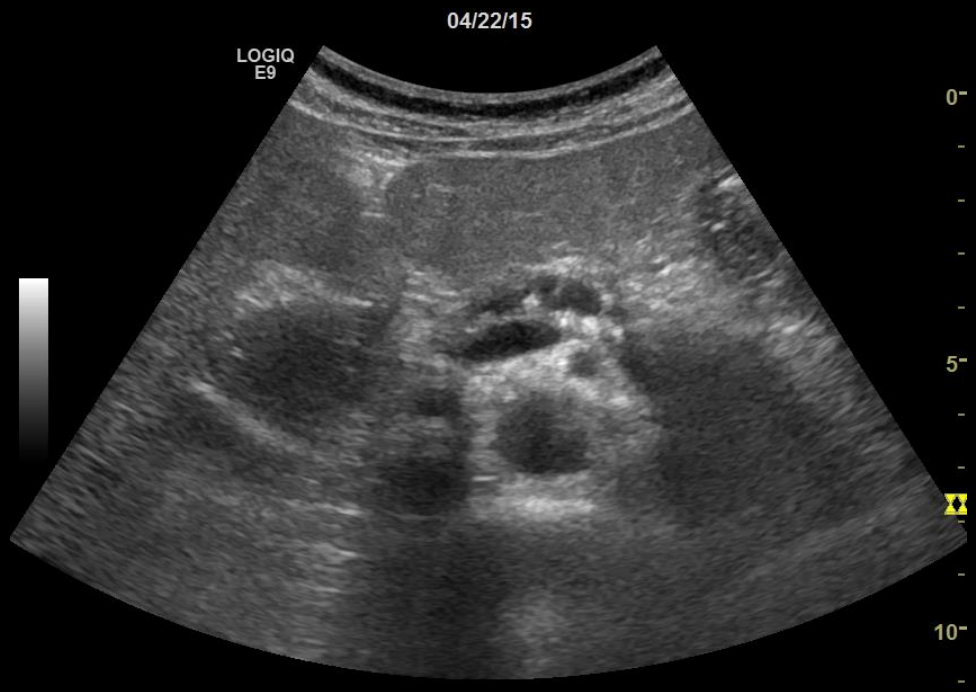


Cauda

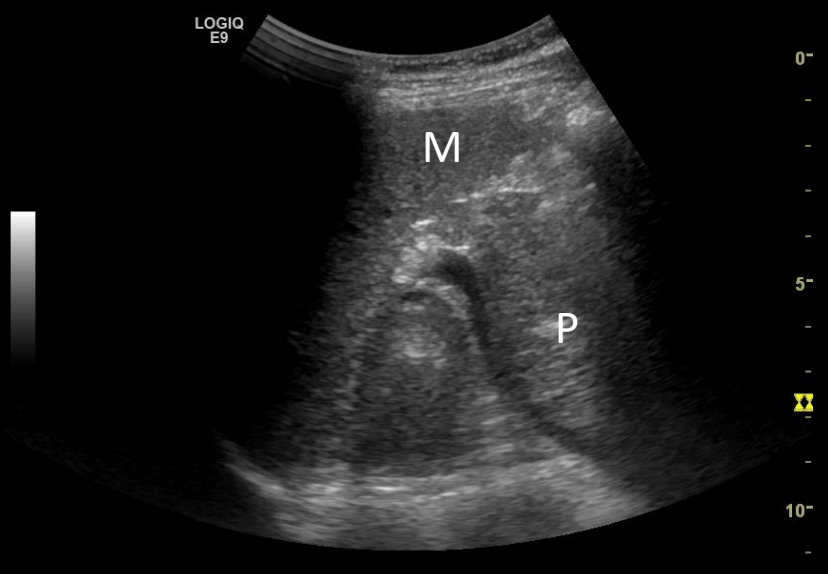


K Nylund

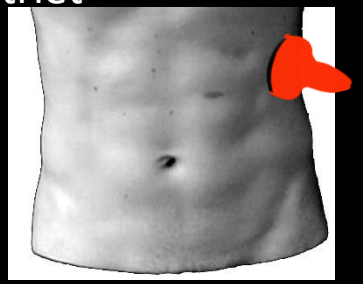
Pankreas-fremstilling



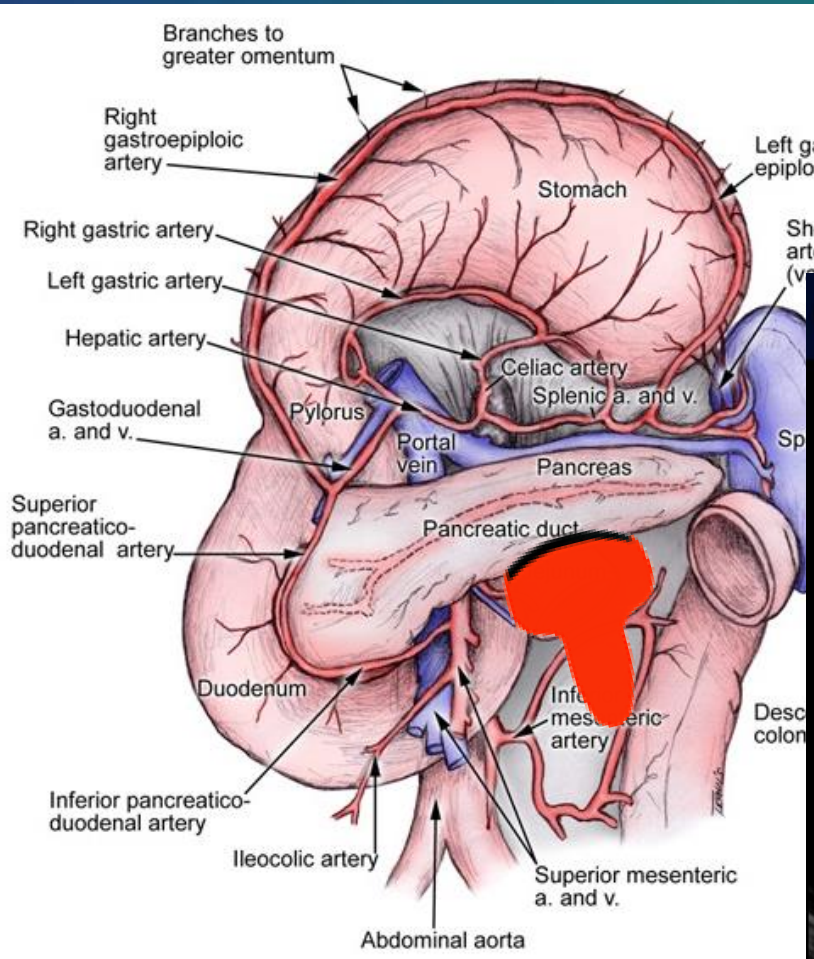
Dilatert og kalibervekslet ductus ved KP

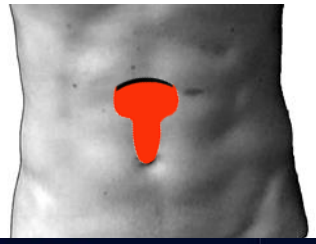


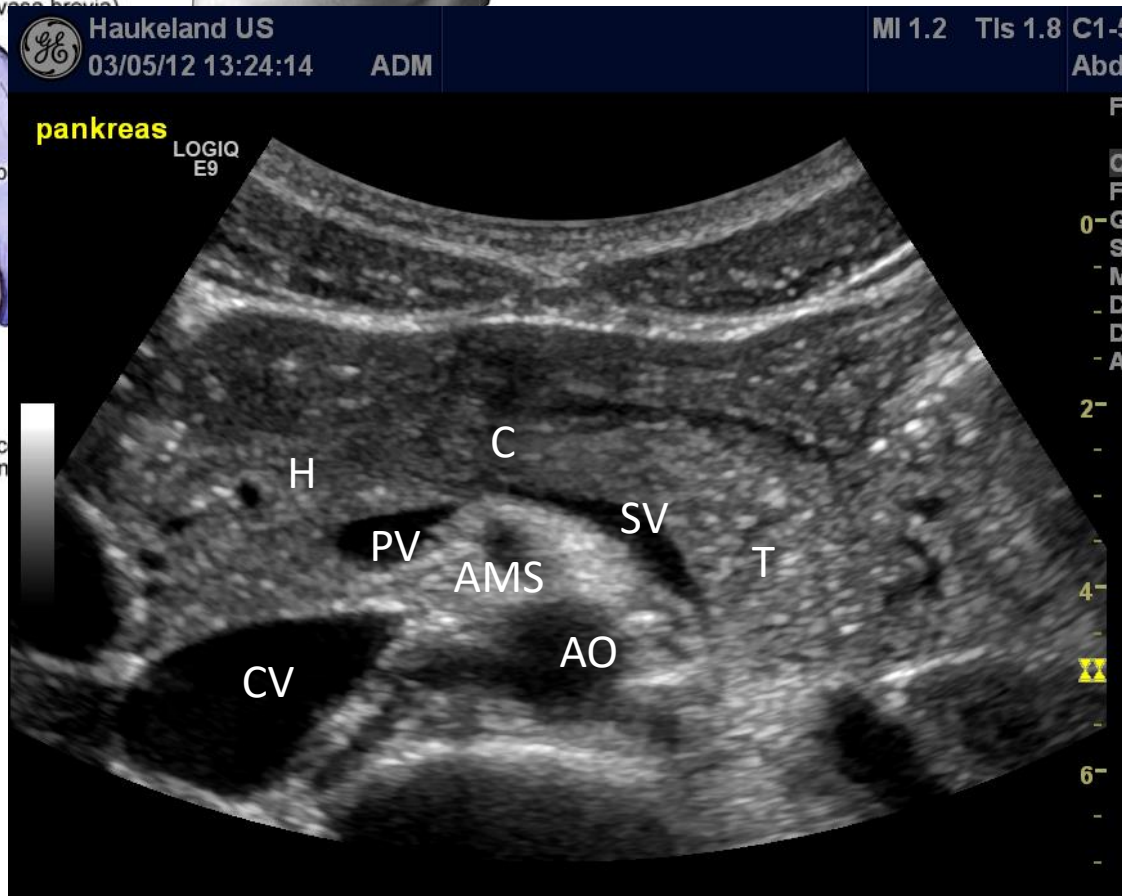
Pankreashalen kan sees «via» milten ved dårlig innsyn i epigastriet



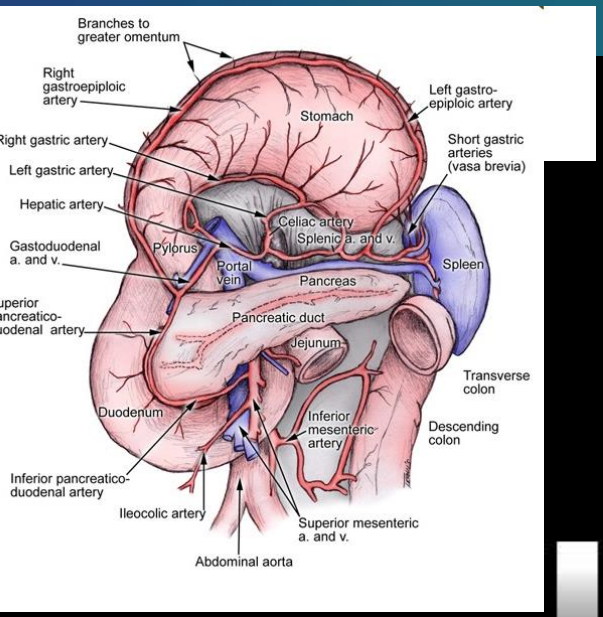
Pankreas-oversikt

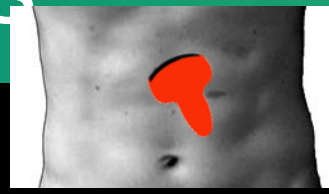






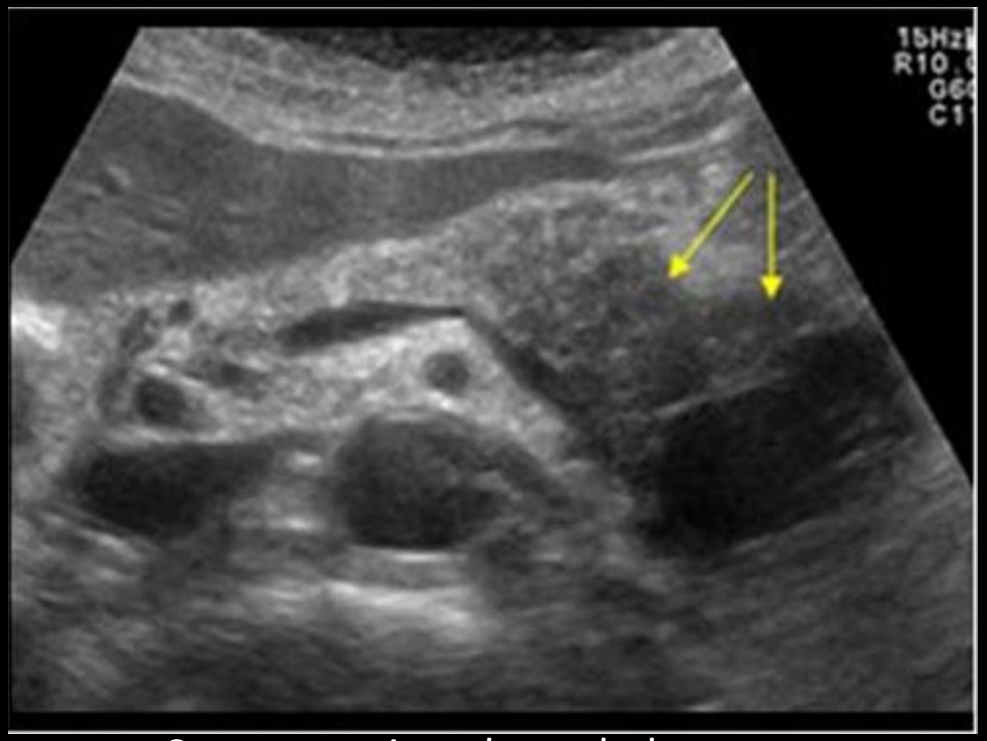
Pankreas-real time scanning





Tumor i pankreas

- UL førstelinjediagnostikk, Må suppleres med CT/ MR.
- Hypo ekkogen oppfylning i pankreas.
  - Obstr av pankreasgang?
  - Obstr av galleveier?
  - Lymfeknuter?
  - Metastaser
  - Tidlig washout ved kontrast
  - Komplikasjoner
    - Ascites
    - Venøse tromber
    - Innvekst i kar



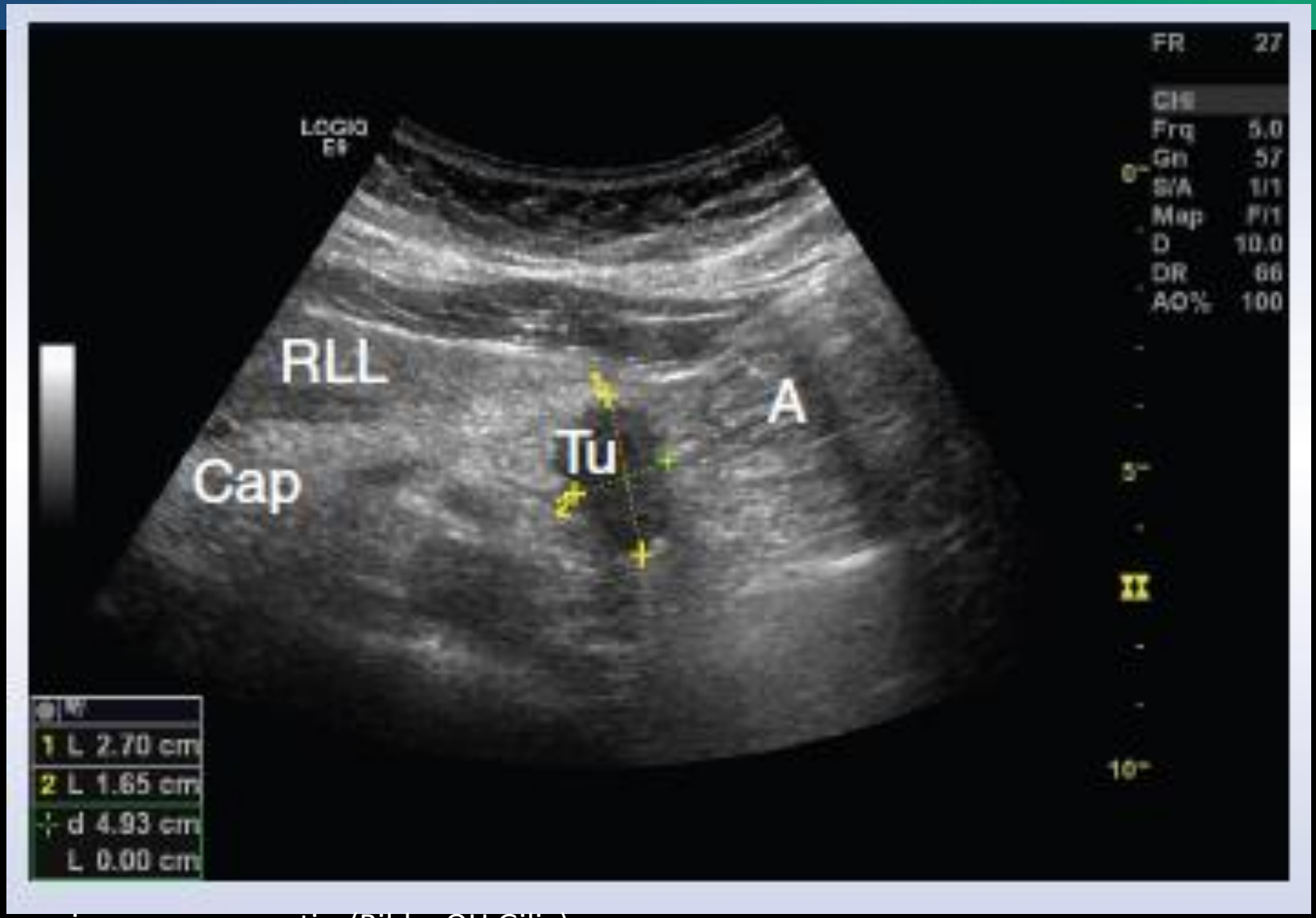
Stor tumor i pankreas hale

Nytte av ultralyd ved pankreascancer

- Ultralyd har god accuracy:
  - Sens 88,6 (På linje med CT)
  - Uerfaren operatør, dårlig innsyn, små tumores, spesielt i papilleområdet reduserer verdi.
- Nytte i preoperativ vurdering:
  - Dårligere enn CT for å vurdere resektabilitet
    - Lik CT: innvekst i AMS, VMS, TC, levermetastaser:
    - Dårligere enn CT: Innvekst i portvener og leverarterie
- US FNA har god accuracy, som EUS FNA

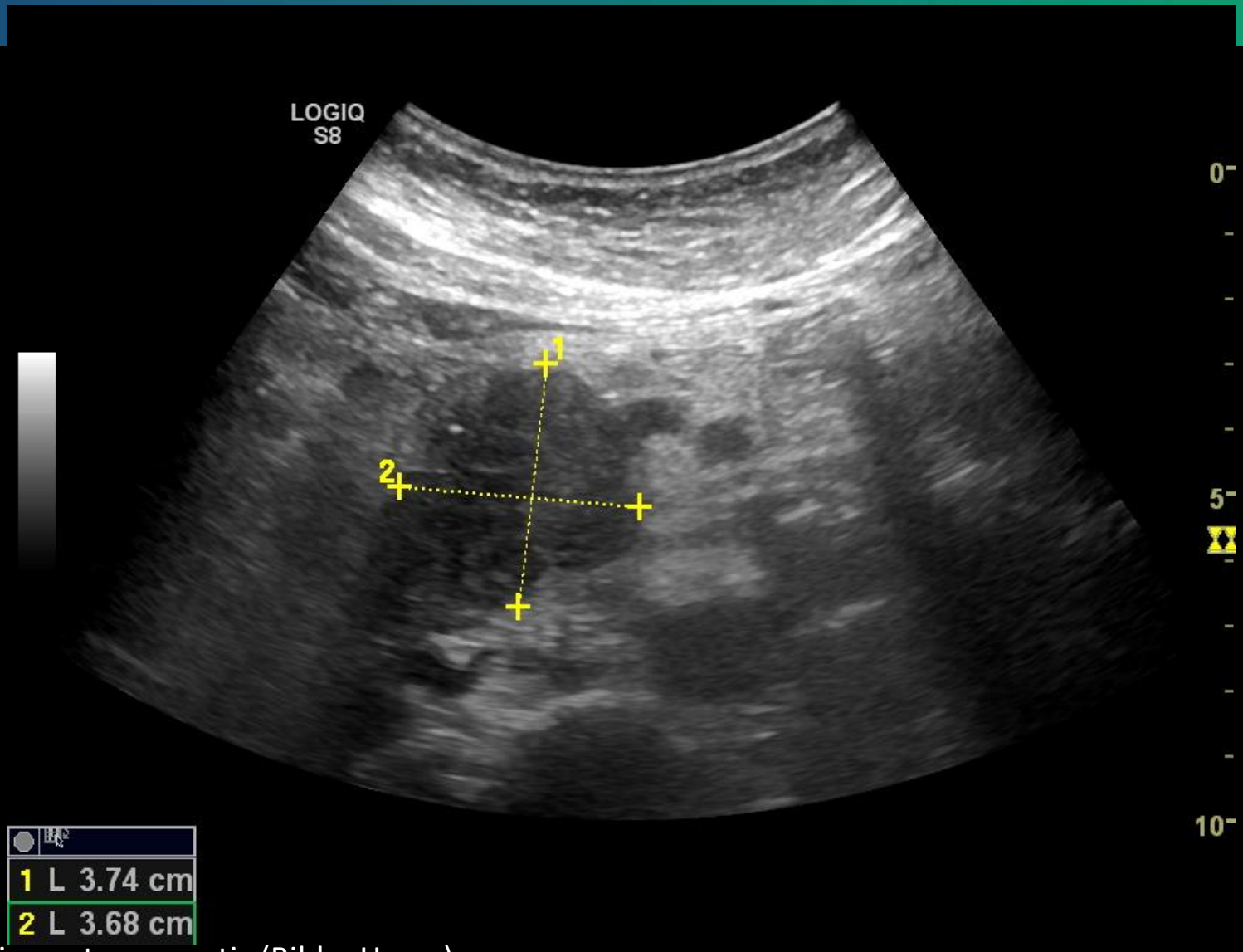
- Karlson & Al. Abdominal US for diagnosis of pancreatic tumor: prospective cohort analysis. Radiology 1999 Oct;213(1):107-11
- Minniti S& AL. Sonography versus helical CT in identification and staging of pancreatic ductal adenocarcinoma. J Clin Ultrasound 2003 May;31(4):175-82.
- D'Onofrio & AL. Ultrasound-guided percutaneous fine-needle aspiration of solid pancreatic neoplasms: 10-year experience with more than 2,000 cases and a review of the literature. Eur Radiol 2015 Sep 16.

Cancer pancreas



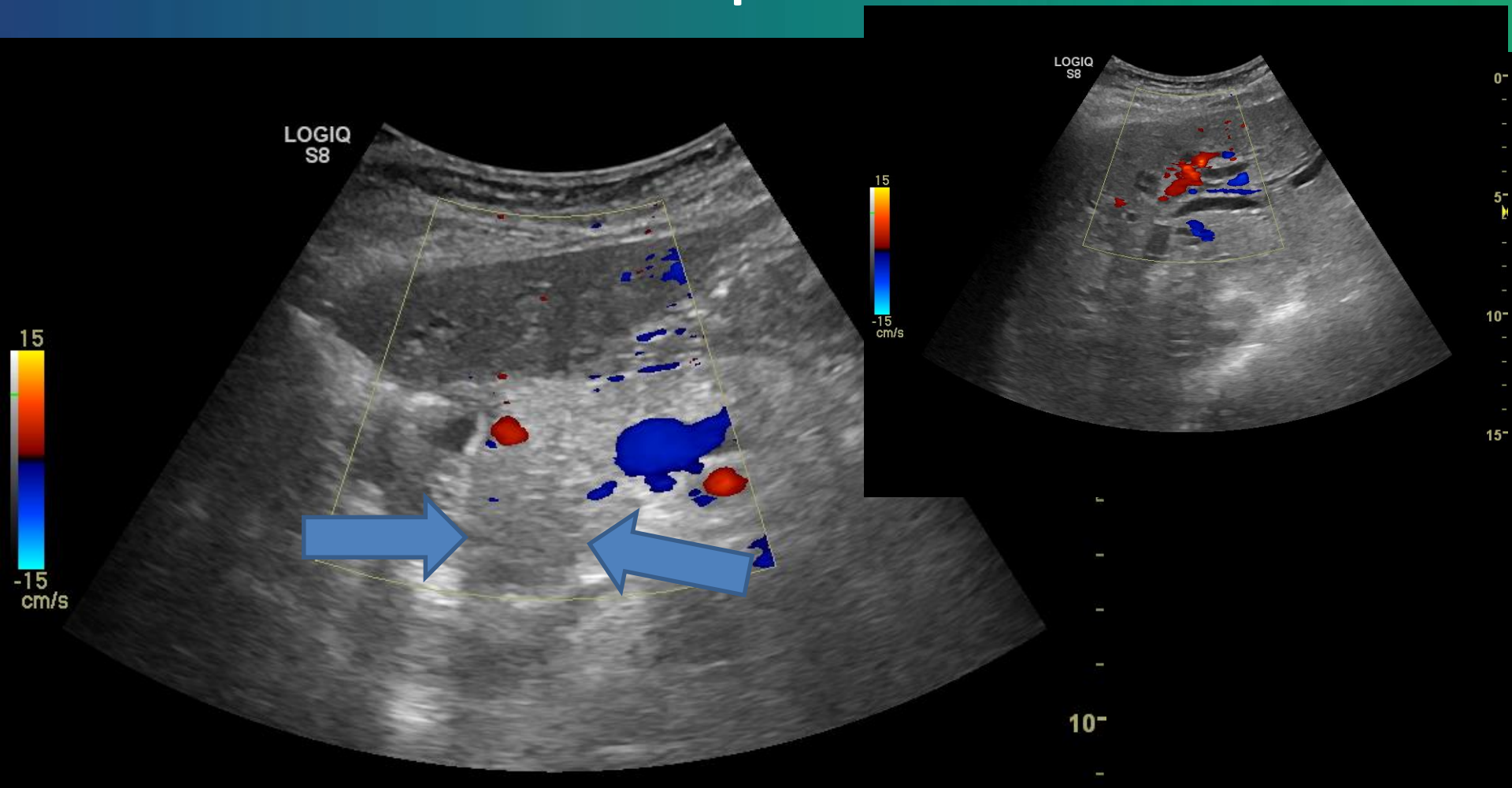
Tumor i corpus pancreatis. (Bilde: OH Gilja)

Cancer pancreas



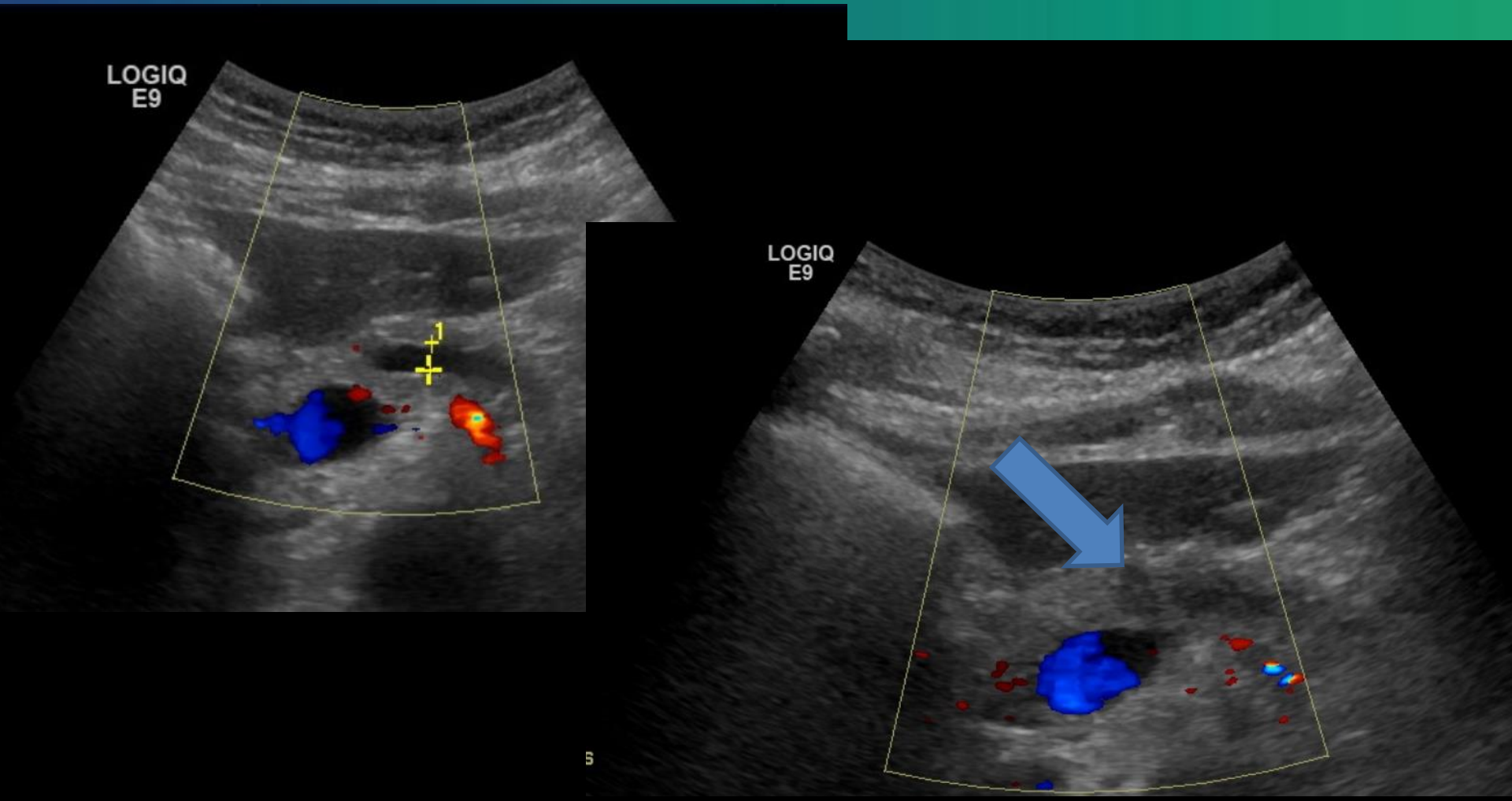
Tumor i caput pancreatis (Bilde: Havre)

Cancer pancreas



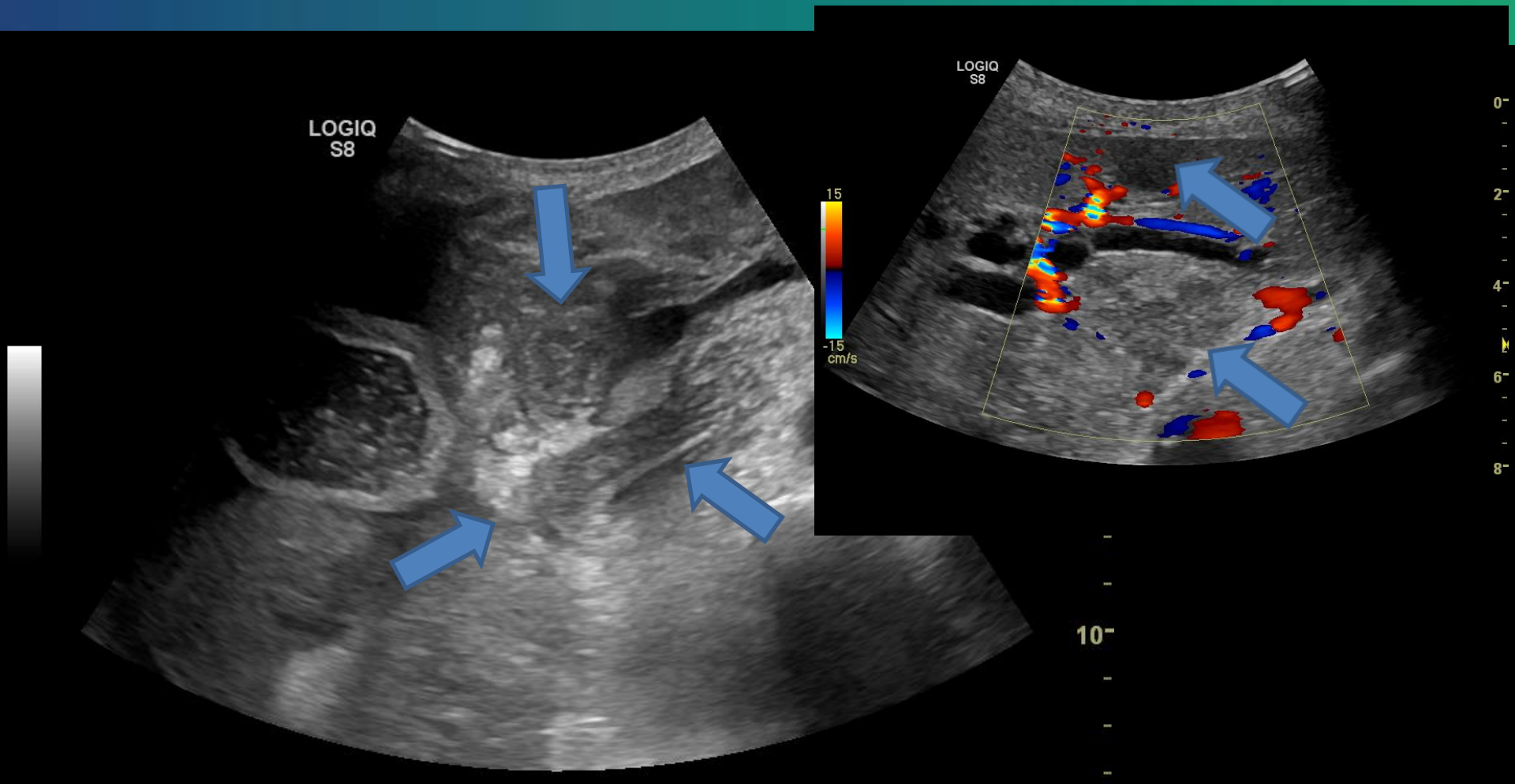
Tumor i caput pancreatis med dilaterte intrahepatiske galleveier (Bilde: Engjom)

Cancer pancreas?



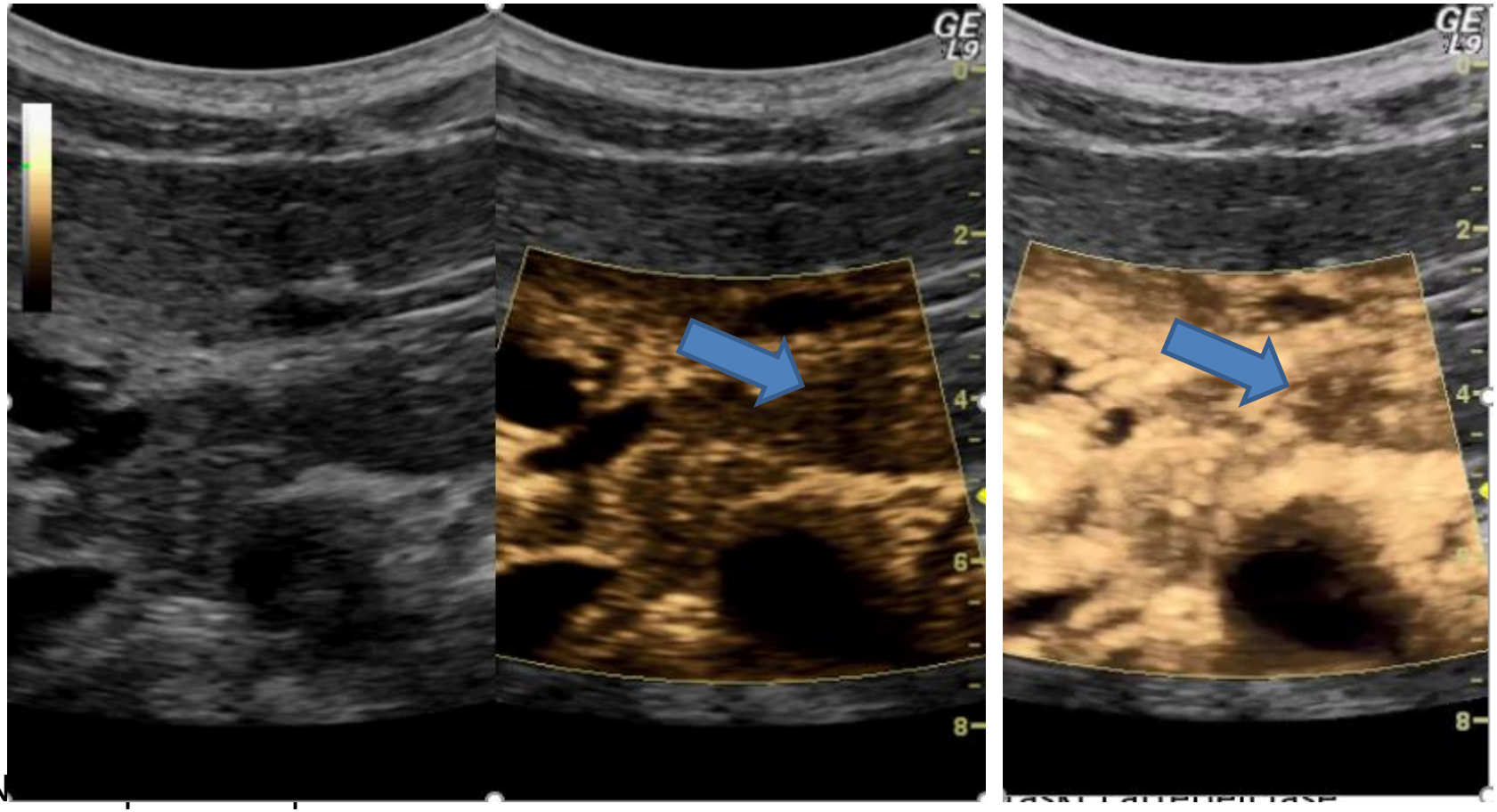
Betydelig dilatert pankreasgang med brå avslutning (Bilde: Engjom)
Er det noe i enden av gangen?

Cancer pancreas- store tumores



Stor tumor i caput pancreatis med dilaterte intrahepatiske galleveier og to levermetastaser (Bilde: Engjom)

Contrast enhanced ultrasound



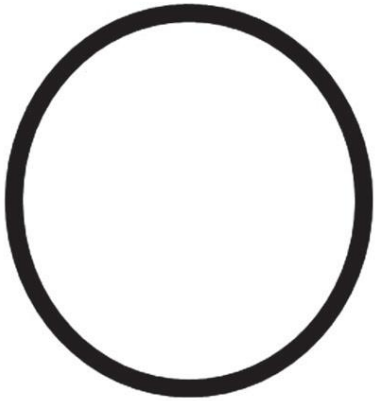
- N
- Maligne tumores i pankreas har manglende fylling eller tidlig utvasking allerede i
- Løpet av første 30 sekunder.
- Kan skille malign tumor fra inflammatorisk lesjon eller neuroendokrin tumor.

Cystiske pankreaslesjoner

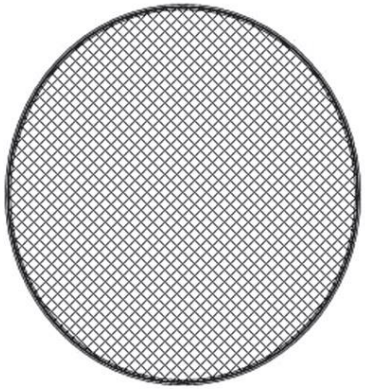
Box 1 Classification of pancreatic cystic lesions (PCLs)
Non-neoplastic cysts
Pseudocyst
Simple or congenital cyst
Retention cyst
Neoplastic cysts [pancreatic cystic neoplasms (PCNs)]
Mucinous cystic lesions
Intraductal papillary mucinous neoplasm (IPMN)
Mucinous cystic neoplasm (MCN)
Non-Mucinous cystic neoplastic lesions
Serous cystic neoplasm (SCN)
Solid-pseudopapillary neoplasm (SPN)
Cystic neuroendocrine neoplasm
Acinar-cell cystic neoplasm
Other neoplastic lesions
Ductal adenocarcinoma with cystic degeneration

- Oppdages ofte tilfeldig på ultralyd eller CT
  - Prev : 1,2-19%
  - 80% non-neoplastisk
  - Økende PCN med alder
- Serøse vs mucinøse.

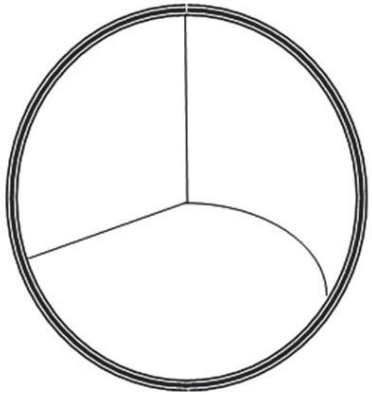
Cystiske pankreaslesjoner



Pseudocyste



Serøs cystisk neoplasme

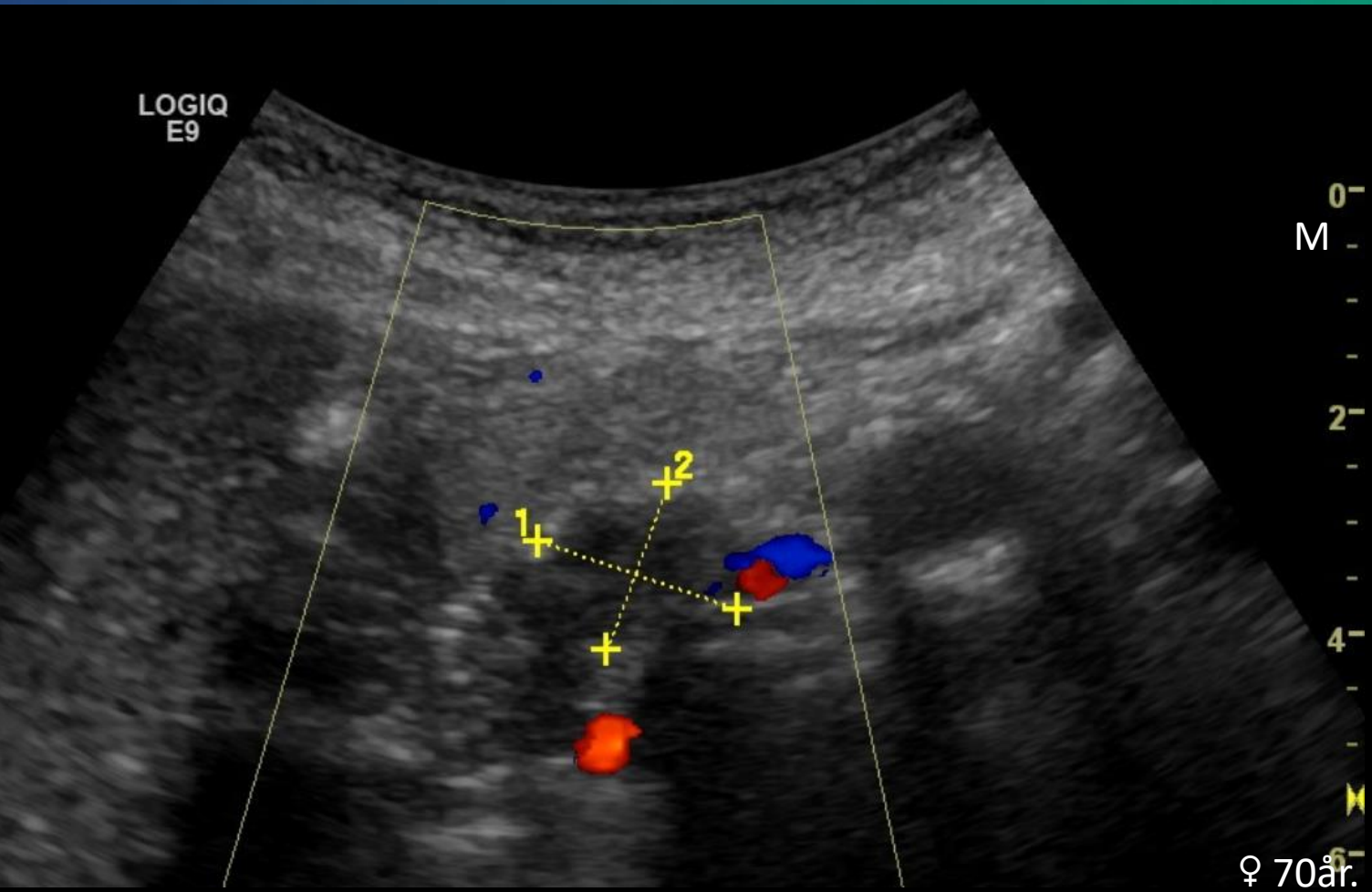


Mucinøs cystisk neoplasme

Malign IPMN intraductal papillary mucinous neoplasm

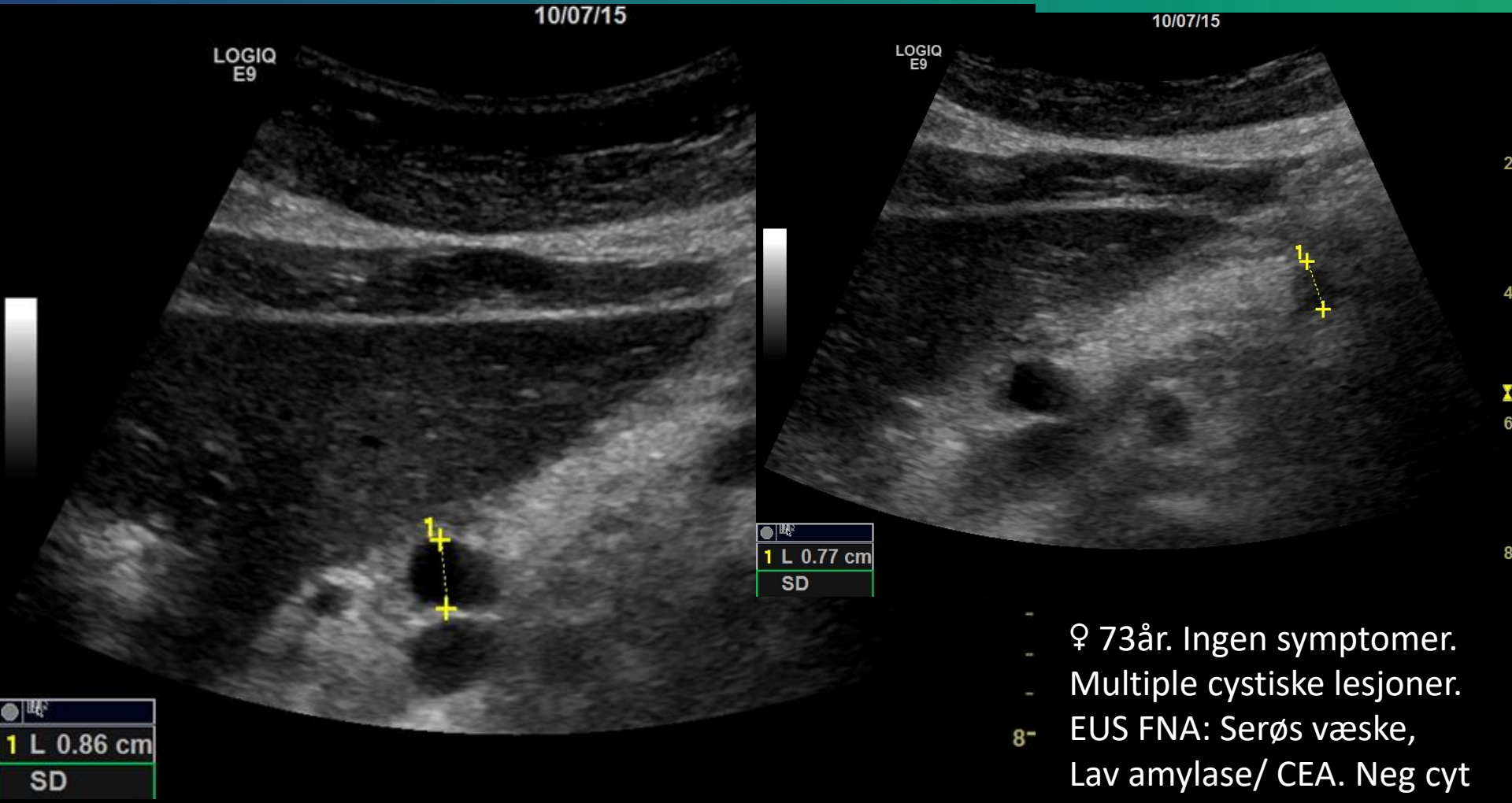
Brugge. Diagnosis and management of cystic lesions of the pancreas
J Gastrointest Oncol. 2015 Aug; 6(4): 375–388. doi: 10.3978/j.issn.2078-6891.2015.057

Cystiske pankreaslesjoner



♀ 70år. Diffuse magesmerter
Cyste i kalcifisert pankreas
Diagnose: Pseudocyste

Cystiske pankreaslesjoner



♀ 73år. Ingen symptomer.
Multiple cystiske lesjoner.
EUS FNA: Serøs væske,
Lav amylase/ CEA. Neg cyt
Diagnose: SCN

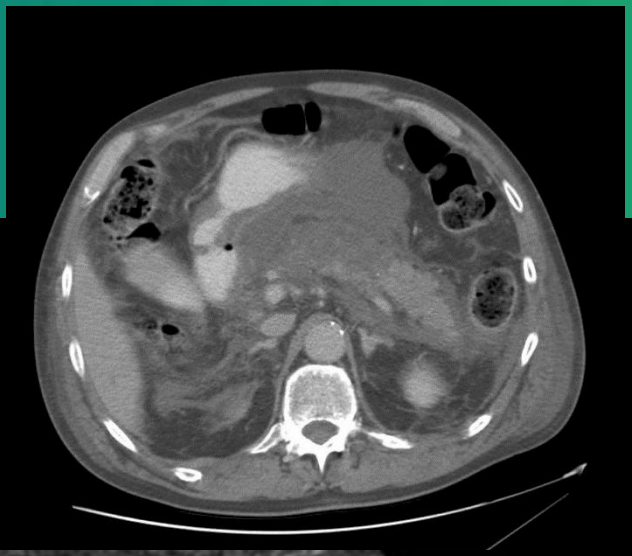
Cystiske pankreaslesjoner

	Pseudocyst	IPMN (MD/ BD)	MCN	SCN
Patients	Alcohol abuse, hist of pancreatitis middle aged men	Middle aged and older individuals	Middle-aged women	Older women
Localization	Common in tail, varying size	Common in head, incidental and multifocal	Body and tail, incidental, single lesion	Entire pancreas, many small cysts or oligo /macrocystic
US charact.	Thick-walled, anechoic, unilocular cystic lesion	MD: Dil of MPD, hyperech nodules arising ductal wall; BD: small-cluster grapelike dilations , mural nodule	Macrocystic lesion few septations. Sometimes focal, peripheral, calcification, no ductal dilation.	Multiple, small, cystic areas. Honeycomb. Sometimes central fibrosis or calcification
Cyt/ biokj	Thin, clear/ brown, non-muc., CEA low, amyl/lipase high.	Thick mucus, CEA usually high, amylase may be high	Thick mucus, CEA concentration usually high	Clear and thin, CEA and amylase very low
Mal pot	No	**MD**: Ca 60%. **BD** ca 25% i resected, 2-3% årlig risk.	Ca 30%	Rare. Obs >4cm/ growing

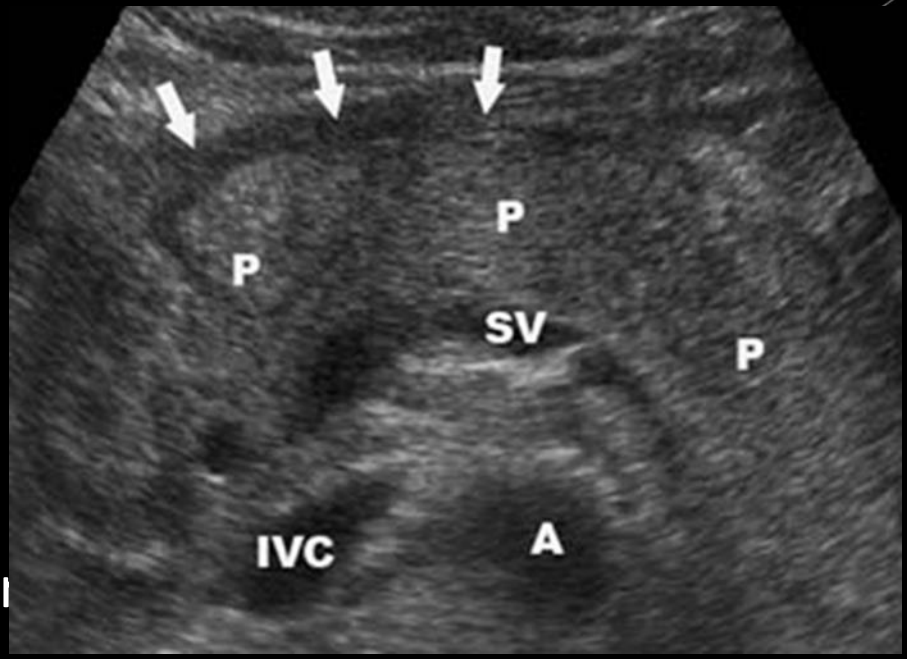
Ultralyd ved Akutt pankreatitt

- God innledende undersøkelse, men klare begrensninger gjør supplerende CT nødvendig
  - Smerte og distendert colon gir hemmet innsyn.
- Fordeler
  - Bedside, monitorering for komplikasjoner.
  - God fremstilling av galleveier/ gangobstruksjon/ konkrementer.
  - Veilede for intervensjoner.
  - CEUS for inflammatoriske masser vs nekroser.

Akutt pankreatitt



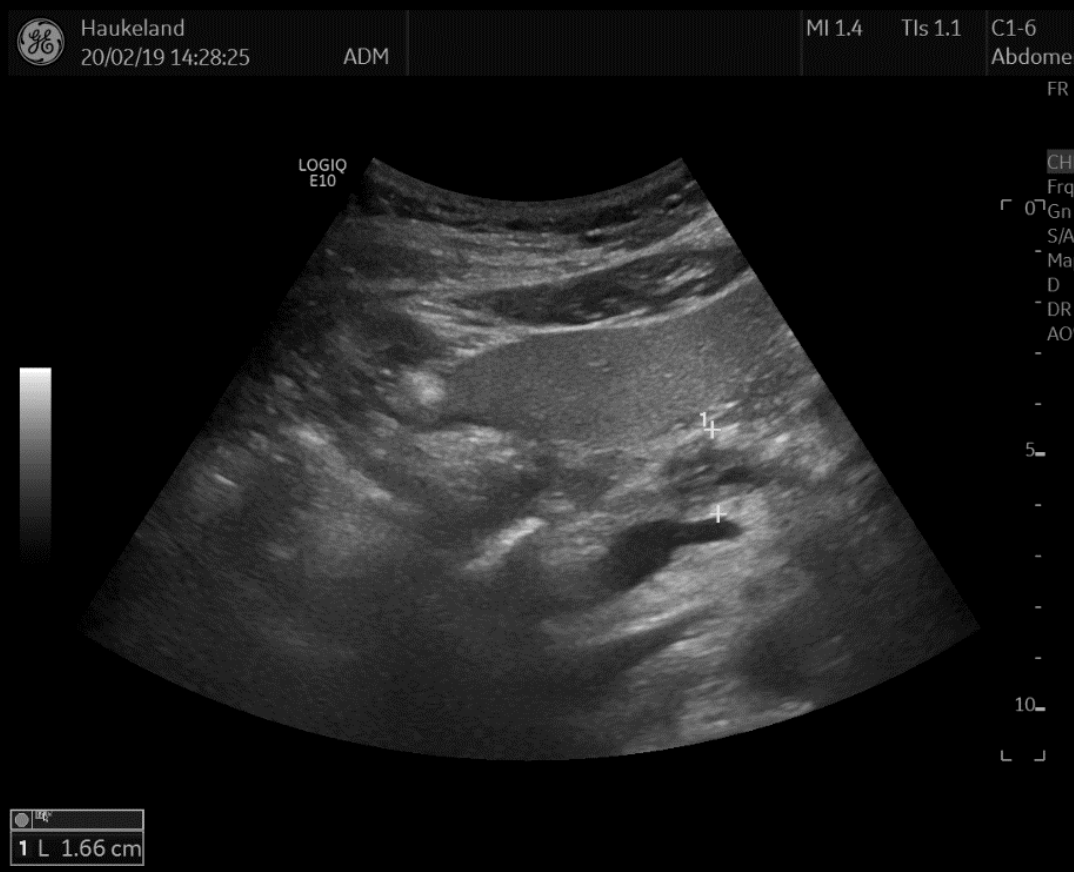
- Tidlig fase: Initialt intra- og peripankreatisk ødem
  - Subtile funn/ normalt
  - Forstørret pankreas
  - Uthvisket grense
  - Heterogent vev (nekrose)
  - Dilatert gang/ koledochus
  - Oppklaringer rundt pankreas
  - Konkrementer/ gallestener



Akuttfase; svullen pankreas, peripankr. ødem

Fokal akutt pankreatitt

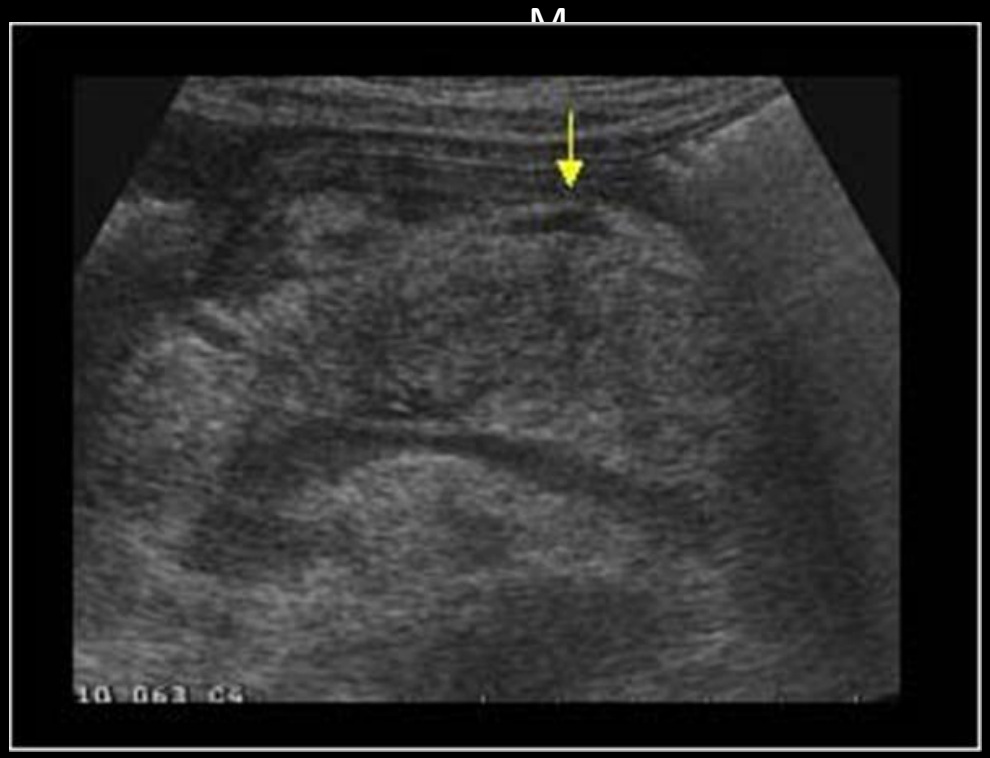
- Fokale pankreatitter kan se ut som cancer



Fokal pankreatitt, dilatert og ødematøs gang

Akutt pankreatitt

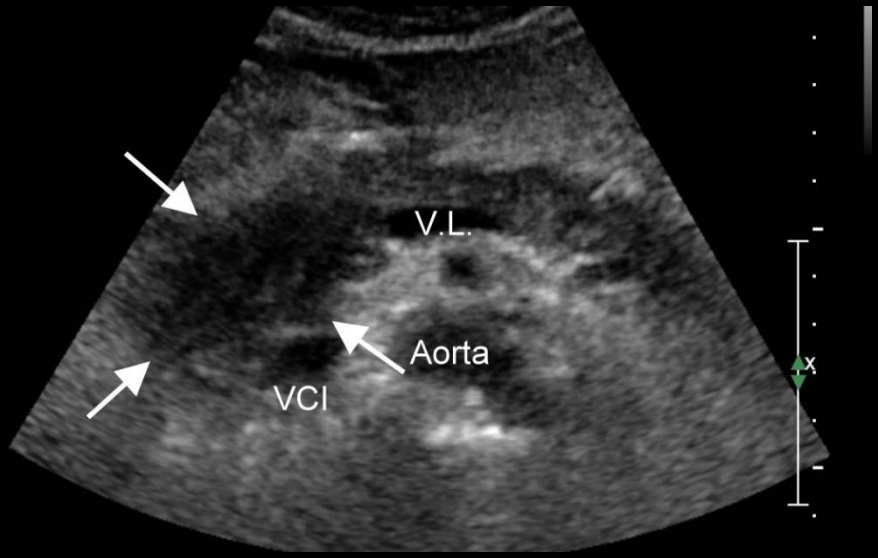
- **Senere komplikasjoner**
  - Pseudocyster
  - innkapsl peripankr væske
  - Nekroser
  - Pseudoaneurismer
  - Portospleniske tromboser
  - Blødninger
  - Abscesser
  - Ascites/ pleuravæske



Peripankreatisk væske (www.ultrasoundcases.info)

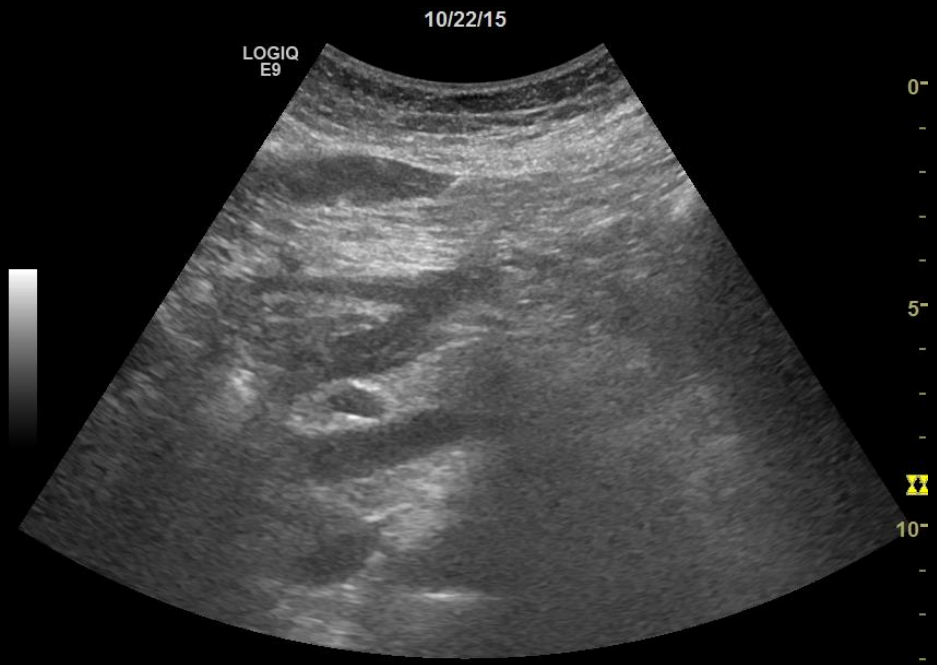
Komplikasjoner til akutt pancreatitt

Pseudocyster/ Abscess



(www.sonographiebilder.de

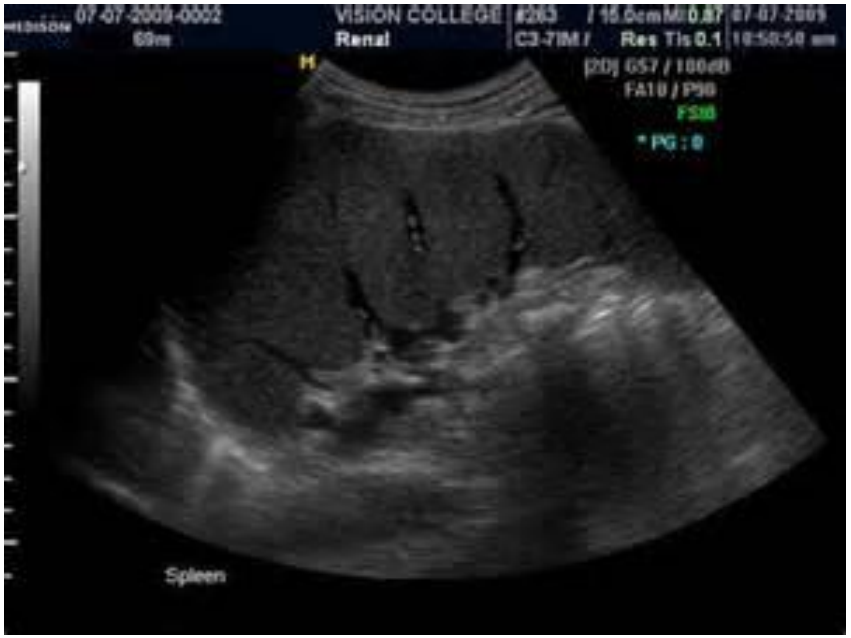
Etablert pseudocyste



Bilde: Engjom

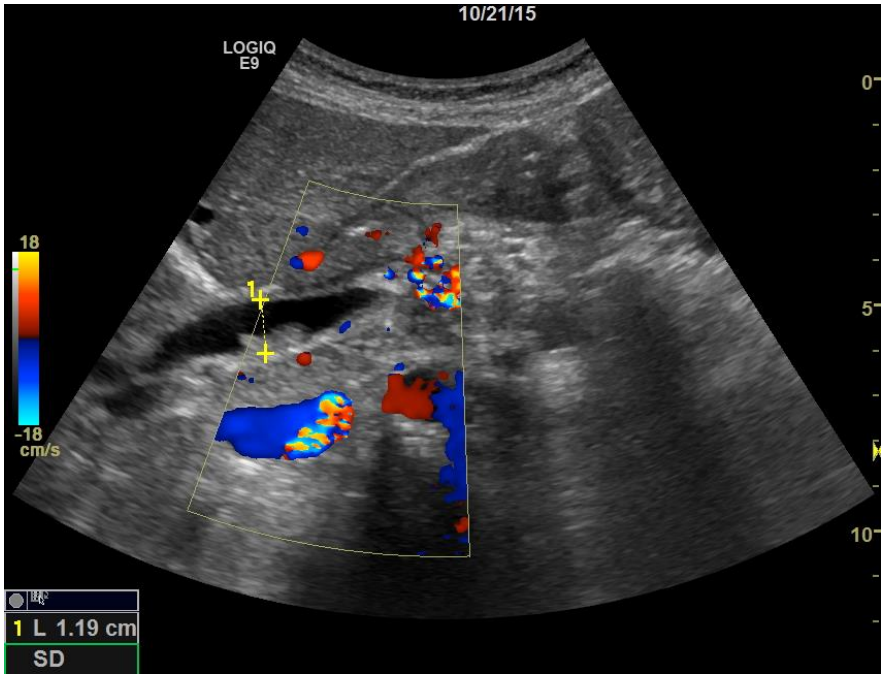
Komplikasjoner til akutt pankreatitt

Miltvaricer ved miltvenetrombose



Miltvaricer. www.sean-duffy-art.com

Konkrementer/ Kron. pankreatitt



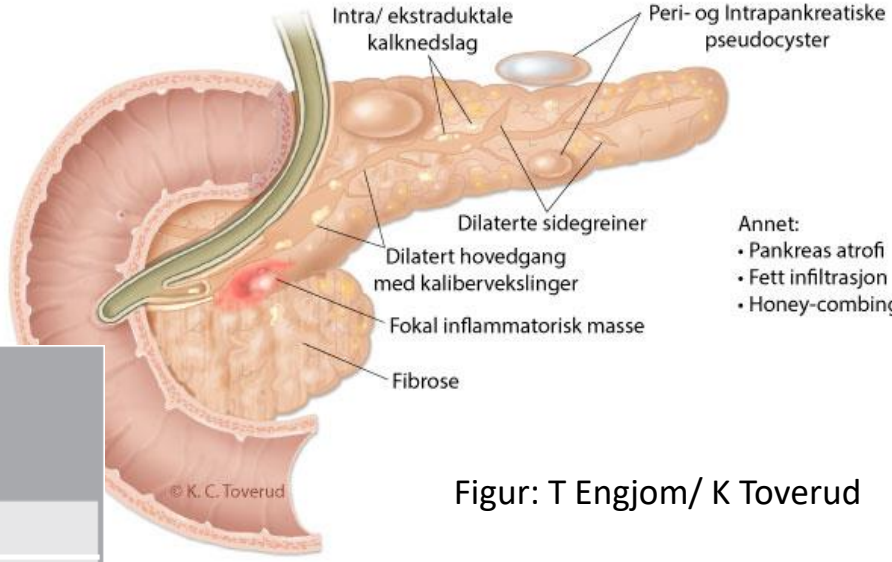
Dilatert koledochus med konkrement.
Kalk i pankreas, Twinkling artefact.
Bilde: Engjom

Kronisk pankreatitt

- CT er mest brukte modalitet
  - Begrensninger for små forandringer I gang og parenchym
- Ekstern ultralyd er ved adekvat innsyn et godt verktøy for å følge forandringer ved kronisk pankreatitt
- Endoskopisk ultralyd er gullstandard.
- MR kan vise tidlige forandringer
  - Sekretinstimulering gor bedre fremstilling av sidegangsforandringer

Diagnostic Accuracy of Transabdominal Ultrasound in Chronic Pancreatitis. Engjom et al. Ultrasound in medicine & biology. 2017;43(4):735-43.
Catalano, M. F., et al. EUS-based criteria for the diagnosis of chronic pancreatitis: the Rosemont classification. Gastrointest.Endosc. 69.7 (2009): 1251-61.

Kronisk pankreatitt



Figur: T Engjom/ K Toverud

Table 1. Correspondence between characteristics in standard endoscopic ultrasonography and pathologic findings in chronic pancreatitis.

Standard EUS	Pathologic findings
Parenchymal criteria	
Hyperechoic foci	Small calcifications
Hyperechoic strands	Fibrosis
Lobularity	Edema or fibrosis
Cysts	Pseudocysts
Calcifications	Calcifications
Ductal criteria	
MPD dilatation	MPD dilatation
MPD irregularity	MPD irregular
Hyperechoic MPD walls	Ductal fibrosis or edema
Visible side branches	Dilated secondary branches

EUS: Endoscopic ultrasonography; MPD: Main pancreatic duct.

Erchinger F, Dimcevski G, Engjom T, Gilja O. Transabdominal ultrasound of the Pancreas: Basic and new aspects. Imaging in Medicine 20113:411-422.

Table 2. Rosemont consensus definition.

Rank	Features	Definition	Diagnostic findings	Location
Parenchymal features				
1	Major A	Hyperechoic foci with shadowing	Echogenic structures ≥2 mm in length and width that shadow	Body and tail only
2	Major B	Lobularity with honeycombing	Well circumscribed, ≥5 mm structures with enhancing rims and relatively echo-poor centers, with ≥3 lobules	Body and tail only
	Minor	Lobularity with honeycombing	Well circumscribed, ≥5 mm structures with enhancing rims and relatively echo-poor centers, with noncontiguous lobules	Body and tail only
3	Minor	Hyperechoic foci without shadowing	Echogenic structures ≥2 mm in length and width with no shadowing	Body and tail only
4	Minor	Cysts	Anechoic, rounded/elliptical structures with or without septations	Head, body and tail only
5	Minor	Stranding	Hyperechoic lines ≥3 mm in length in at least two different directions with respect to the imaged plane	Body and tail only
Ductal features				
1	Major A	MPD calculi	Echogenic structures within the MPD with acoustic shadowing	Head, body and tail only
2	Minor	Irregularity of MPD contour	Uneven or irregular outline and ectatic course	Body and tail only
3	Minor	Dilated side branches	Three or more tubular anechoic structures each measuring ≥1 mm in width, budding from MPD	Body and tail only
4	Minor	MPD dilation	≥3.5 mm in body or >1.5 mm in tail	Body and tail only
5	Minor	Hyperechoic duct margin	Echogenic, distinct structure greater than 50% of the entire MPD	Body and tail only

MPD: Main pancreatic duct.

Catalano, M. F., et al. EUS-based criteria for the diagnosis of chronic pancreatitis: the Rosemont classification. Gastrointest.Endosc. 69.7 (2009): 1251-61.

Mayo/ Layer score

TABLE 1. Clinical Score for CP

Diagnostic Criteria for CP, 4 Points are Required for the Diagnosis	
Pancreatic calcifications or typical histologic findings	4 points
Moderate or marked morphological changes on ultrasonography, computed tomography, or endoscopic retrograde pancreatography	3 points
Definite morphological changes on MRI	3 points
Reduced exocrine pancreatic function by EST or FE1	2 points
History of acute pancreatitis or upper abdominal pain	2 points
Diabetes mellitus or impaired glucose tolerance test	1 point

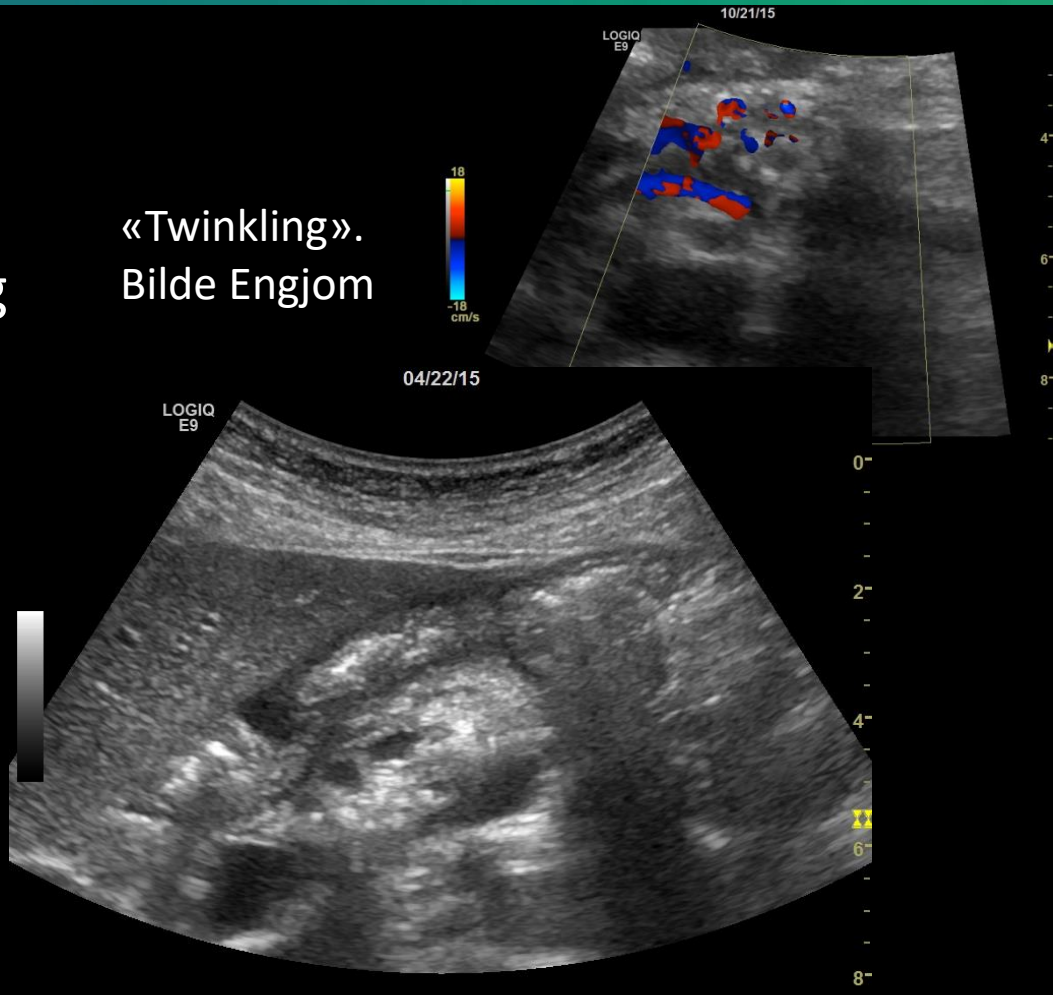
Modified after Layer et al, *Gastroenterology* 1994; 1481–1487

A clinical score published by Peter Layer was modified to fit our available clinical tools. In this study, Lundhs test was replaced by secretin-stimulated short EST. Steatorré was replaced by FE1.

Layer, P., et al. "The different courses of early- and late-onset idiopathic and alcoholic chronic pancreatitis." Gastroenterology 107.5 (1994): 1481-87.

Calcifikasjoner

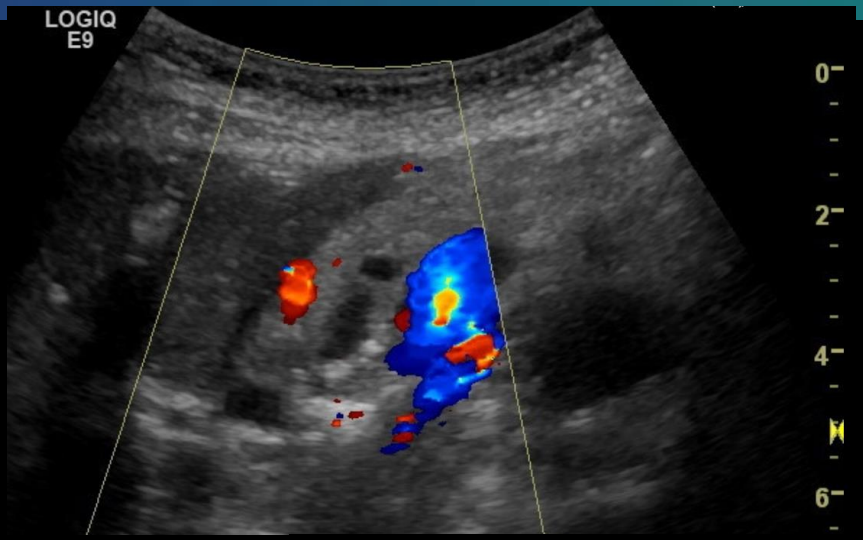
- Ekstern UL har god sens. for kalk i pankreas
  - Bør ha en viss mengde og størrelse for å tolkes.
  - Forsiktighet ved dårlig innsyn. Lett å overtolke.
  - «Twinkling artefacts» på doppler

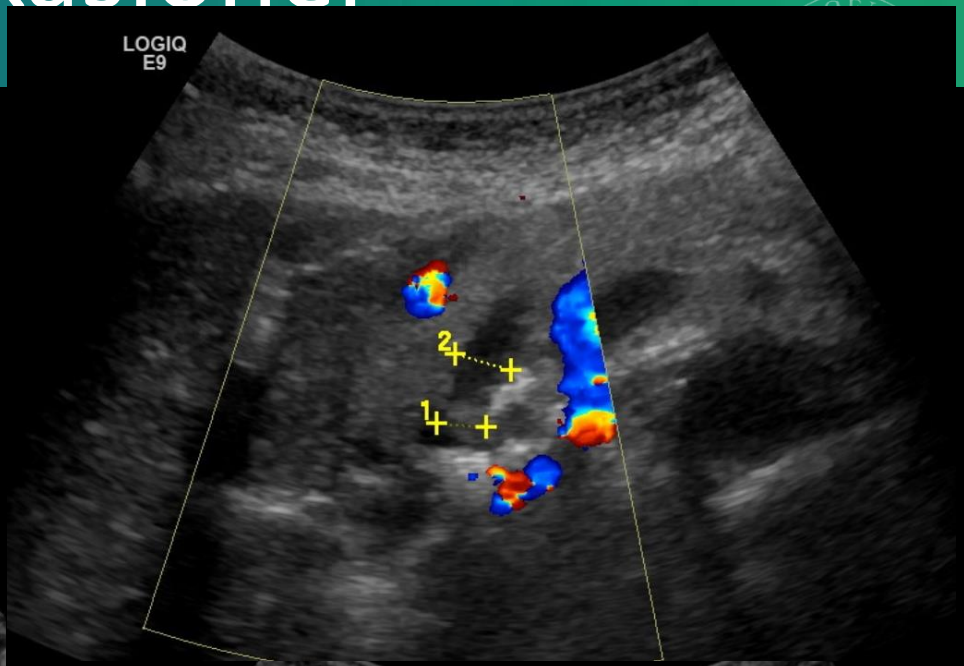


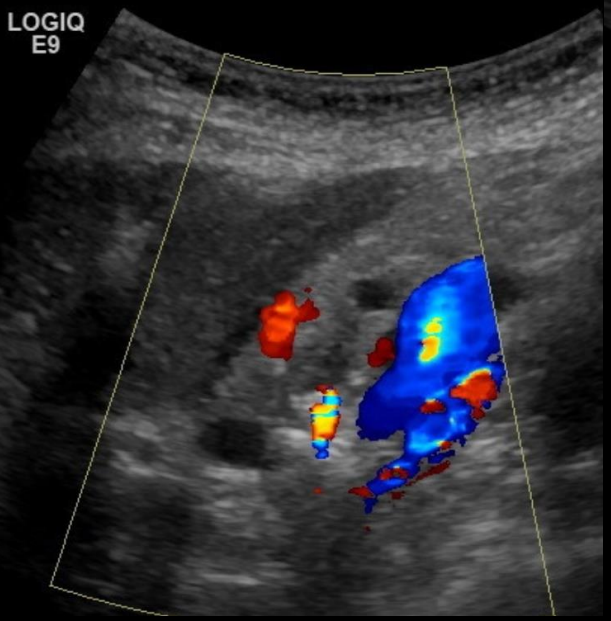
«Twinkling». Bilde Engjom

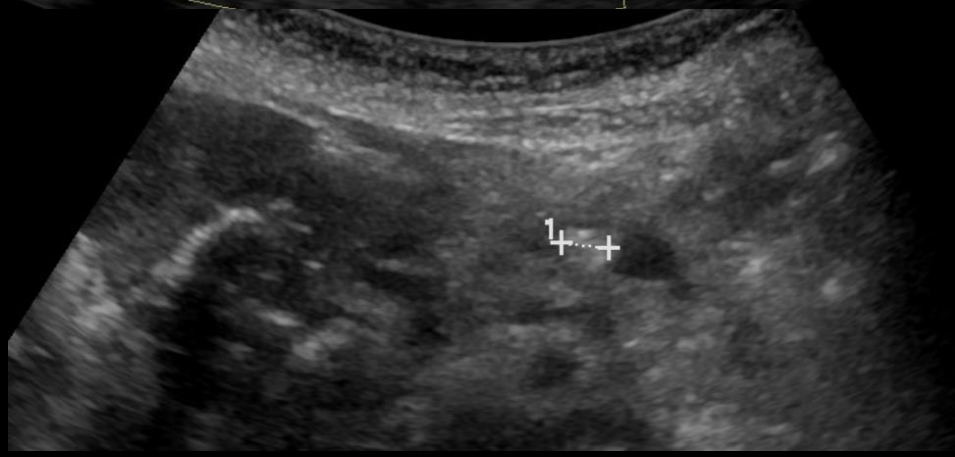
Kalk i gang og vev ved KP

Calcifikasioner





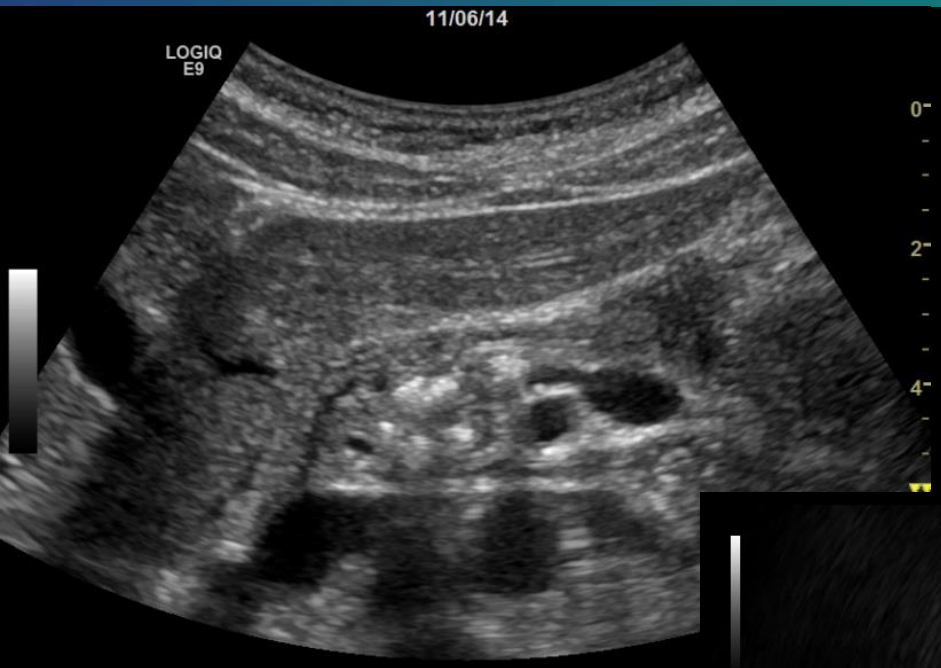




Sten i dilatert og kalibervekslet gang «Twinkling». Bilde Engjom

Kalk i gang og vev ved KP

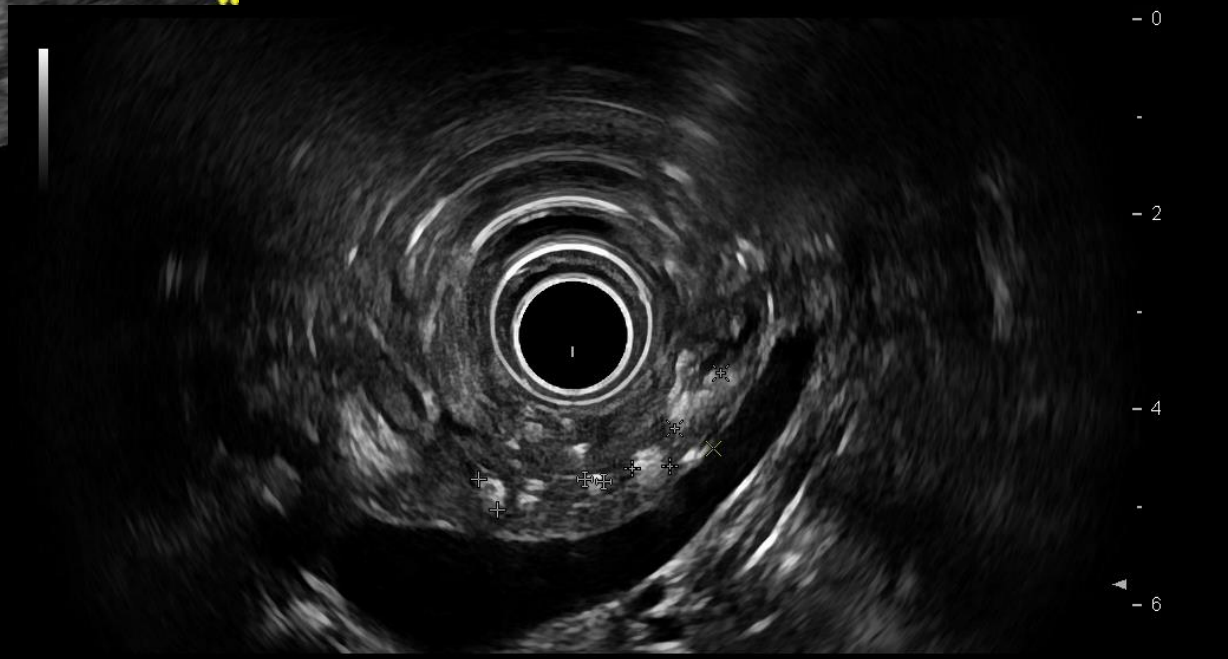
Calcifikasjoner



5mHz

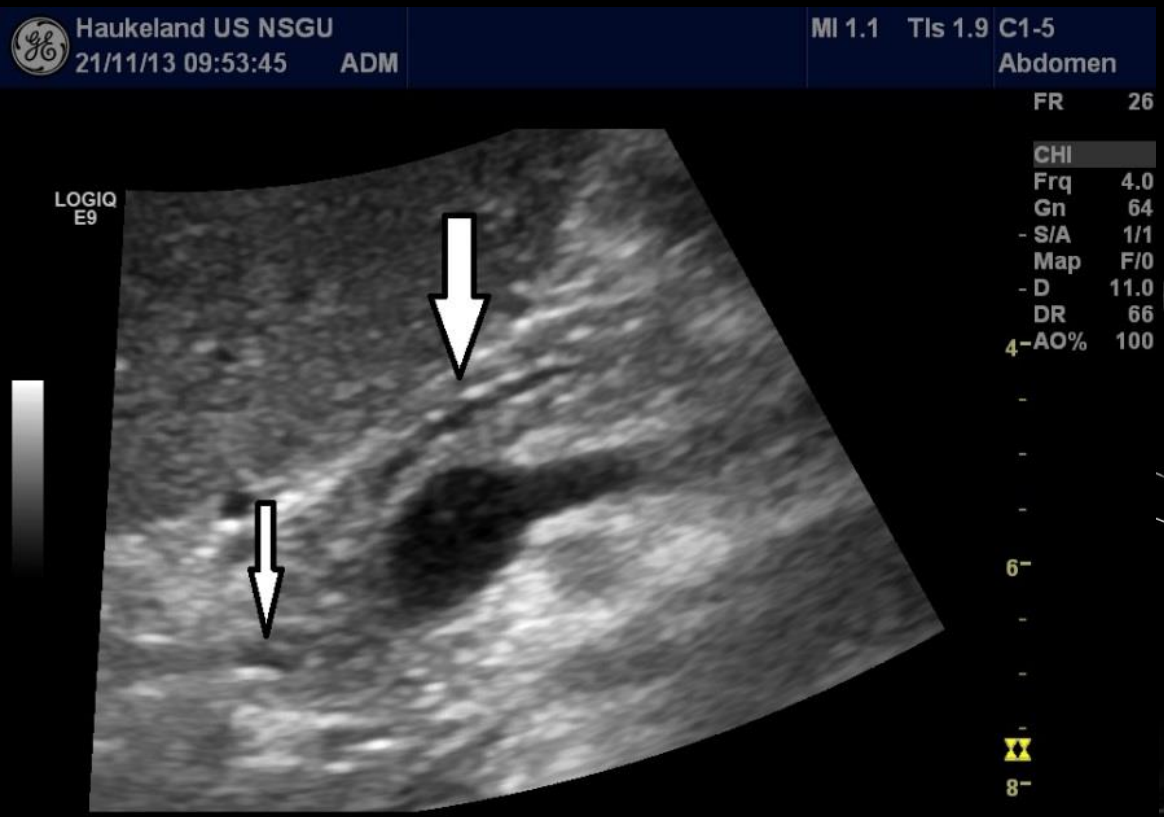
Tydeligere skygger på lavfrekvent ekstern ultralyd enn på høyfrekvent EUS

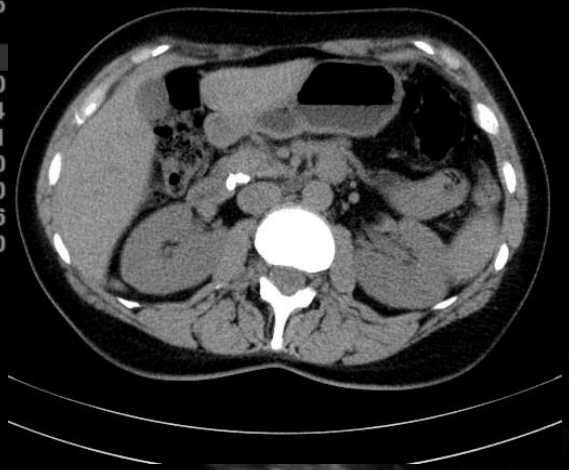
12mHz

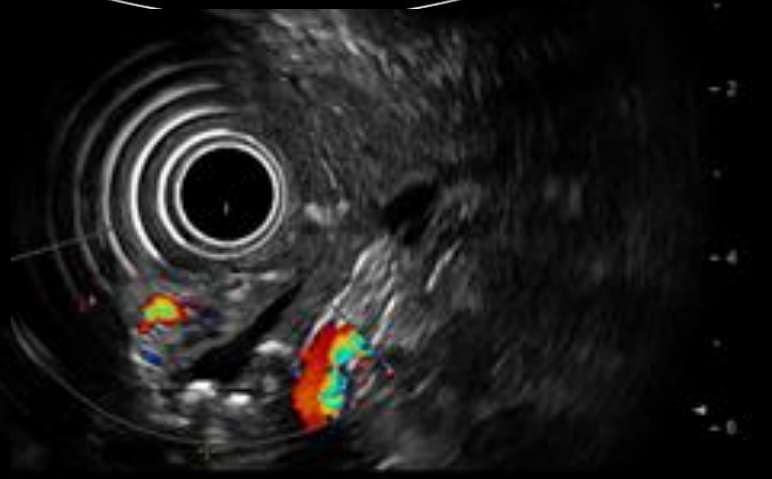


Calcifikasjoner

Ekstern ultralyd kan påvise konkrementer i dilatert gang



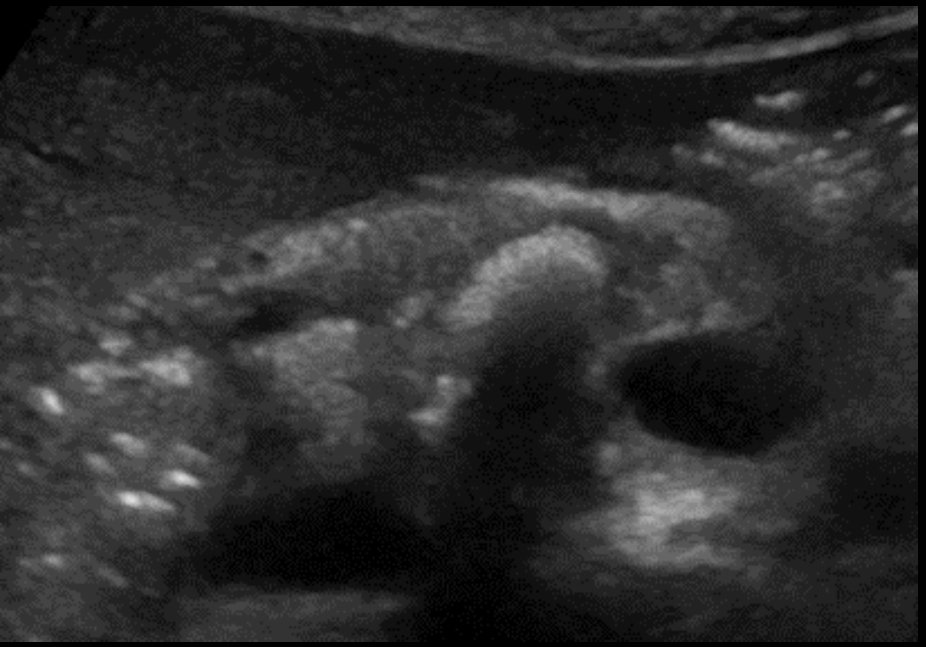


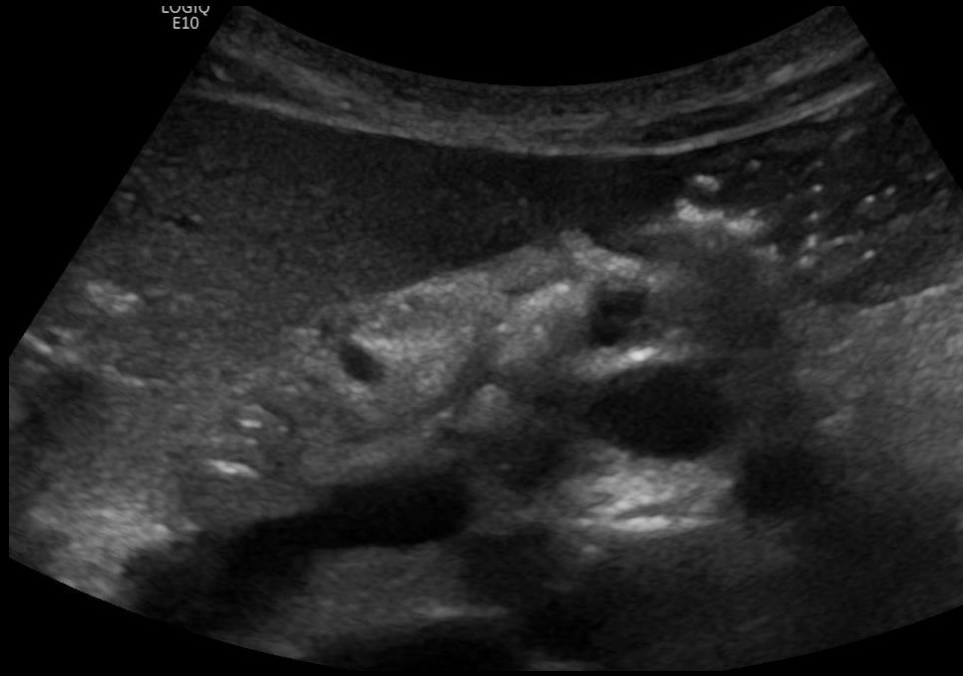


Bilde: Engjom

Calcifikasjoner

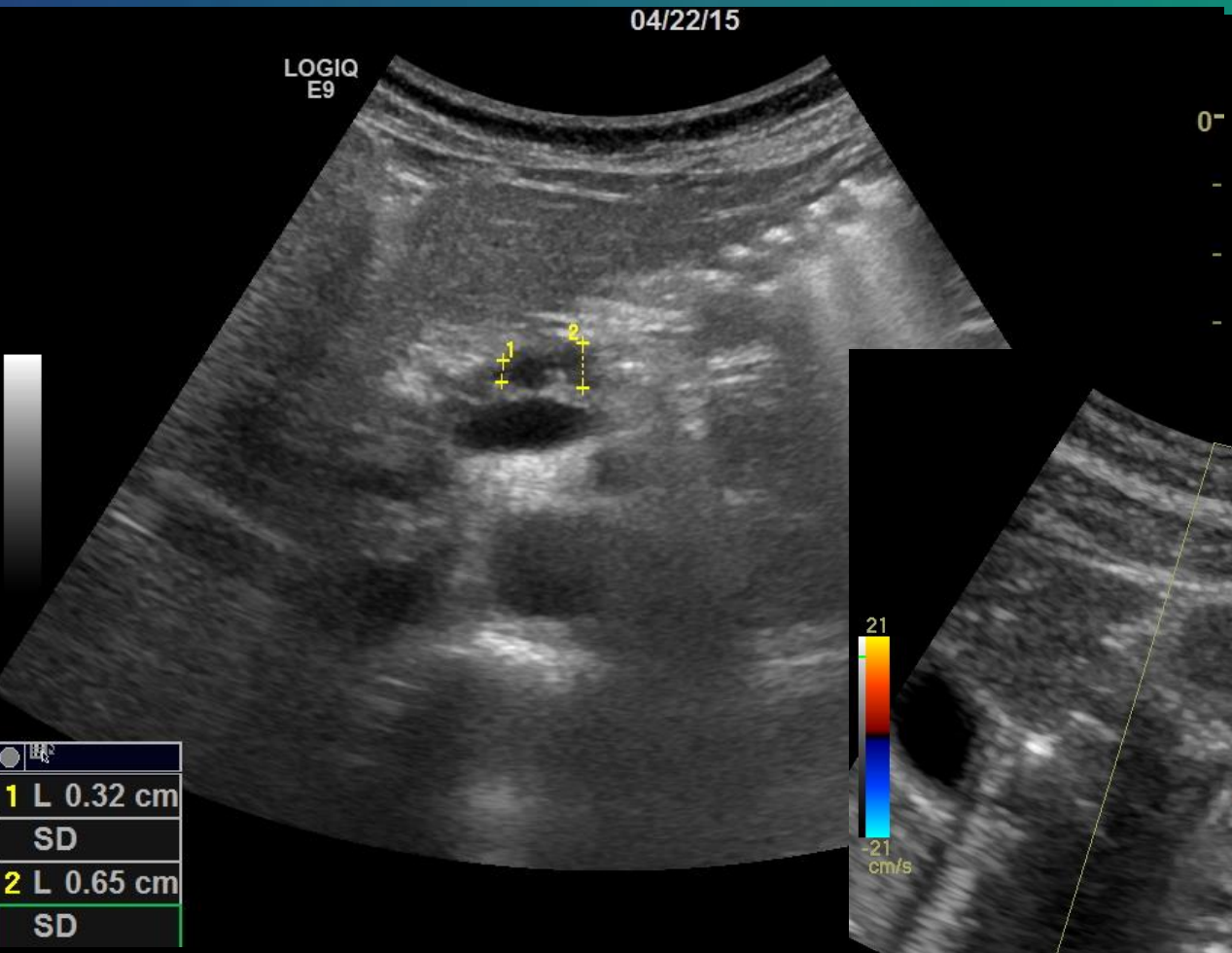
Store konkrementer kan skygge for pankreasparenchymet

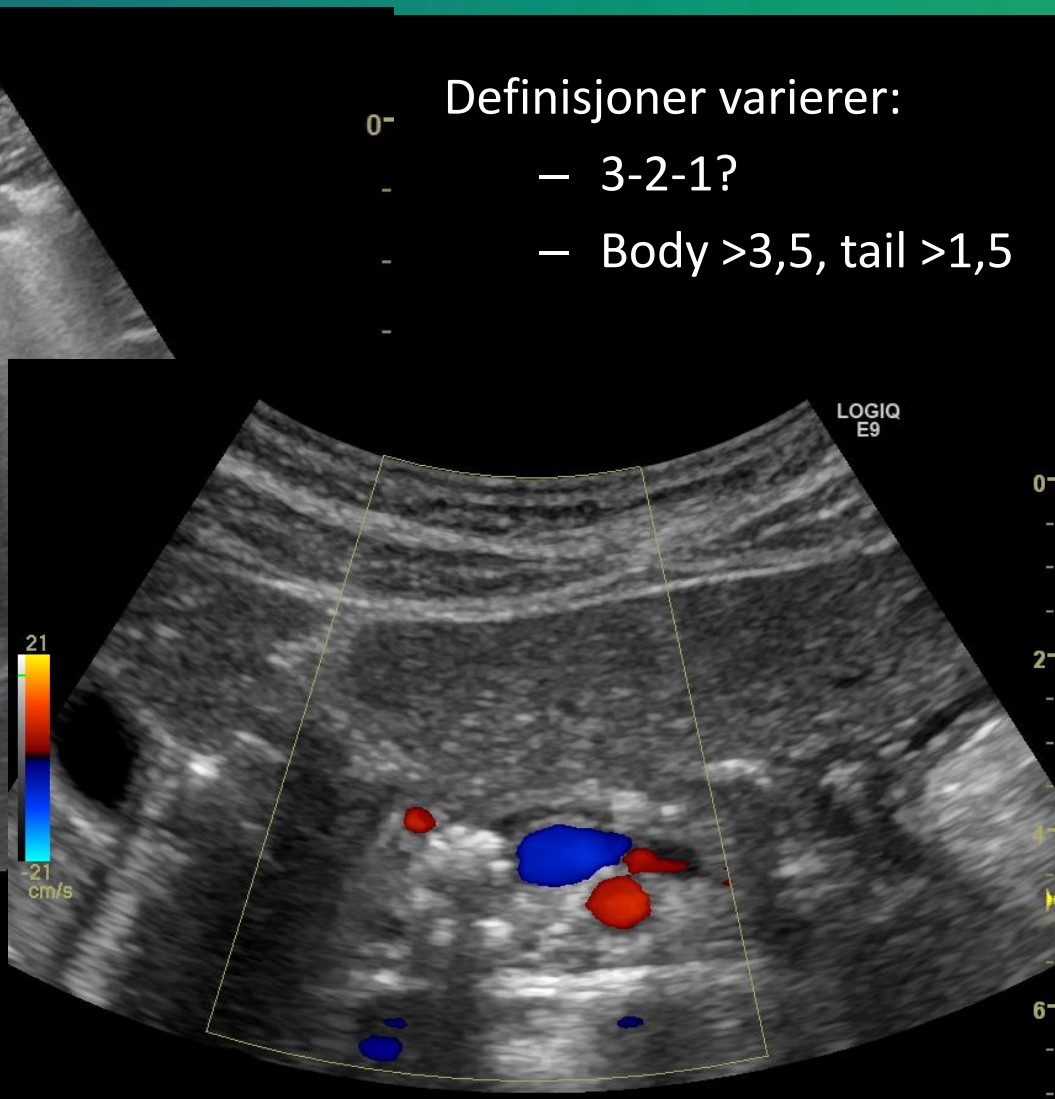




Bilde: Engjom

MPD



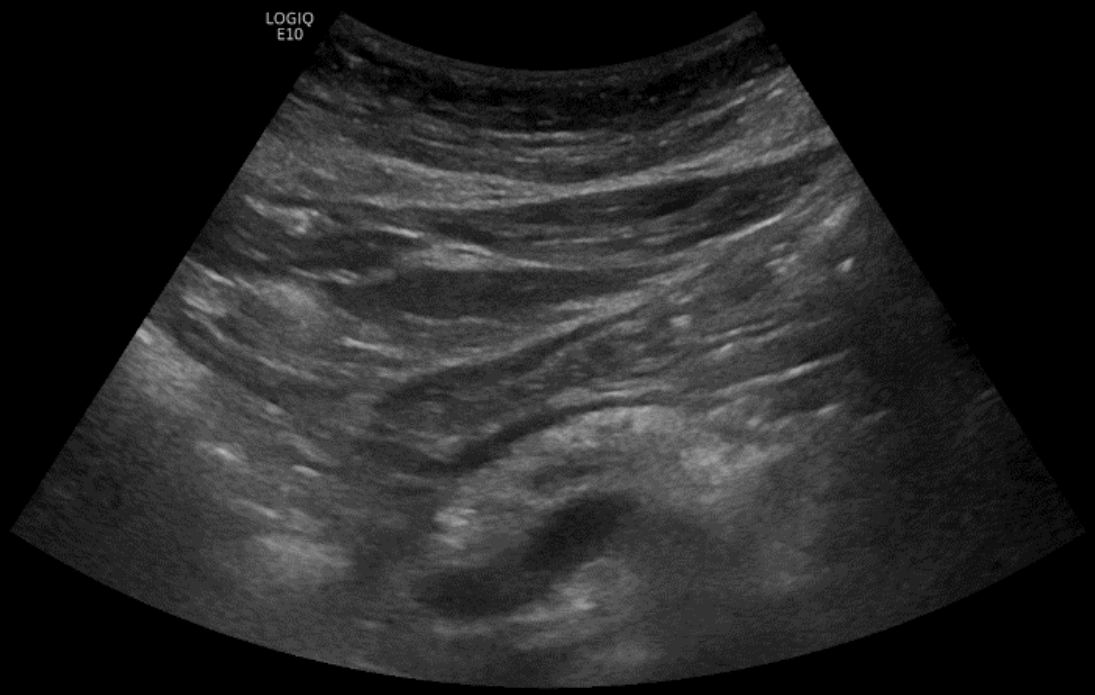


Definisjoner varierer:

- 3-2-1?
- Body >3,5, tail >1,5

Kalibervariasjoner og dilatert gang: Bilde: Engjom

Pankreas atrofi

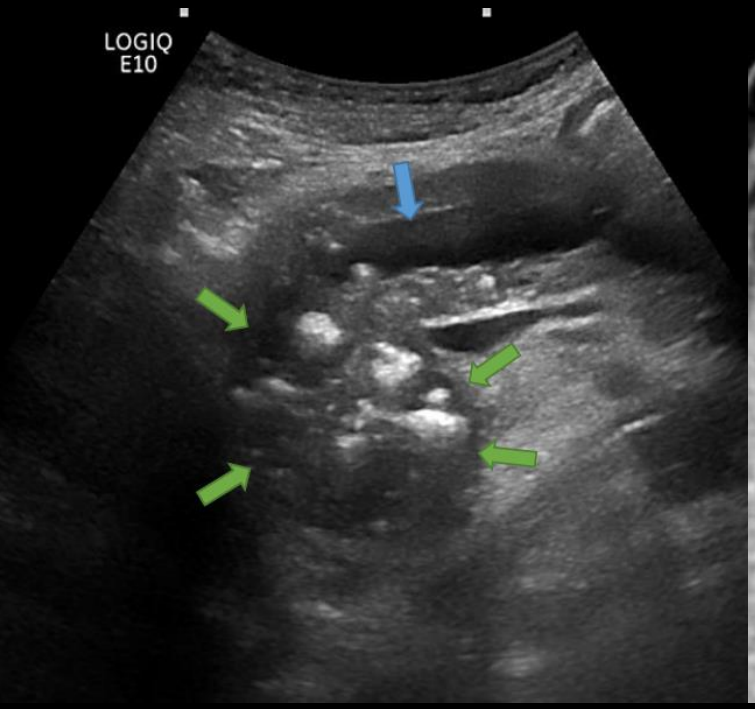


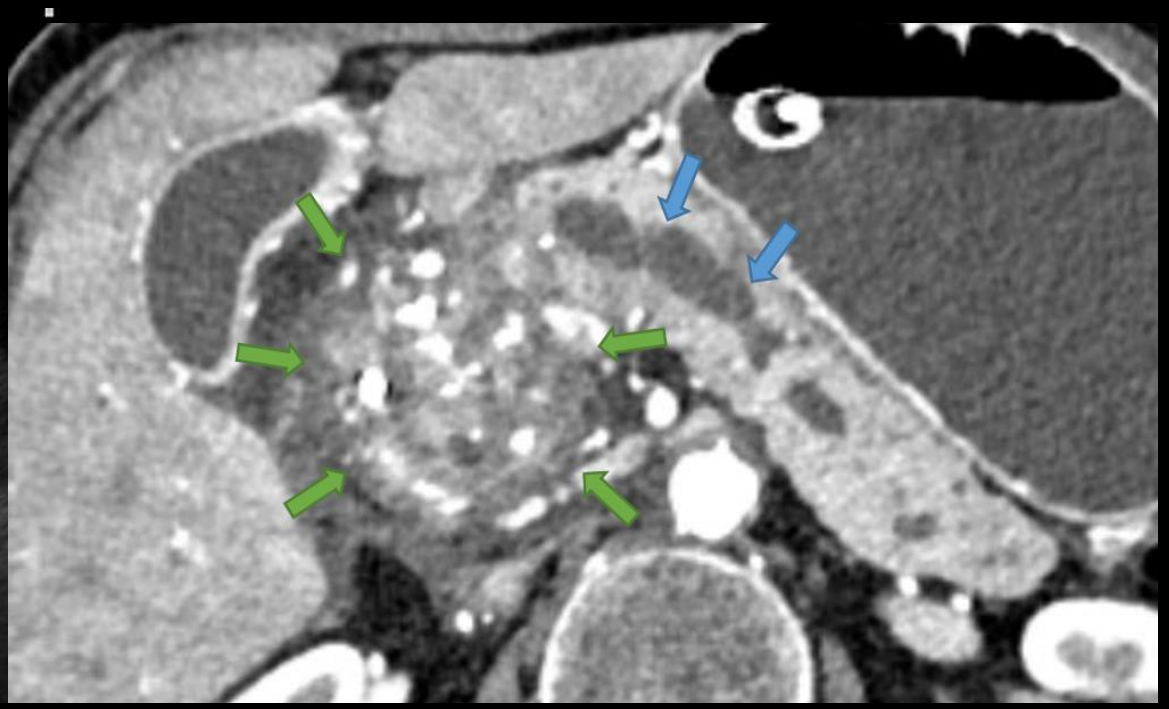
Relativt begrep

- Ved ultrlyd kan en sammenligne utvikling over tid.
- Etablert cutoff finnes ikke
- Kvinner har mindre pankreas enn menn

Atrofisk pankreas etter ca 10 år med residiverende pankreatitter

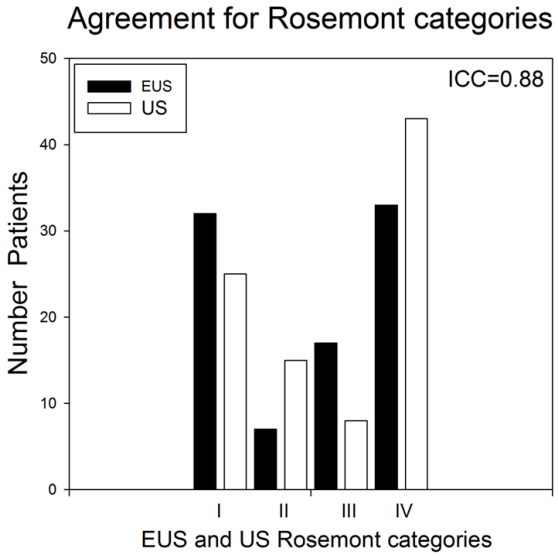
Obstruerende inflammatorisk masse





Kalcifisert inflammatorisk masse som obstruerer pankreasgang og gir ventrikkelretensjon
En ganske tydelig indikasjon for kirurgi

US vs EUS Acuracy



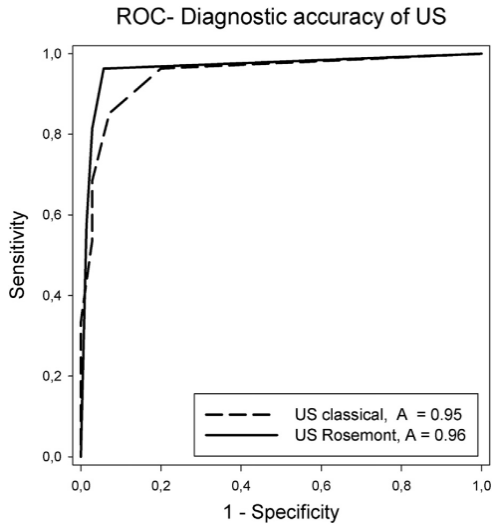


Table 4. Accuracy of unweighted (classic) and Rosemont scores for the diagnosis of chronic pancreatitis

US scores	Sensitivity	Specificity	Cutoff	Accuracy
Classical score	0.69 (0.54–0.80)*	0.97 (0.90–1)	≥3	0.95 (0.91–0.99)
Rosemont score	0.81 (0.69–0.91)	0.97 (0.90–1)	≤2	0.97 (0.93–1)

* Median (95% confidence interval).

Engjom T, Sangnes DA, Havre RF et al (2017) Diagnostic Accuracy of Transabdominal Ultrasound in Chronic Pancreatitis. Ultrasound Med Biol 43:735-743

US vs CT Acuracy

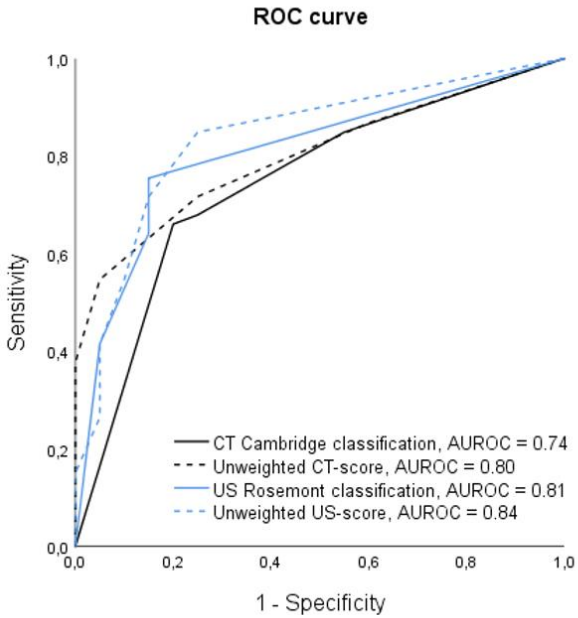


Table 3. Diagnostic performance indices for diagnosing chronic pancreatitis

	AUROC	Cut-off	Sensitivity (%)	Specificity (%)
CT Cambridge	0.75 (0.63-0.87)	≥2	68 (54-80)	75 (51-91)
CT Unweighted	0.80 (0.70-0.90)	≥2	72 (58-83)	75 (51-91)
US Rosemont	0.81 (0.71-0.91)	≤2	64 (50-77)	85 (62-97)
US Unweighted	0.84 (0.74-0.94)	≥2	72 (58-83)	85 (62-97)

Nordaas, Engjom, Gilja, Havre, Sangnes, Haldorsen, Dimcevski. Diagnostic Accuracy of Transabdominal Ultrasound and Computed Tomography in Chronic Pancreatitis: a Head-to-Head Comparison. Submitted Ultrasound Med Biol 2021

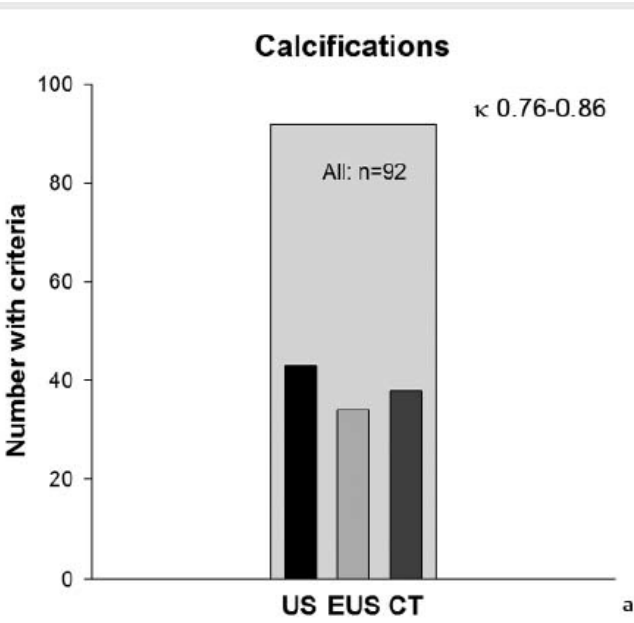
Hva kan vi se med ekstern ultralyd?

Vi ser best cyster, kalk og større MPD variasjoner

▶ **Table 4** Agreement and accuracy for individual criteria and scores.

agreement	criteria	κ	ICC
parenchymal	calcifications	0.66	
	lobularity	0	
	HE foci, no shadow	0.26	
	cysts	0.46	
	stranding	0.21	
ductal	MPD calculi	0.34	
	irregular MPD contour	0.42	
	dilated side branches	0.18	
	MPD dilatation	0.58	
	hyperechoic MPD margin	0	
agreement calcifications US vs. CT		0.86	
agreement calcifications EUS vs. CT		0.76	
absolute agreement unweighted criteria			0.74 [0.61 – 0.83]
absolute agreement Rosemont score			0.88 [0.81 – 0.92]

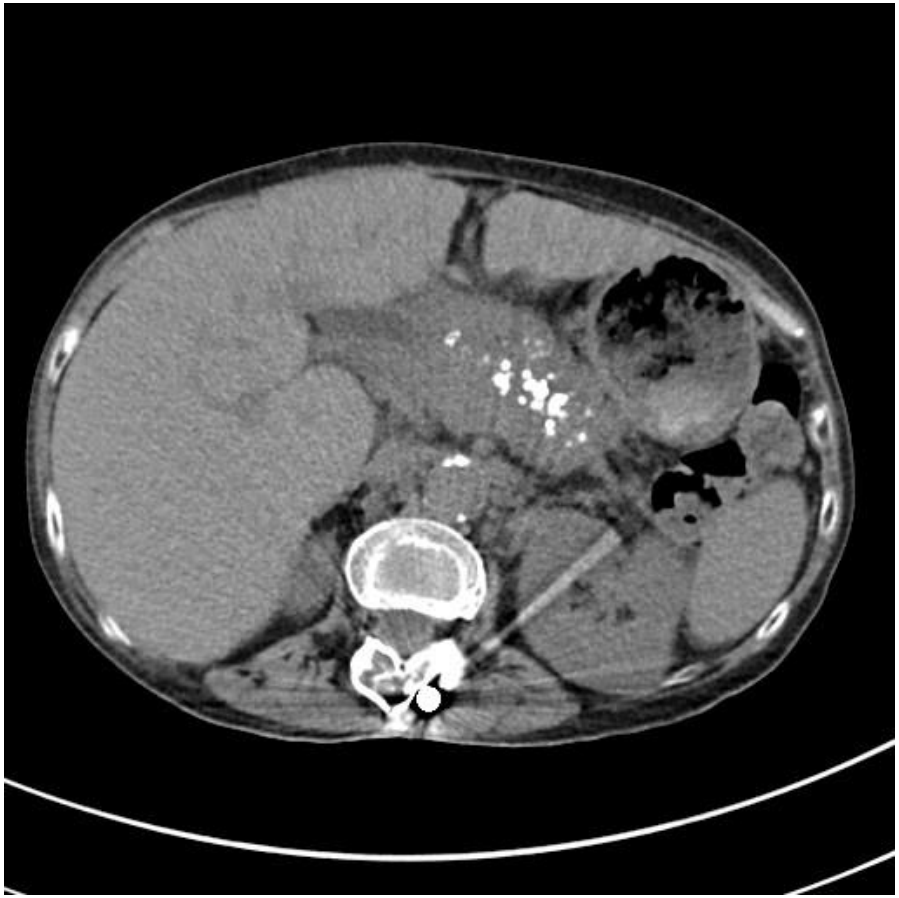
diagnostic accuracy	sensitivity	specificity	cut-off	accuracy
unweighted	0.79 [0.65 – 0.89]	0.90 [0.76 – 0.97]	≥ 2*	0.90
	0.65 [0.51 – 0.78]	0.97 [0.87 – 1.00]	≥ 3	
rosemont score	0.75 [0.61 – 0.86]	0.95 [0.83 – 0.99]	≤ 2	0.91
	0.88 [0.77 – 0.96]	0.98 [0.87 – 1.00]	≤ 3*	



Engjom et Al. Good Agreement Between Transabdominal and Endoscopic Ultrasound of the Pancreas in Chronic Pancreatitis, Ultraschall 2018

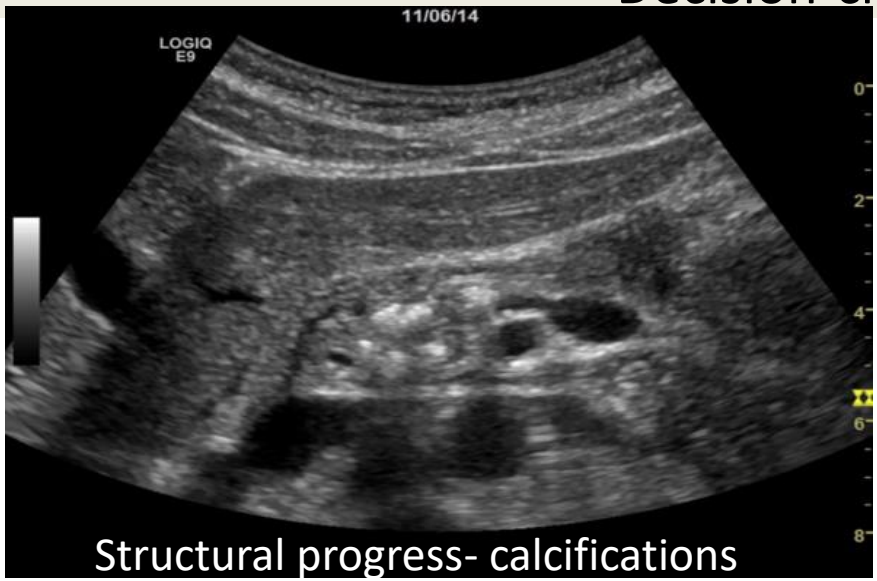
Hver modalitet har sin styrke

- CT gullstandard for kalk og cyster.
- EUS/MR gullstandard for tidlige forandringer
- Ultralyd god i oppfølgning
  - Oppdage pseudocyster
  - Gangdilatasjoner

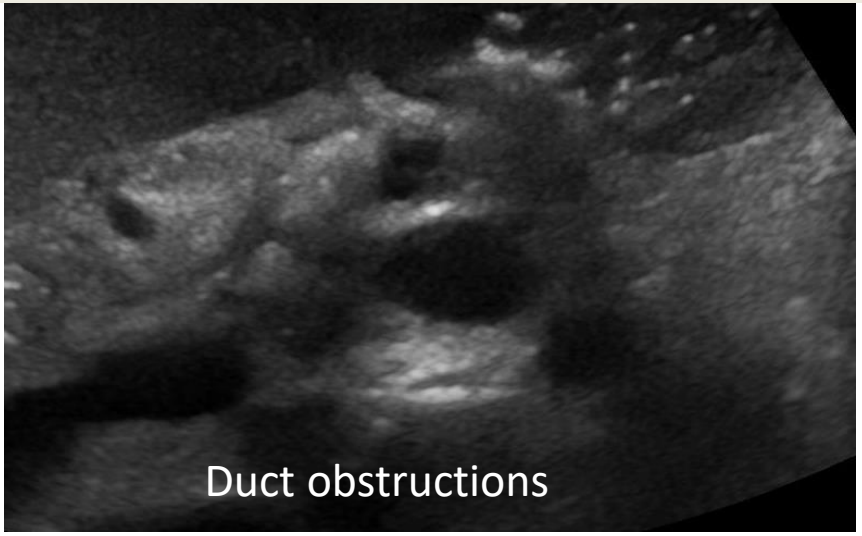


Hva ser vi etter i KP oppfølging:

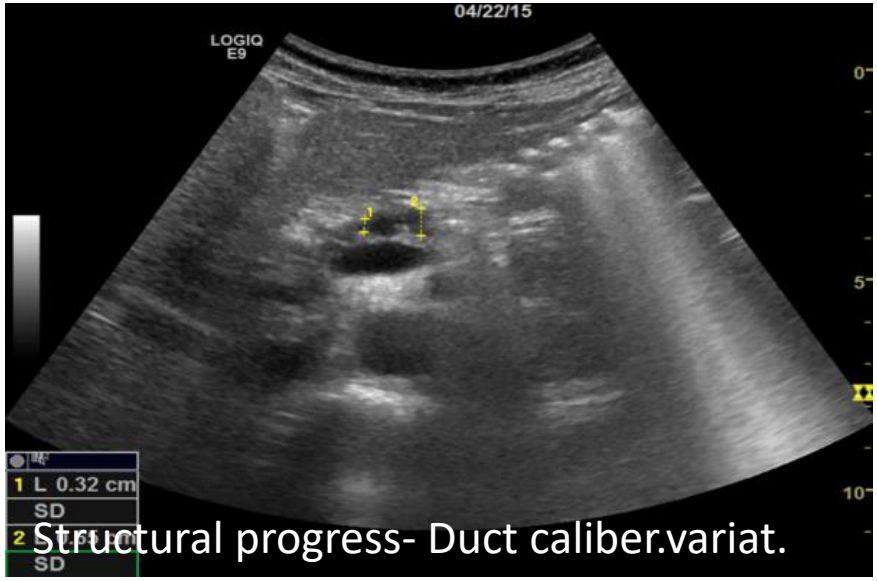
"Decision-close imaging"



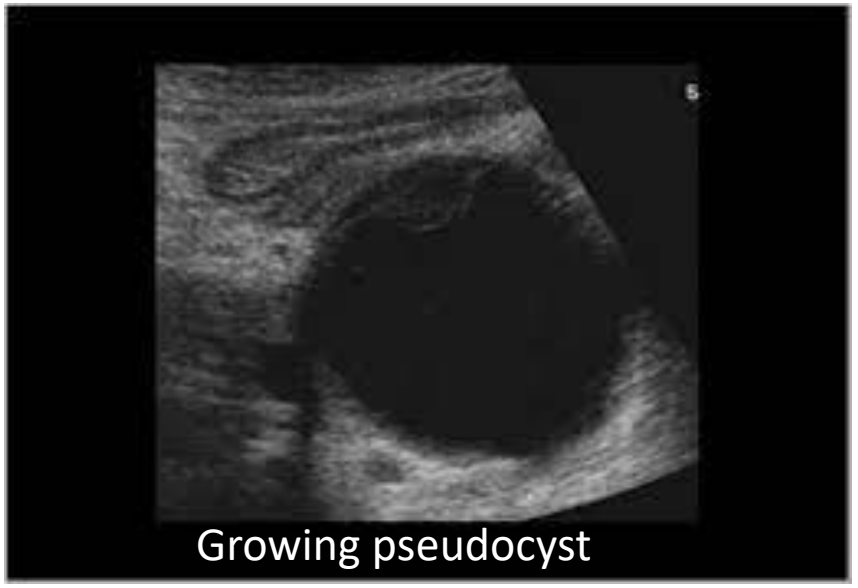
Structural progress- calcifications



Duct obstructions



Structural progress- Duct caliber.variat.



Growing pseudocyst

Images: From the pancreas clinic; Engjom

Konklusjon

- Ekstern ultralyd pankreas er bedre enn sitt rykte.
  - Nyttig som førstelinjeundersøkelse og som ledd I operabilitetsvurdering for pankreascancer.
  - Nyttig vurdering og oppfølging av akutte og kroniske pankreatitter
  - "Kan gjentas ofte- kan ikke gjentas for ofte…."
  - Som guiding til intervensjon/ diagnostikk
  - Men:
    - Operatøravhengig
    - Pasientavhengig