Kirurgisk behandling av colon- og rectum cancer, inkl. metastasekirurgi

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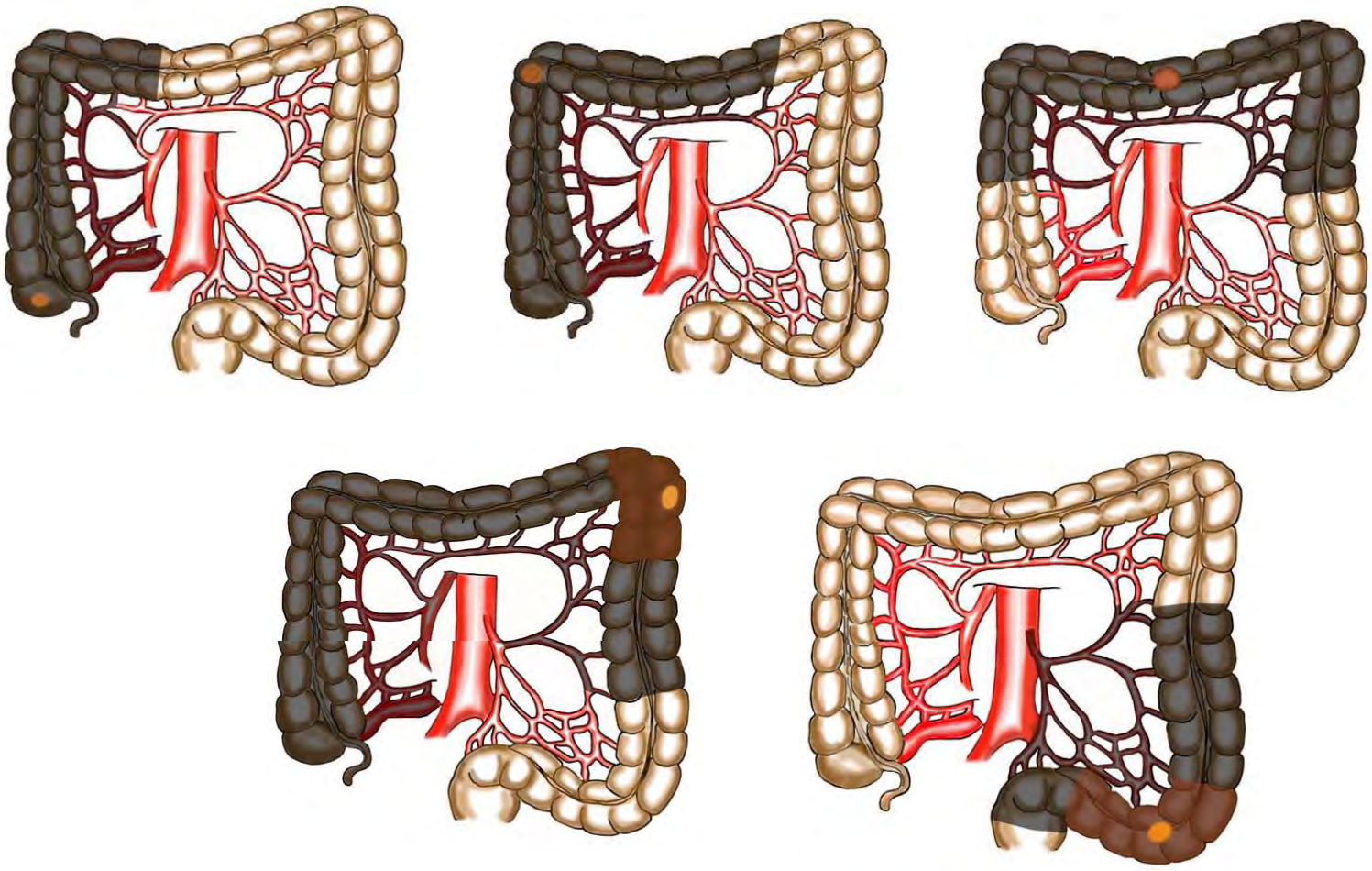
Disposisjon

- Colon cancer
- Rectum cancer
  - Resektabel
  - Lokalavansert (LARC)
  - Lokalt recidiv (LRRC)
- Levermetastaser
- Lungemetastaser
- Peritoneale metastaser

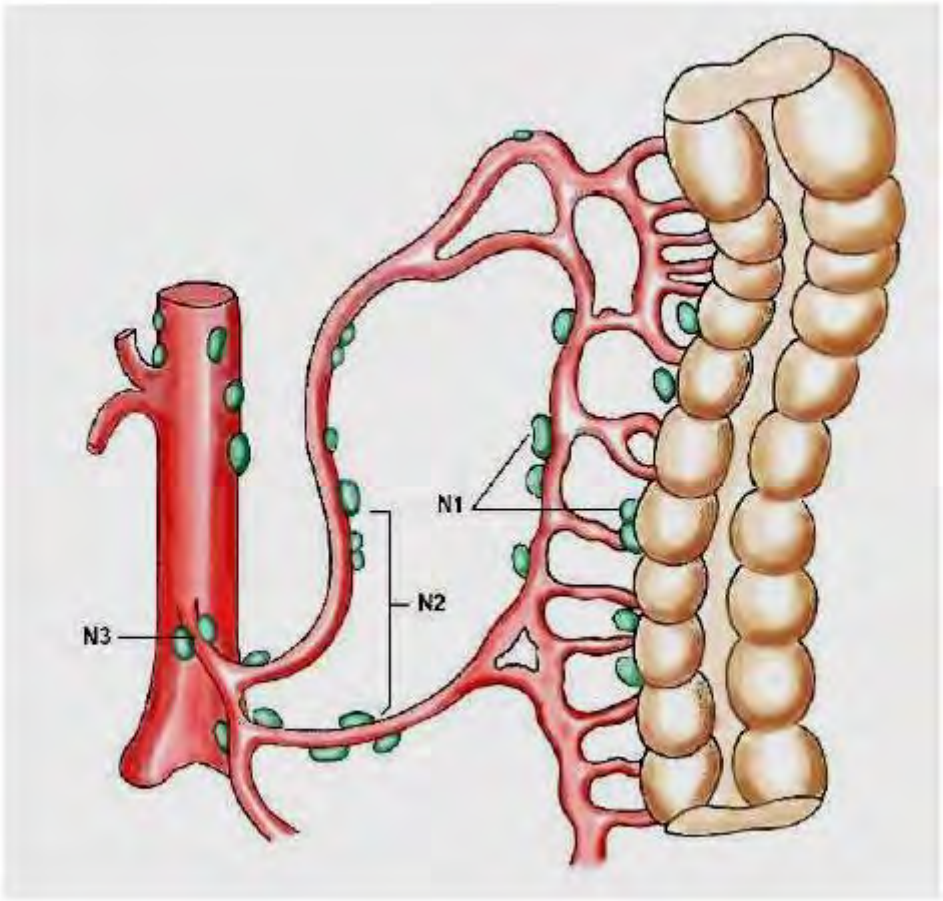
Kolorektal cancer. Diagnose

- Rammer særlig de eldre.
- 10 % er under 55 år.
- 30 % er lokalt voksende (st 1-2), 40 % har lymfeknutemetastaser (st 3), 20 % fjernmet (st 4).
- En del av svulstene er arvelige
- De fleste utvikles fra polypper, men kun 5-10% av polyppene blir maligne.

Tumor lokalisasjon og type reseksjoner



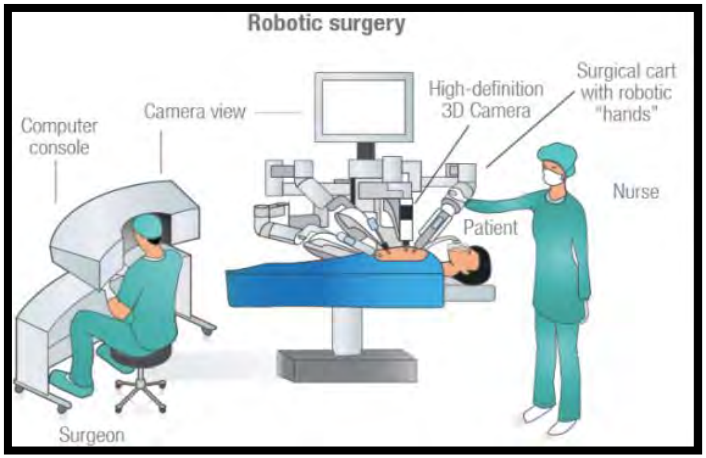
Nivå for lymfeknute fjerning



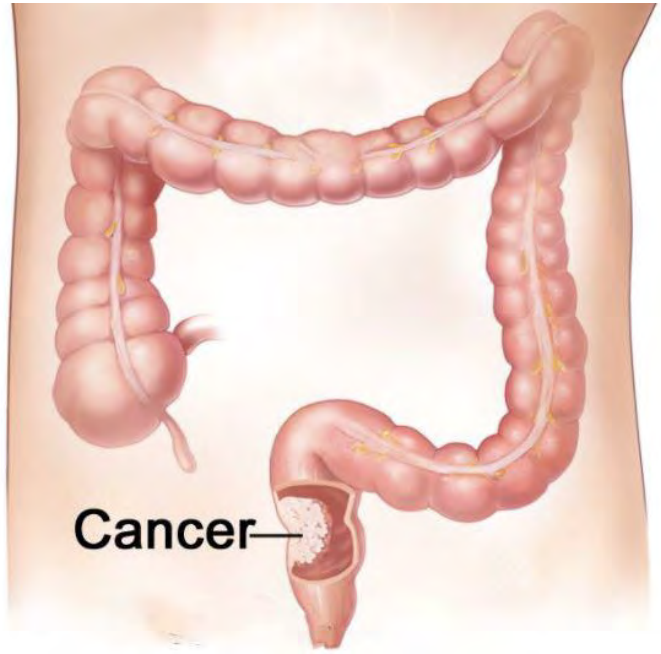
Inngrep colon
(åpen, laparoscopisk eller med robot)

- Høyresidig hemicolectomi
- Venstresidig hemicolectomi
- Transversumreseksjon

  (evt utvidet hø./ eller venstresidig hemicolectomi)
- Sigmoideum reseksjon

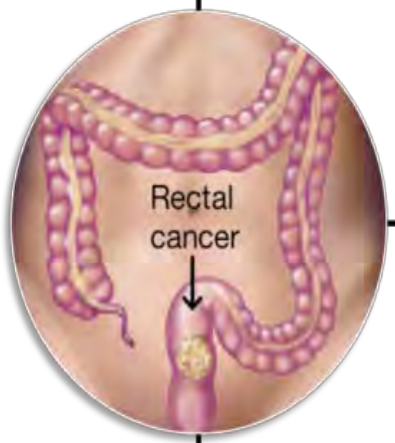


Rectal cancer



Arne M. Solbakken 300322

Rectum cancer

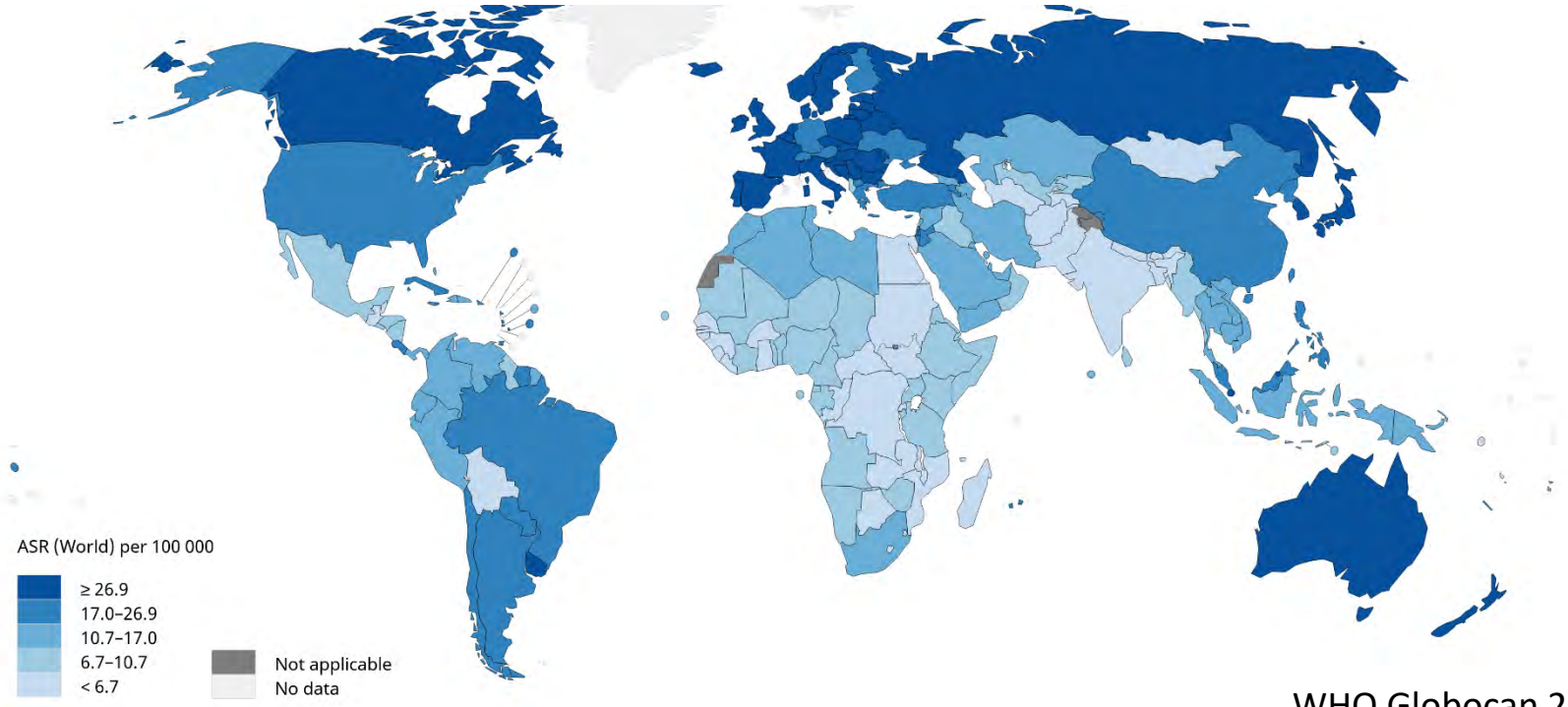


Resectable cases → Standard surgery **TME**

Locally advanced cases **(LARC)** → Chemoradio-therapy → Standard surgery **TME**

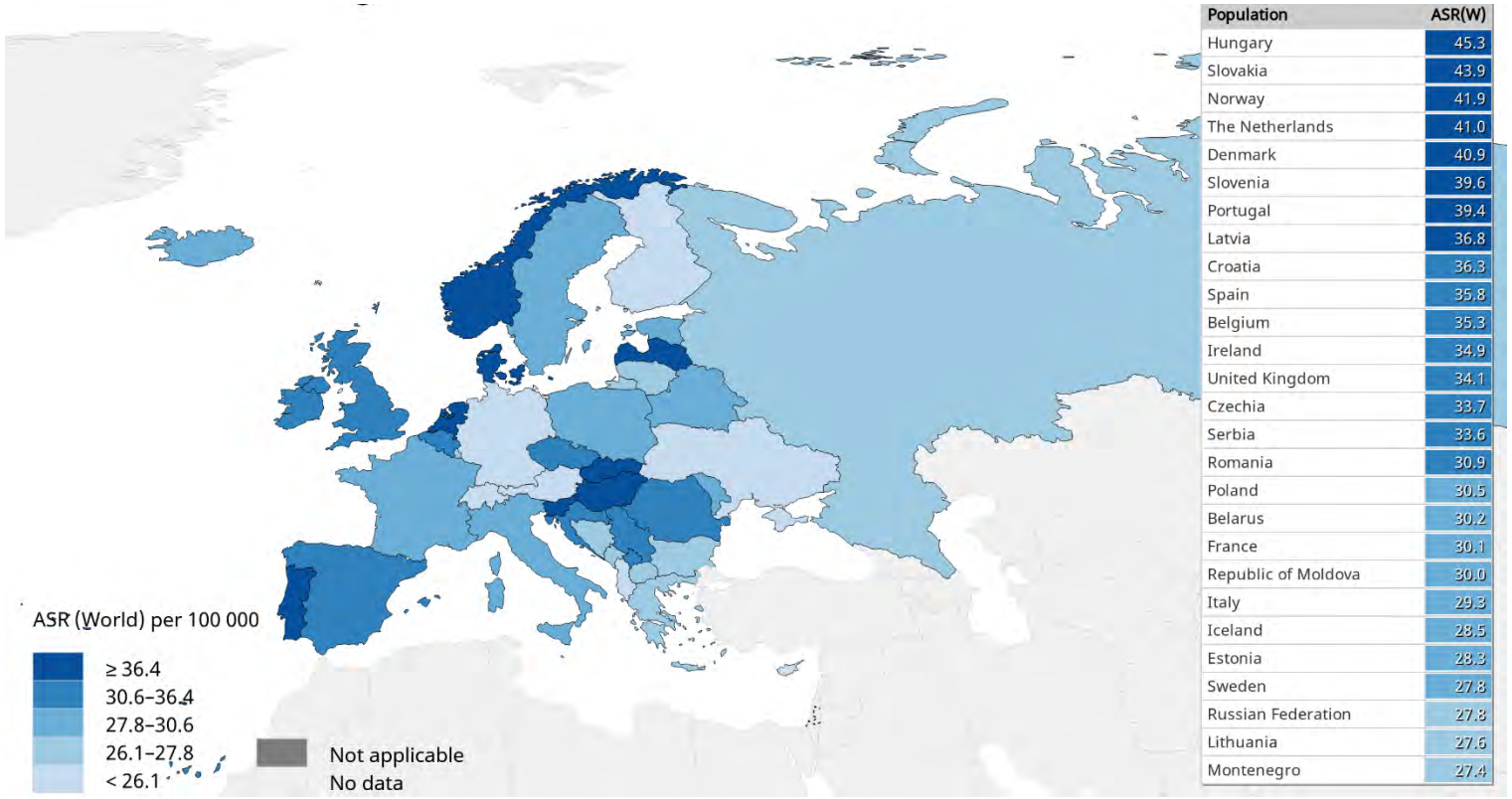
Locally recurrent cases **(LRRC)** → Chemoradio-therapy → Specialized surgery **Beyond TME**

Colorectal cancer incidence 2020



WHO Globocan 2020

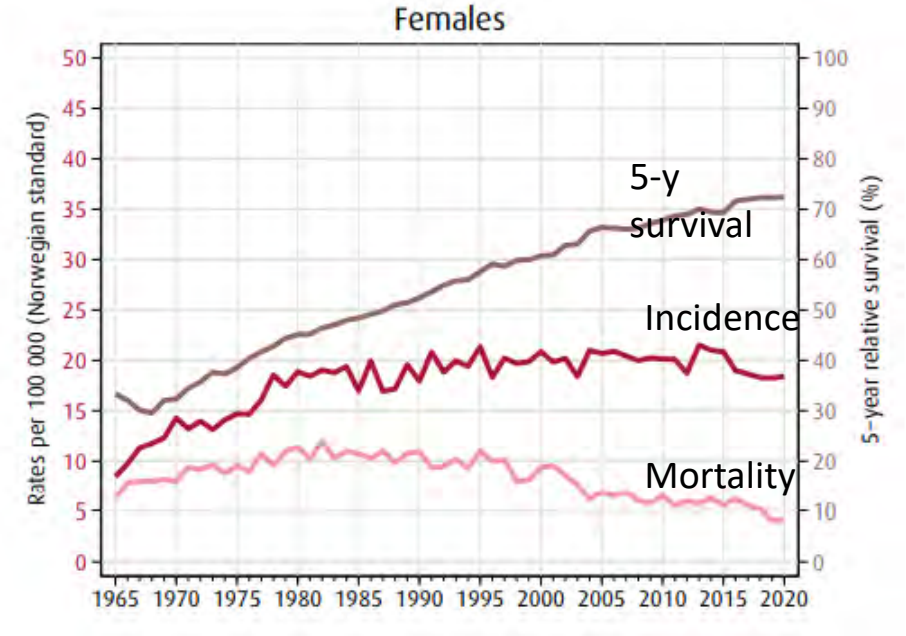
Colorectal cancer incidence Europe 2020 (age-standarized rates)



Population	ASR(W)
Hungary	45.3
Slovakia	43.9
Norway	41.9
The Netherlands	41.0
Denmark	40.9
Slovenia	39.6
Portugal	39.4
Latvia	36.8
Croatia	36.3
Spain	35.8
Belgium	35.3
Ireland	34.9
United Kingdom	34.1
Czechia	33.7
Serbia	33.6
Romania	30.9
Poland	30.5
Belarus	30.2
France	30.1
Republic of Moldova	30.0
Italy	29.3
Iceland	28.5
Estonia	28.3
Sweden	27.8
Russian Federation	27.8
Lithuania	27.6
Montenegro	27.4

WHO Globocan 2020

Rectal cancer trends in Norway
Incidence, mortality and 5-year relativ survival



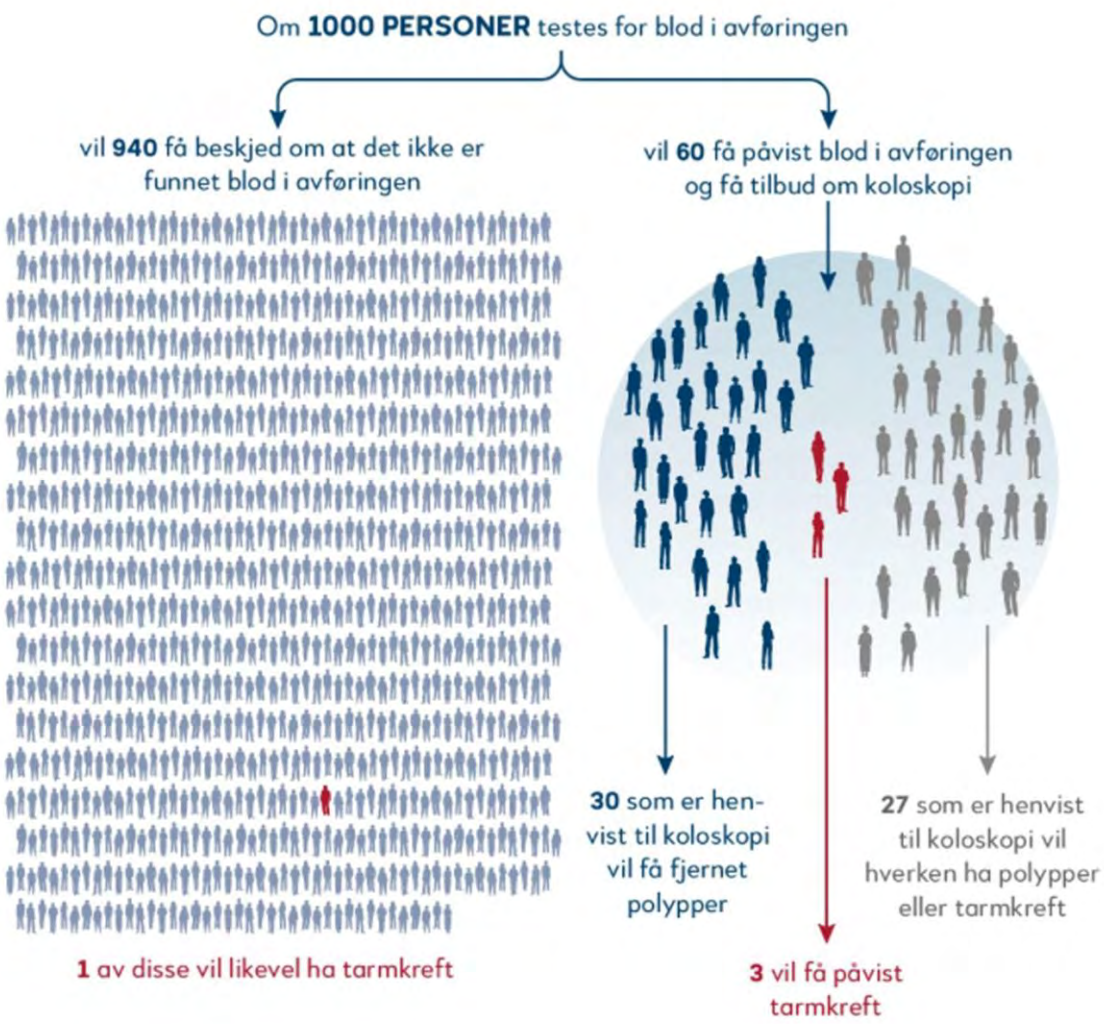
5-y rel. survival after diagnosis: 73 %

5-y rel. survival after operation: 89%

Cancer in Norway 2020

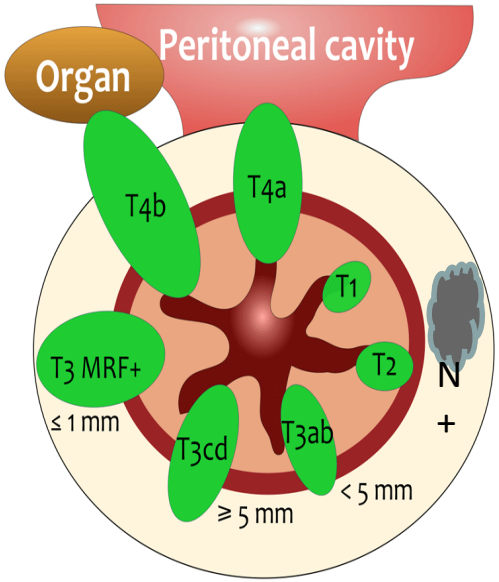
Screening for rectal cancer

- American Cancer Society
  - from 45 years
- Norway 2022
  - from 55 years
    - Fecal occult blood test x !
    - Colonoscopy if pos.
    - In the long run: Colonosc



Cancer in Norway 2020

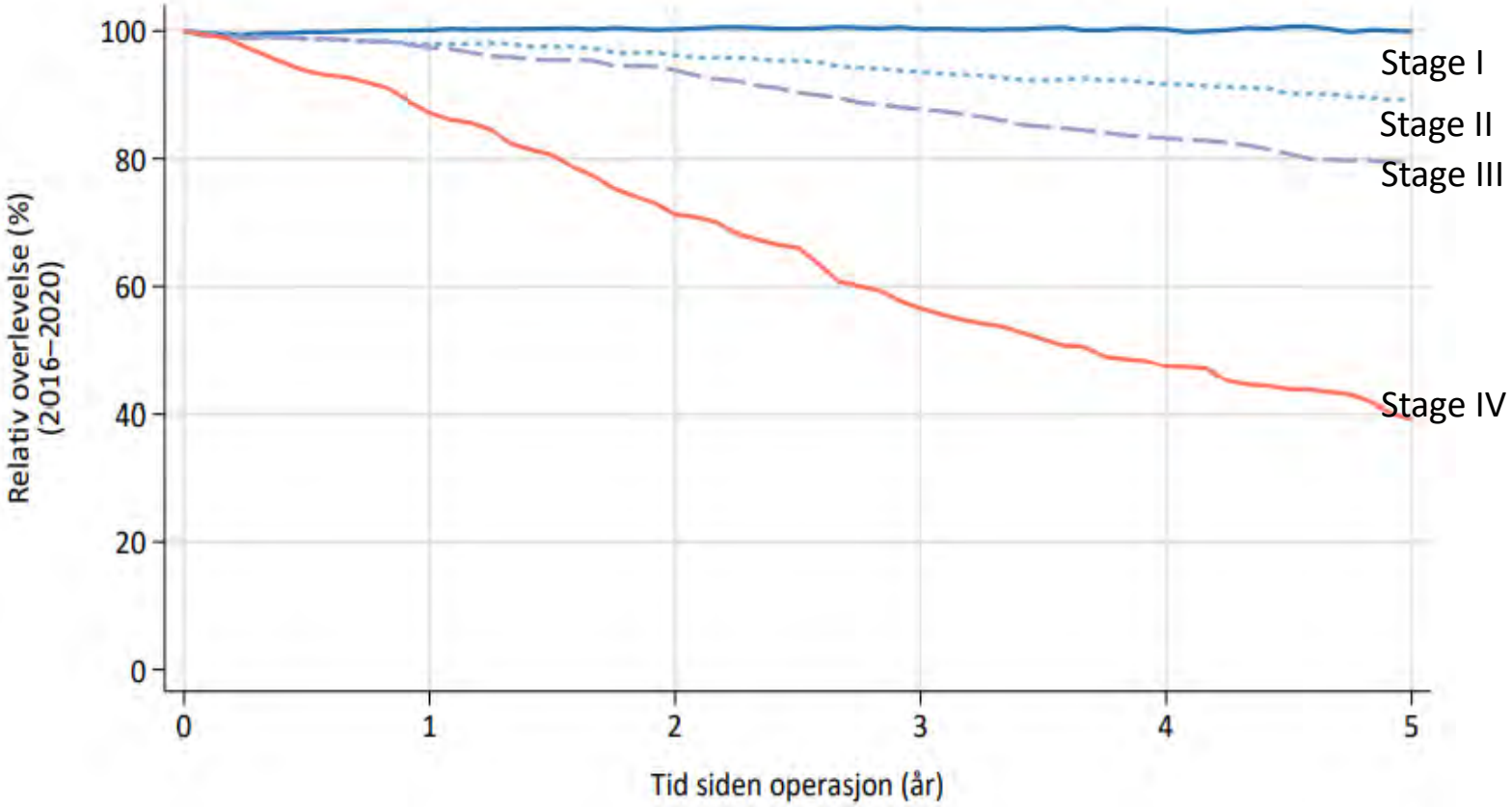
Rectal cancer AJCC stages



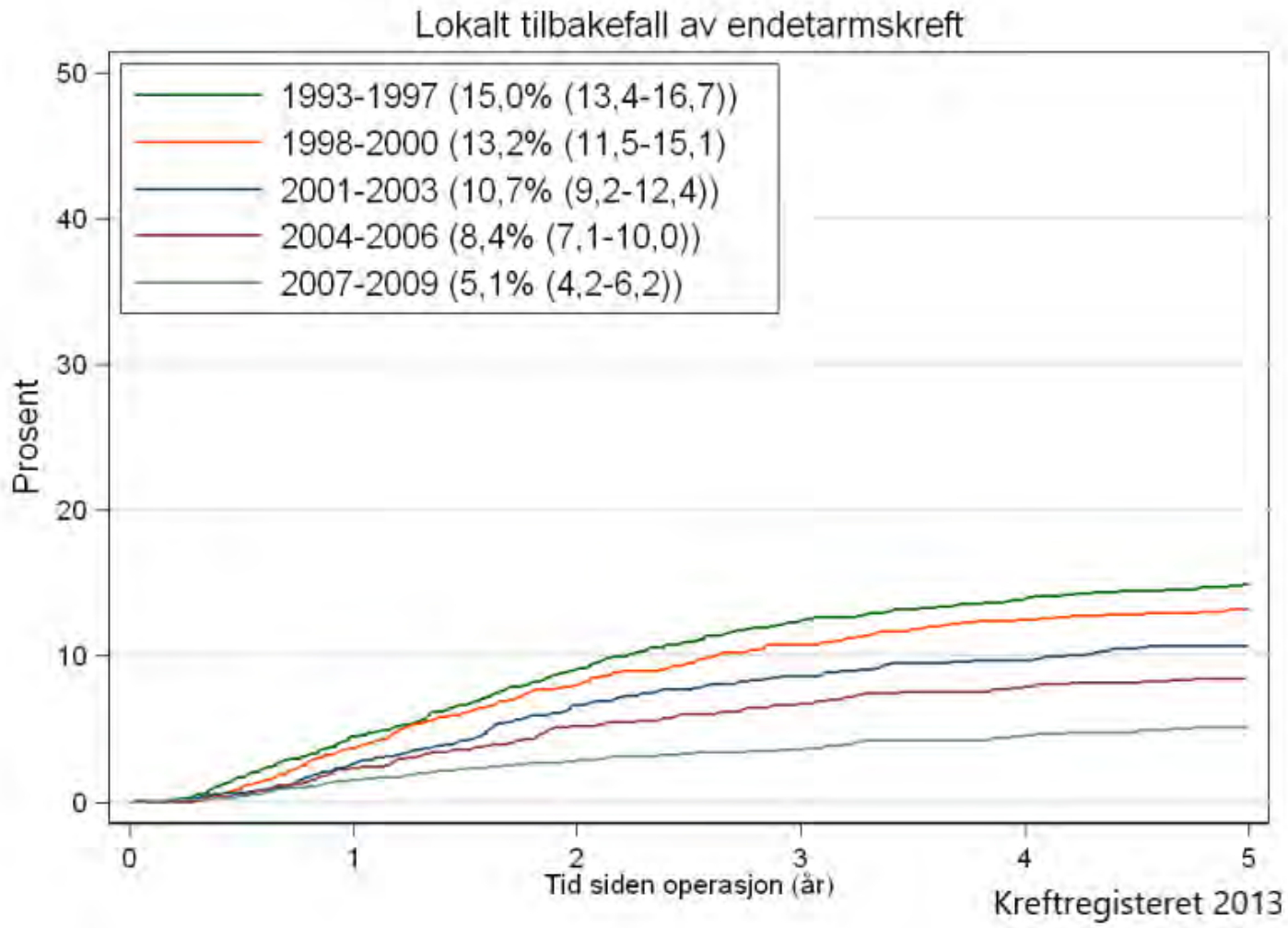
0	Tis	N0	M0
I	T1-T2		
IIA	T3		
IIB	T4a		
IIC	T4b		
IIIA	T1-T2	N1/N1c	
	T1	N2a	
IIIB	T3-T4a	N1/N1c	
	T2-T3	N2a	
	T1-T2	N2b	
IIIC	T4a	N2a	
	T3-T4a	N2b	
	T4b	N1-N2	
IVA	Any T	Any N	M1a
IVB			M1b
IVC			M1c

Source: *AJCC Cancer Staging Manual*, 8th edition. Springer International Publishing, 2017.

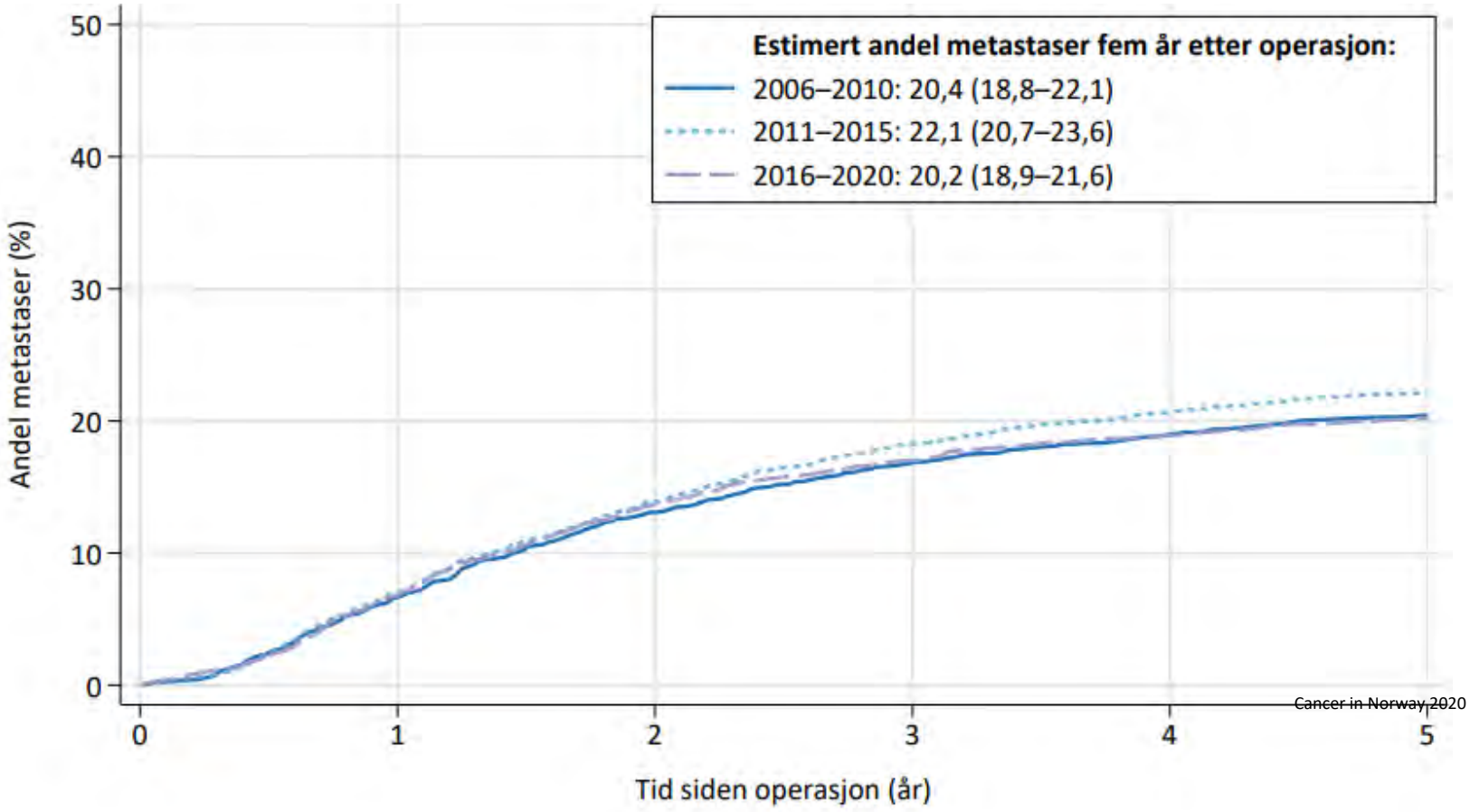
Rectal cancer stages and prognosis (operated patients)



Kontroll med lokale residiver

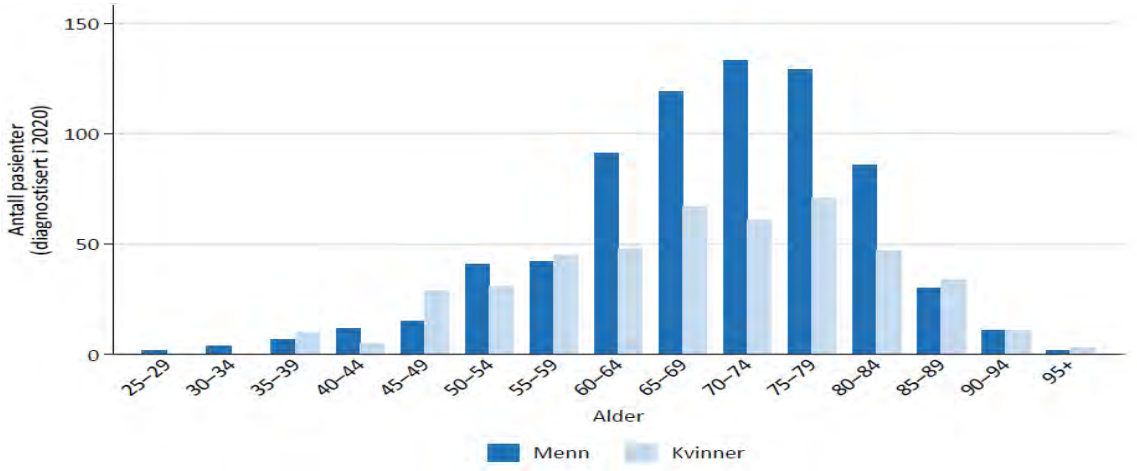


Hva med metastasene?



Inngrep rectum

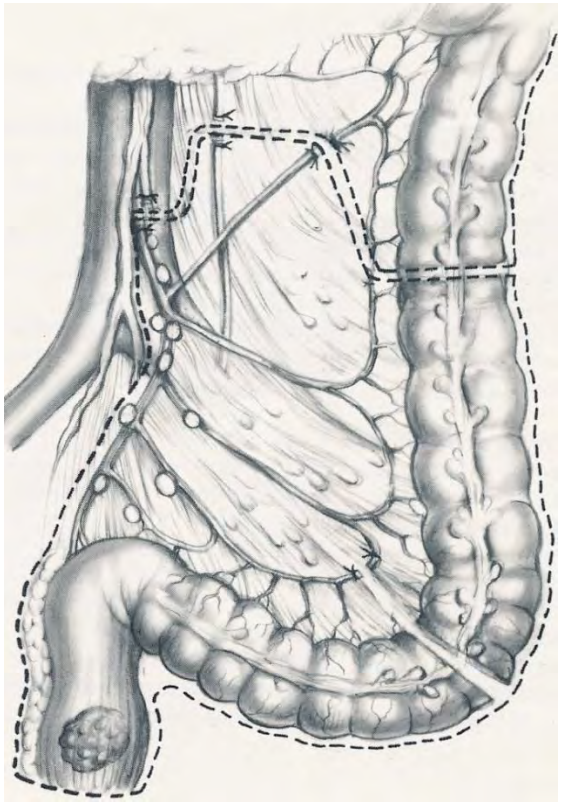
- Kirurgi utføres med TME-teknikk (total mesorectal excisjon) og ved omfattende sykdom evt. utenfor dette planet (beyond-TME (bTME) eller en-bloc reseksjon
- LFR= lav fremre rectum reseksjon
- Hartmann's operasjon = (stomi + anus inntakt)
- APR= abdominoperineal rectumamputasjon

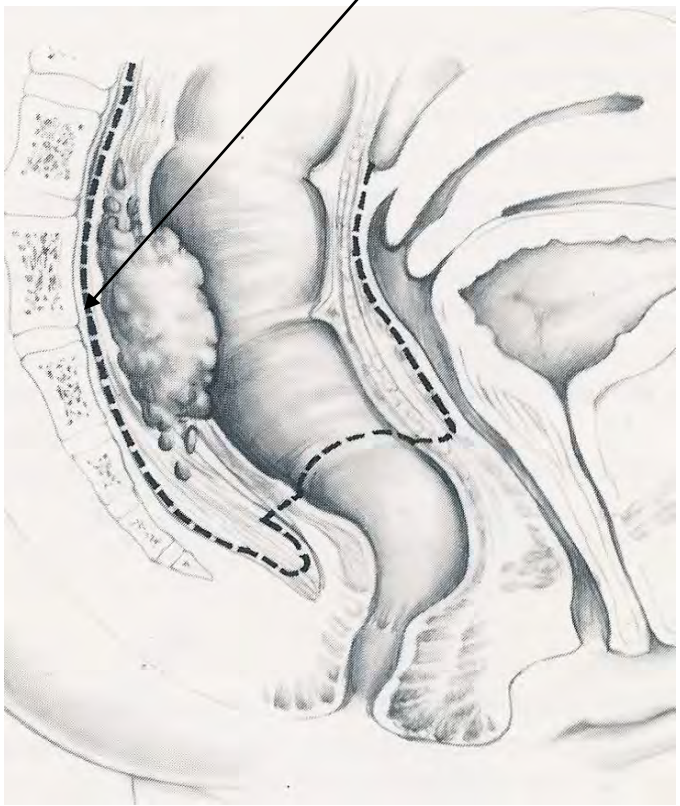


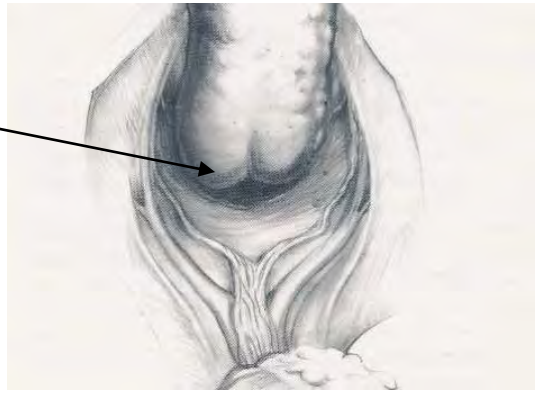
Endetarms kreft i Norge etter 1993.

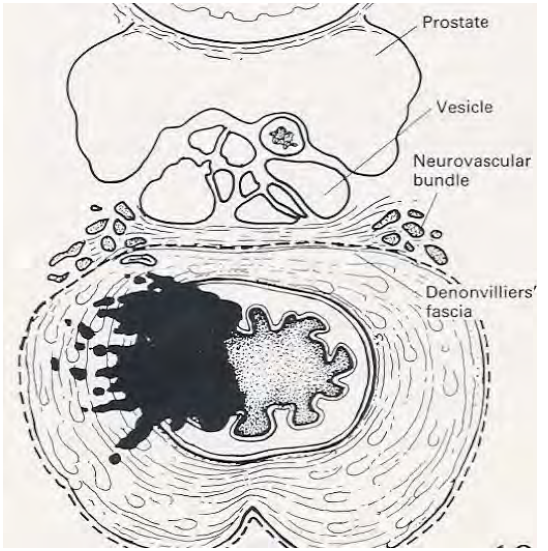
- Innføring av TME(total mesorectal excisjon)
- Utviklet av R J Heald, Basingstoke, publ. 1982.
- Kirurgi i ”nye” anatomiske plan.
- Teknikken er innført i Norge og Sverige fra 1993. Seinere i andre land.
- **Økt volum** (fra 54 sykehus i 1993 til 25 nå).
- **Spesialisering** (knyttet til gastrokirurgene – elektivt)
- **Bedre resultat.** Fjernspredning og lokale tilbakefall

TME (total mesorectal excisjon)
Fra 28% recidiv rate i 1988 til 5 % i Norge i 2000

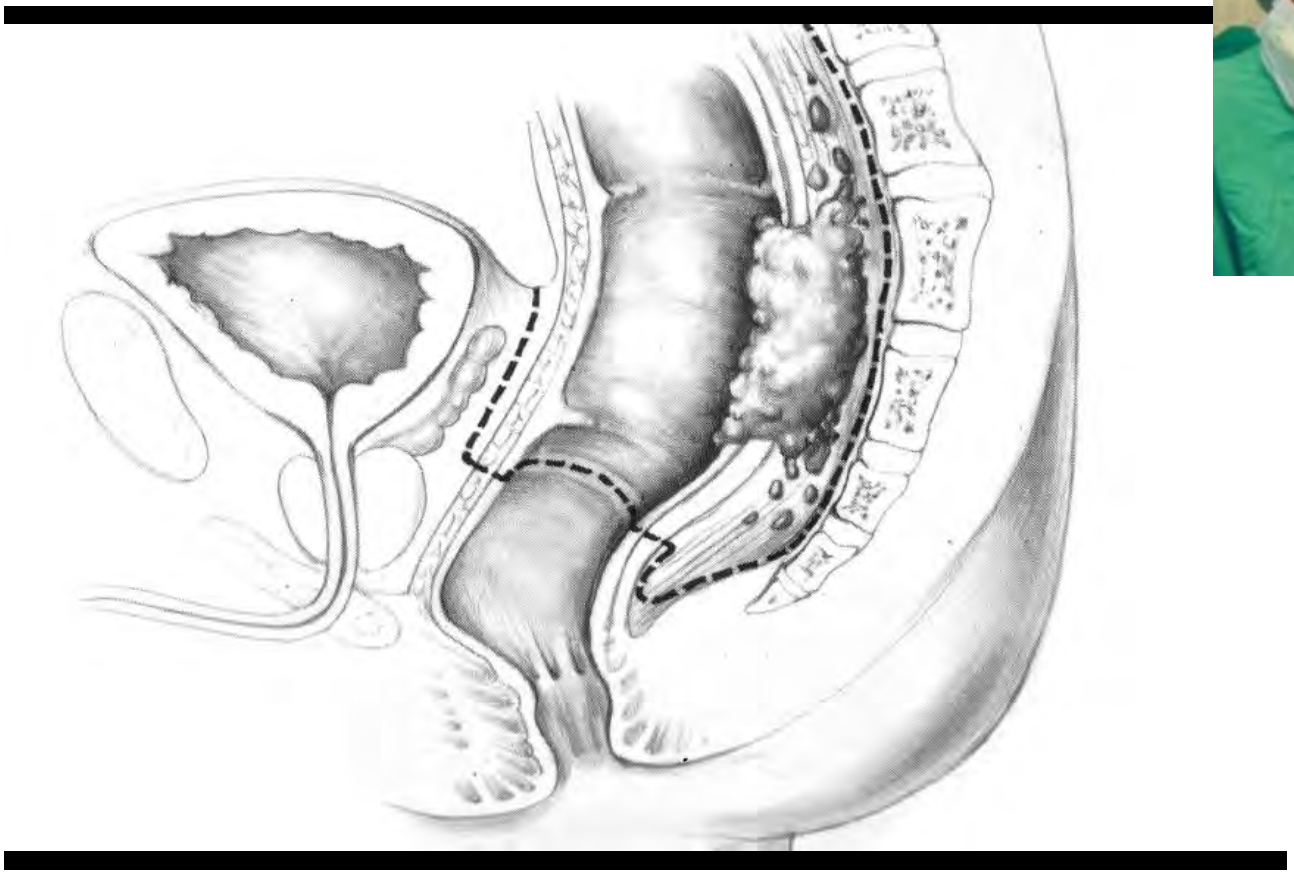






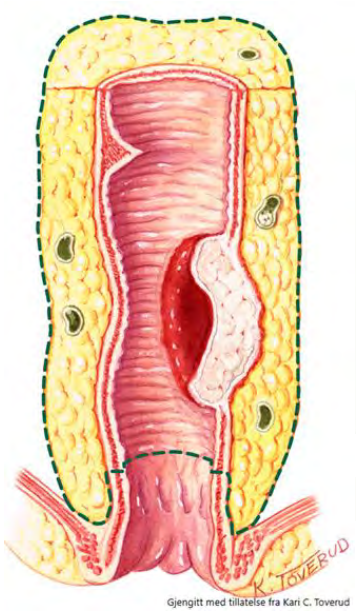


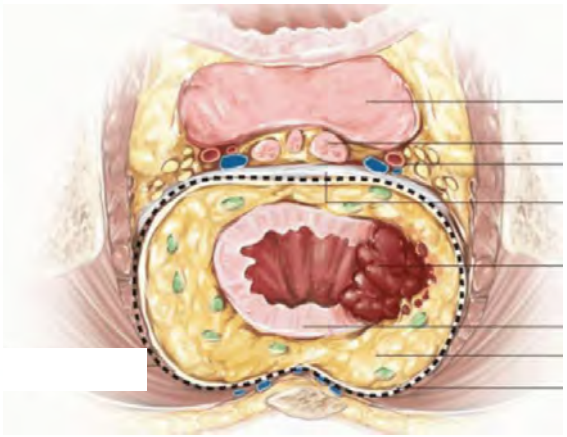
TME[1]: Healds “holy plane”

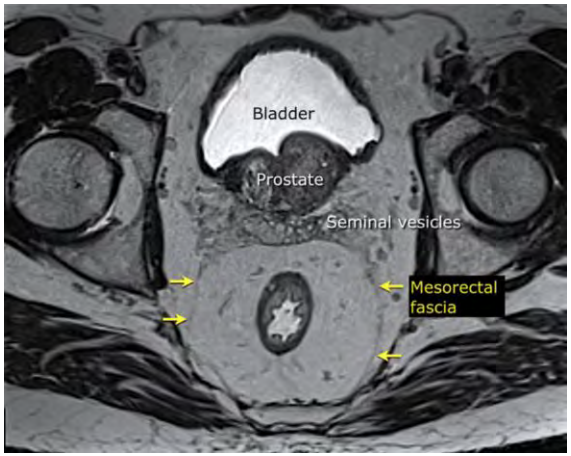


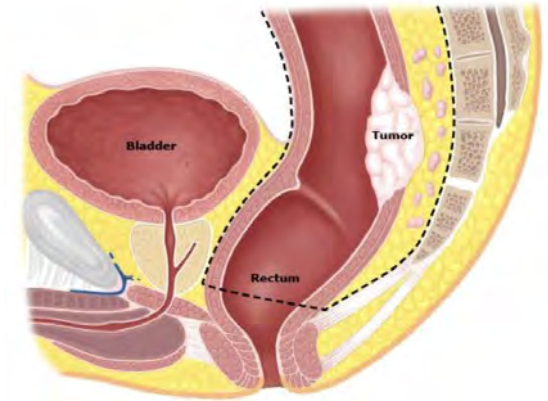
TME: Total mesorectal excisjon. Heald, Lancet 1986. Recidivrate 4%.

Anatomy - the mesorectal fascia (MRF)







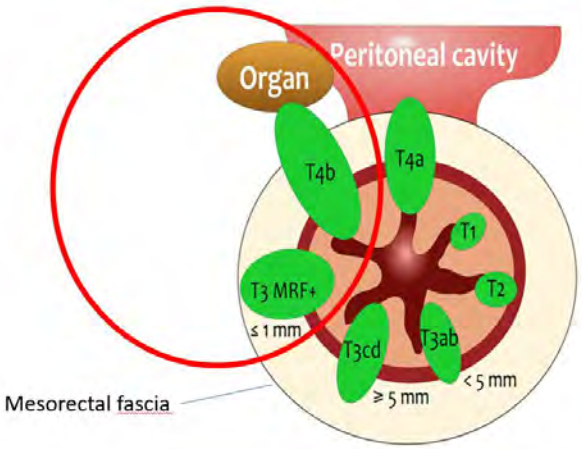


Man kan leve som man vil med stomi

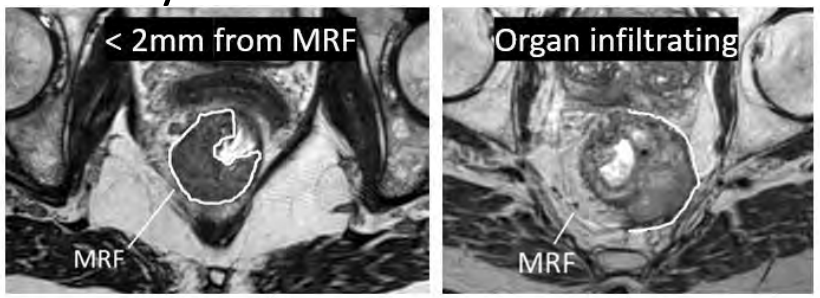
Slik tar Charlotte (24) oppgjør med stomi-tabuet (VG 06.11.16)

-kontaktidrett
-samliv
-turer
-svømming
-badstu

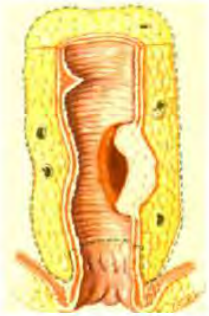
Treatment options depend on the tumours relations to the mesorectal fascia



Primary non- resectable rectal cancer

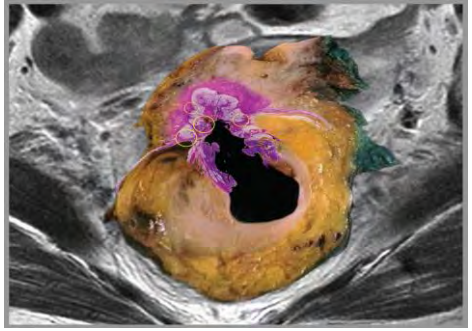


TME

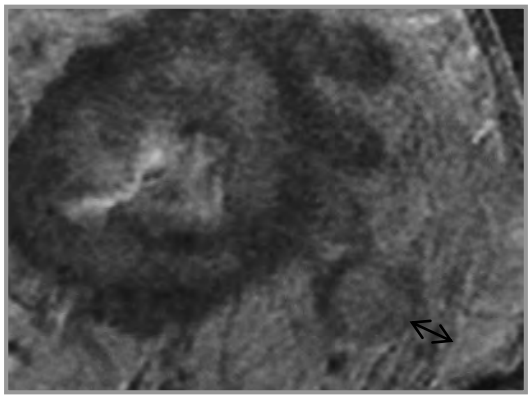


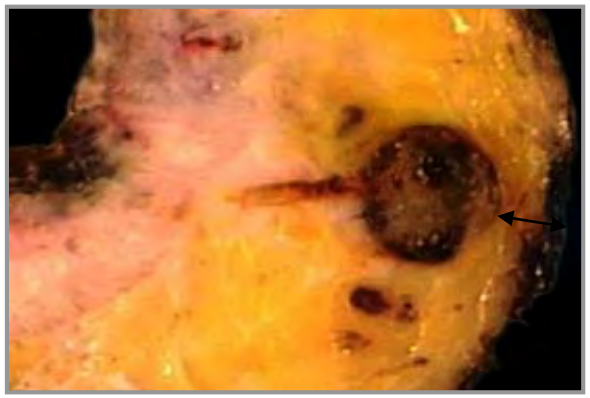
Beyond TME surgery
Radium Hospital: ~ 100/year

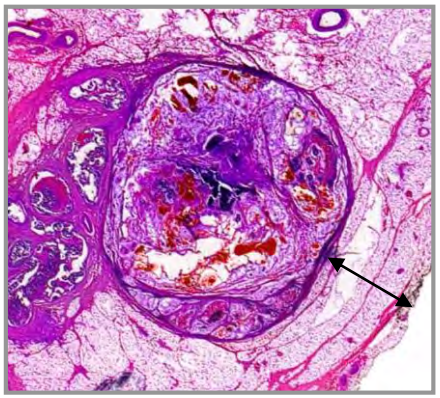
Lokalavanser rectum cancer (LARC)



- 10%–20% har en primært inoperabel svulst pga fiksasjon i bekkenet eller innvekst i andre strukturer/ organer) (Pahlman 1985)
- 1/3 av cancer recti pasientene har truede utre marginer ved < 2 mm avstand til CRM)
- Preoperativ MR er den beste undersøkelsen for å vurdere de lokale forhold i bekkenet (MERCURY study group 2006 and 2007; Beets-Tan 2005)

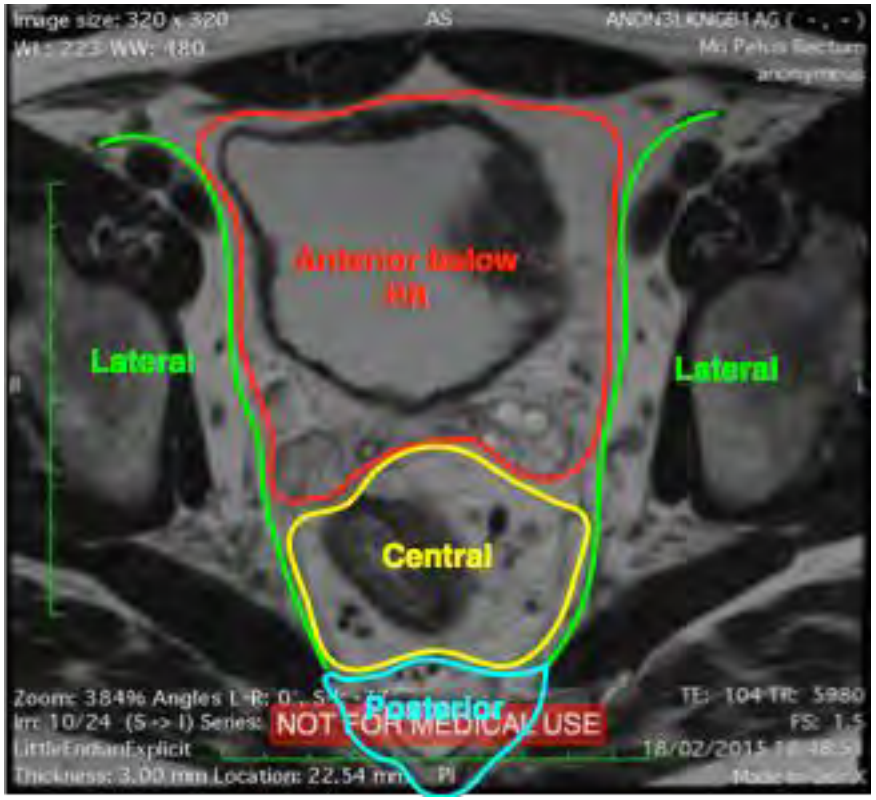


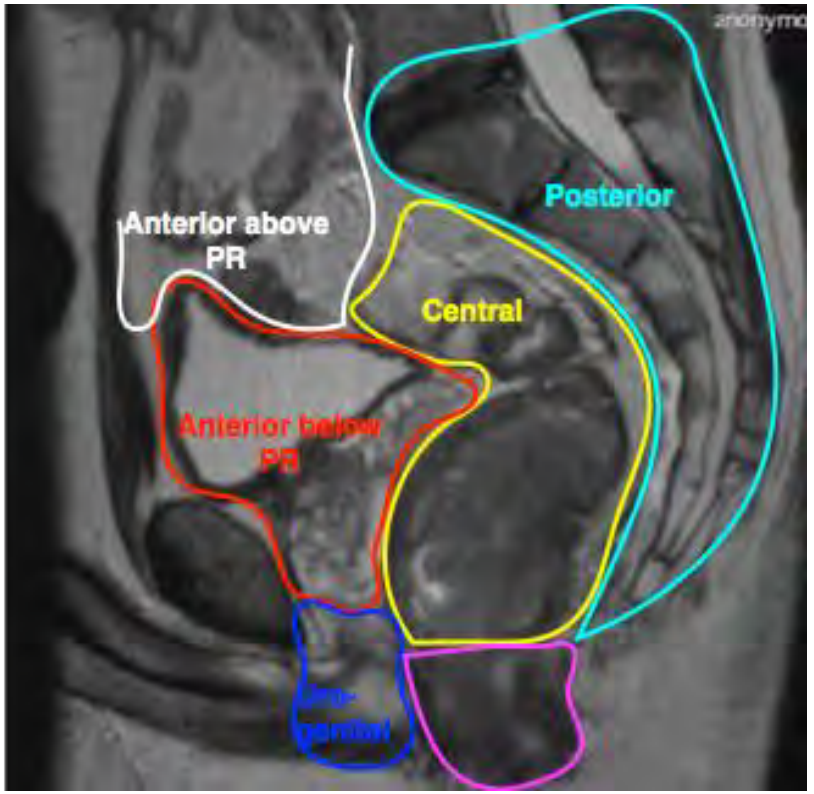


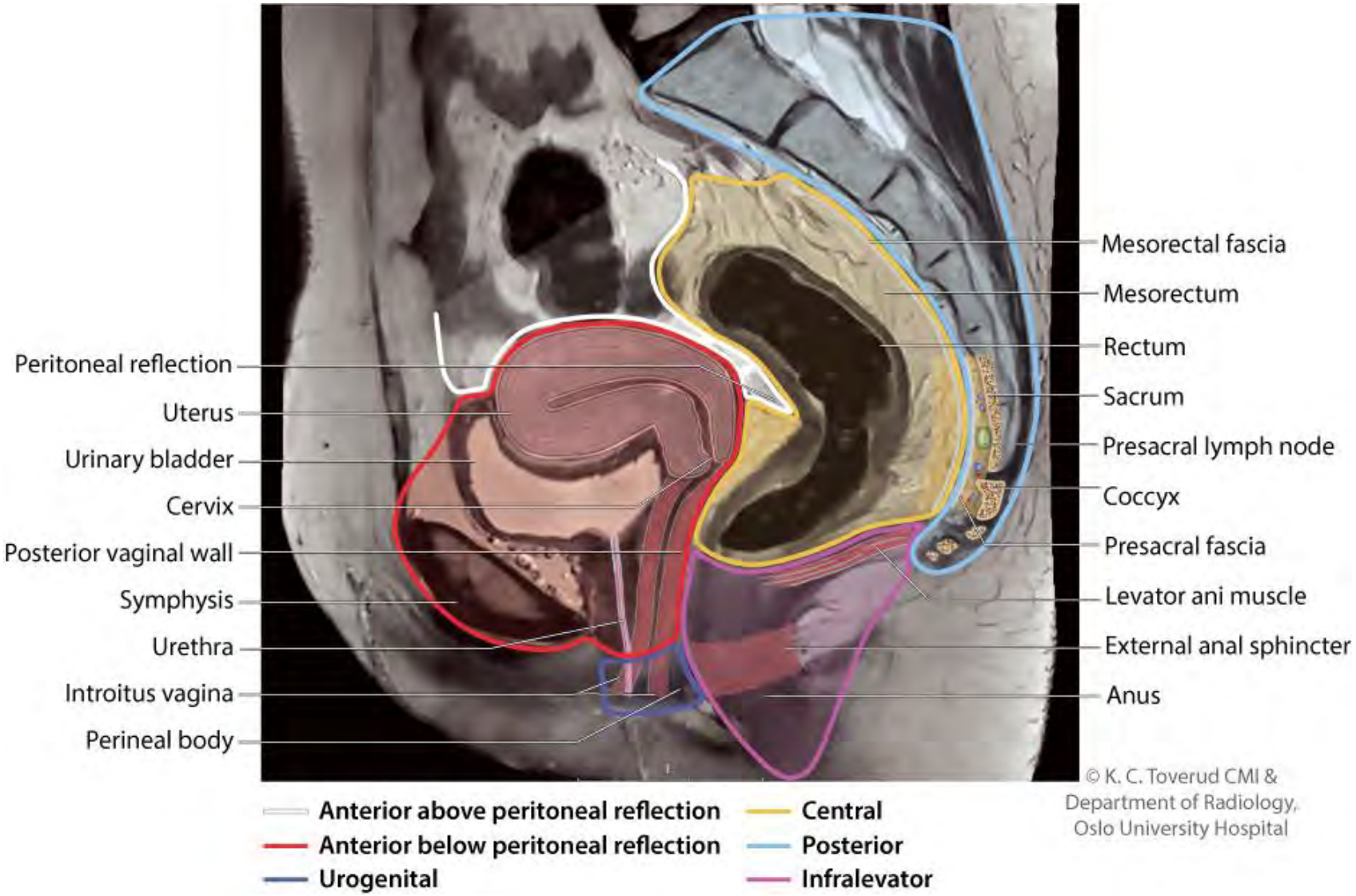


CRM

bTME = tumorvekst utenfor mesorectum






Peritoneal reflection
Uterus
Urinary bladder
Cervix
Posterior vaginal wall
Symphysis
Urethra
Introitus vagina
Perineal body
Mesorectal fascia
Mesorectum
Rectum
Sacrum
Presacral lymph node
Coccyx
Presacral fascia
Levator ani muscle
External anal sphincter
Anus
Anterior above peritoneal reflection
Anterior below peritoneal reflection
Urogenital
Central
Posterior
Infralevator
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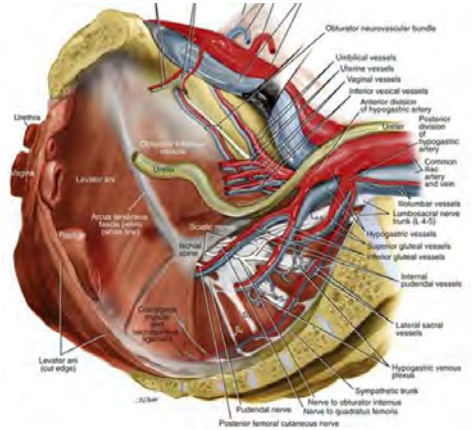
Department of Radiology,
Oslo University Hospital

Beyond TME

Into the presacral and pelvic sidewall fascia



Pelvic inlet
- Peritoneum
- Ureters
- Hypogastric nerves

Anterior
- Urinary bladder
- Vesicoureteric junction
- Pubic symphysis
- Adnex
- Uterus
- Vagina
- Denonvilliers fascia
- Ductus deferens
- Seminal vesicles
- Prostate
- Neurovascular bundle
- Urethra

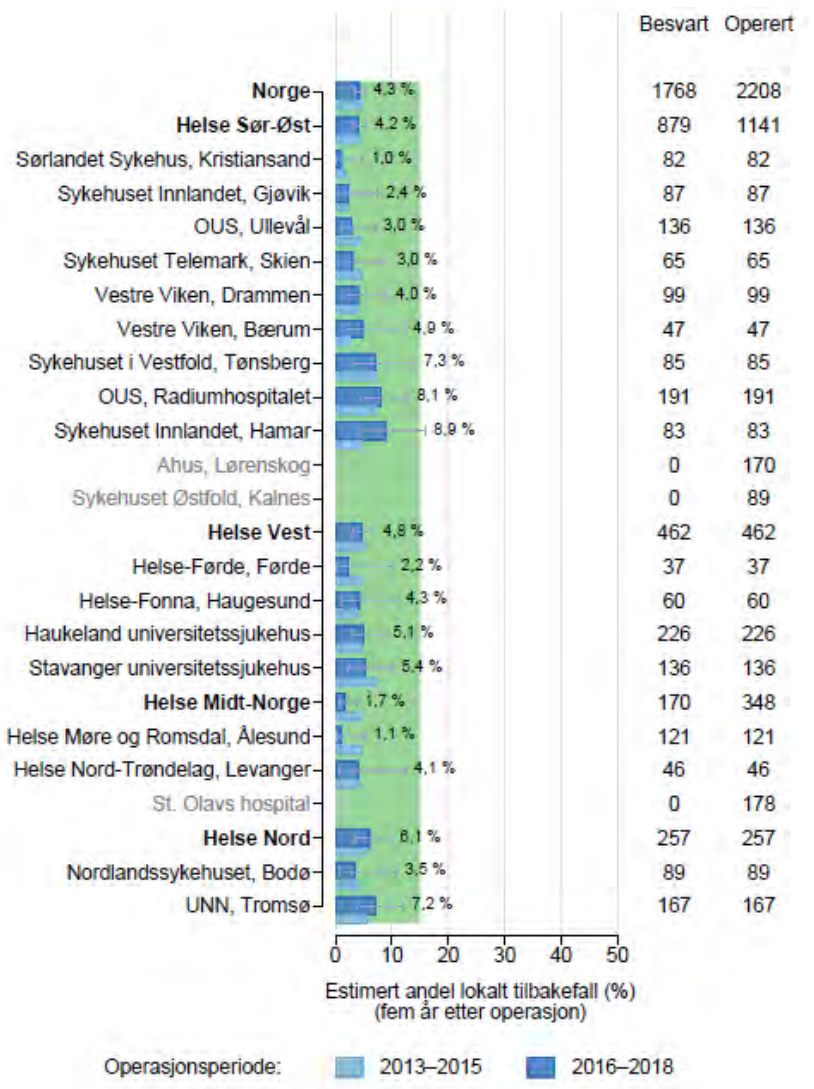
R0?

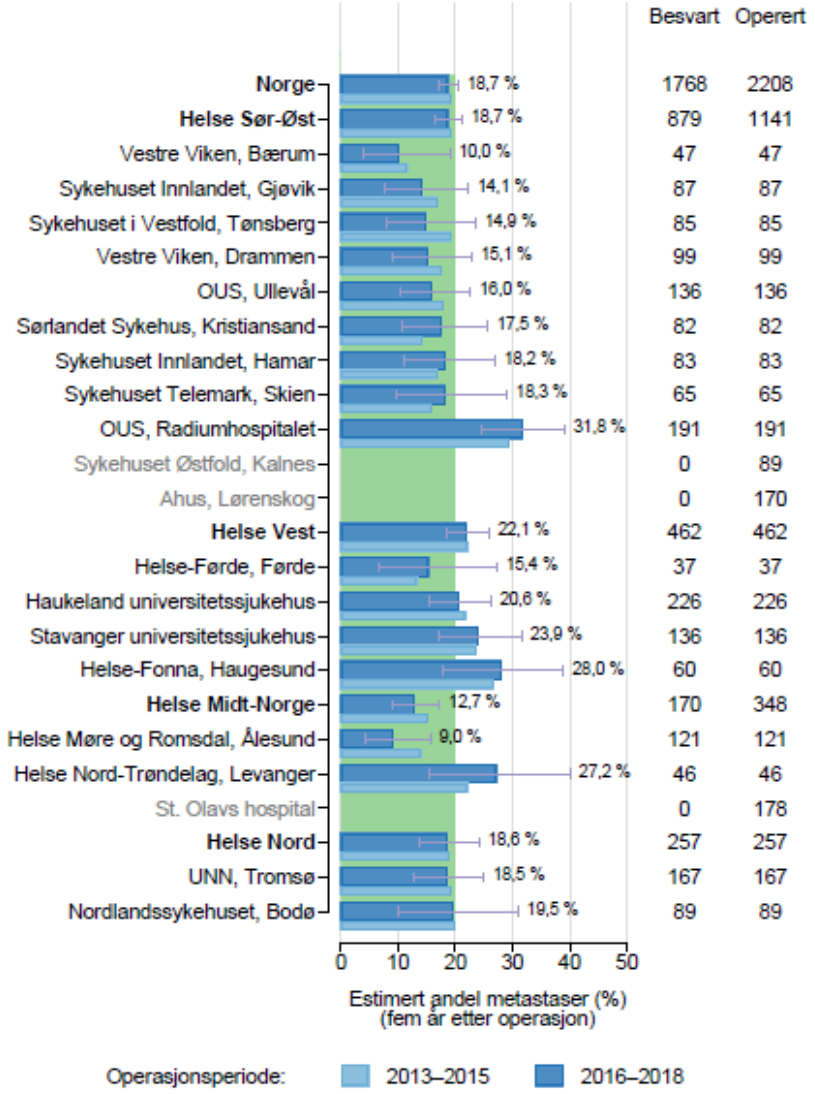
Lateral
- «Lateral ligaments»
- Rectalis media kar
- Pelvic sidewall fascia
  - Common iliac vessels
  - External iliac vessels
  - Internal iliac vessels
    - Lymph nodes
    - Obturatur nerve
- Piriformis muscle
- Coccygeal muscle
- Sacrospinal ligament
- Sacrotuberous ligament
- Internal obturator muscle
- Sciatic spine

Dorsal
- Presacral fascia
- Presacrale vener
- Sacrum
- Sciatic nerve
  - L5 nerve root
  - S1 nerve root
  - S2 nerve root
  - S3 nerve root
- Coccyx

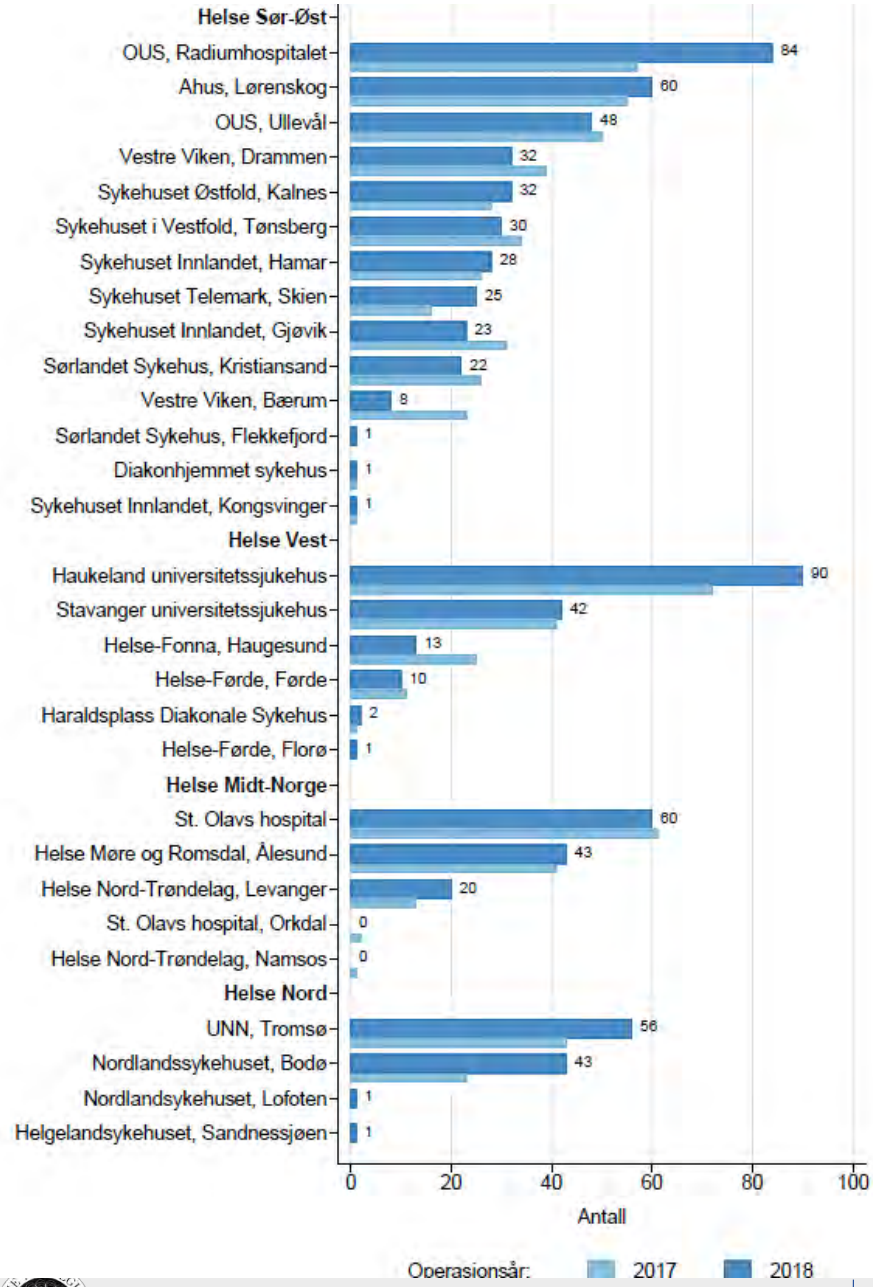
Distal
- Levator ani muscles
- Ischioanal fossa/fat
- External sphincter complex
- Urogenital diaphragm
- Penis / clitoris

Årsrapport 2018, lokale residiv og metastaser





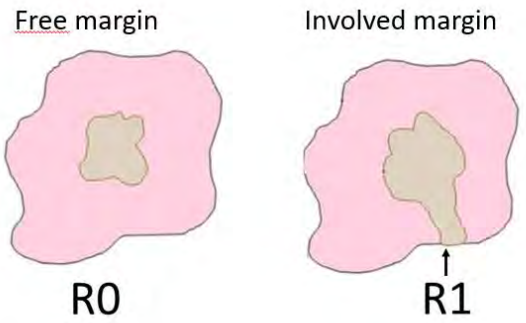
Økt sentralisering av avansert kirurgi

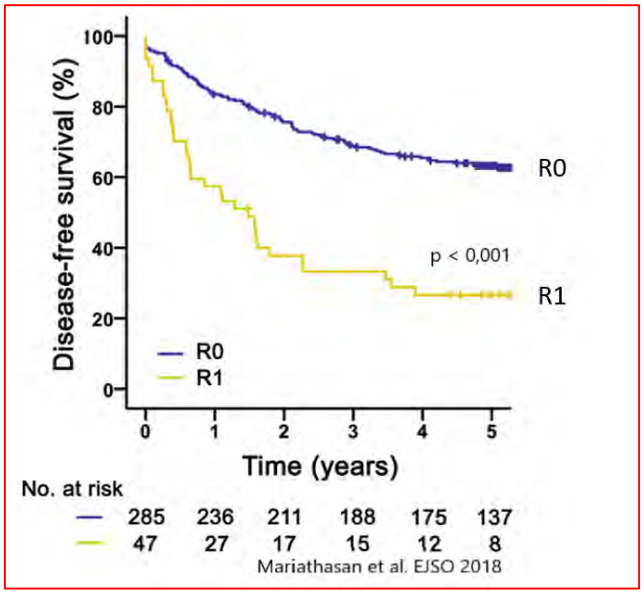


Treatment

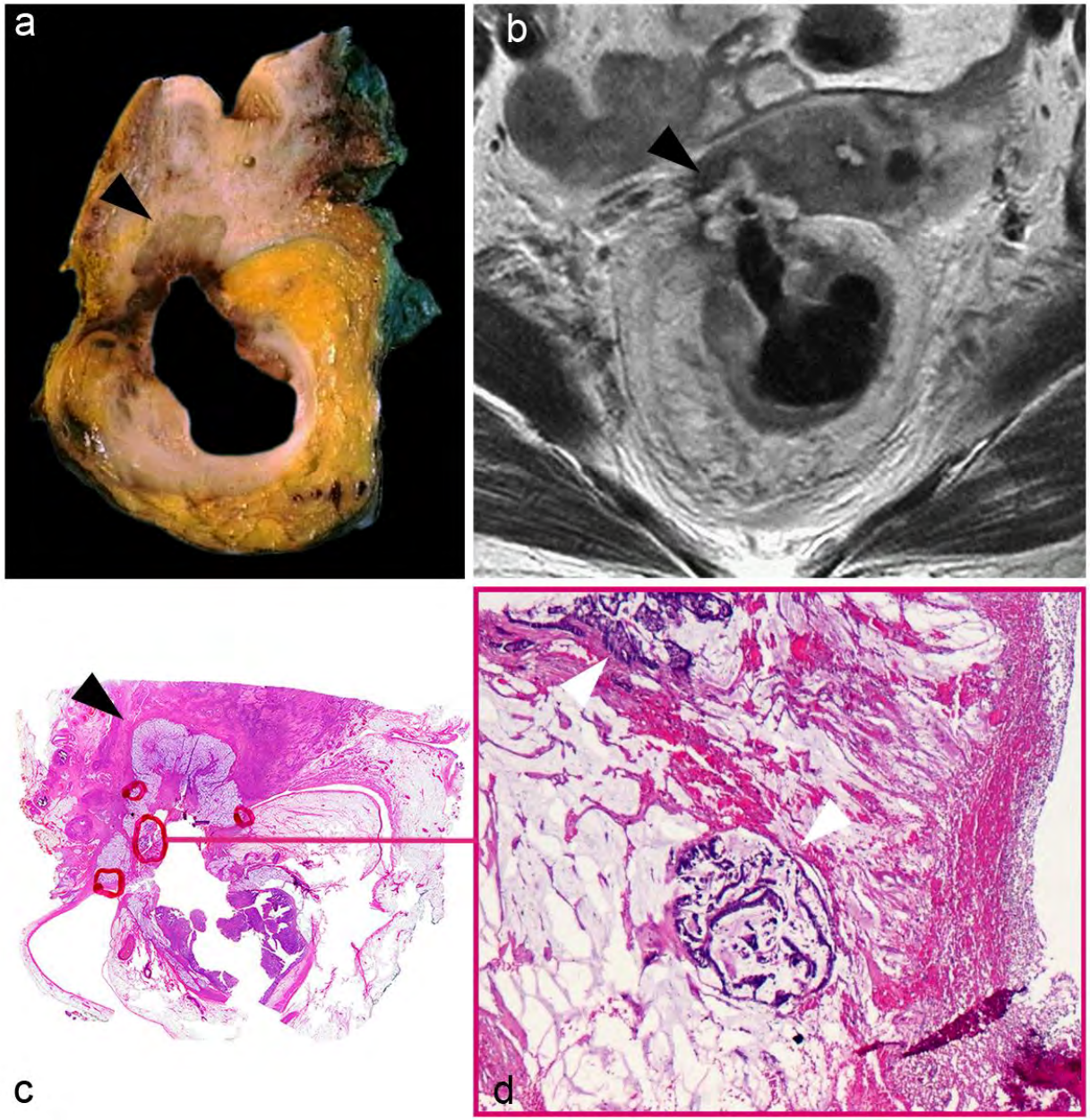
Pre-operative oncological treatment
for some to increase chances of R0

- Primary resectable rectal cancer
- Primary non-resectabel rectal cancer



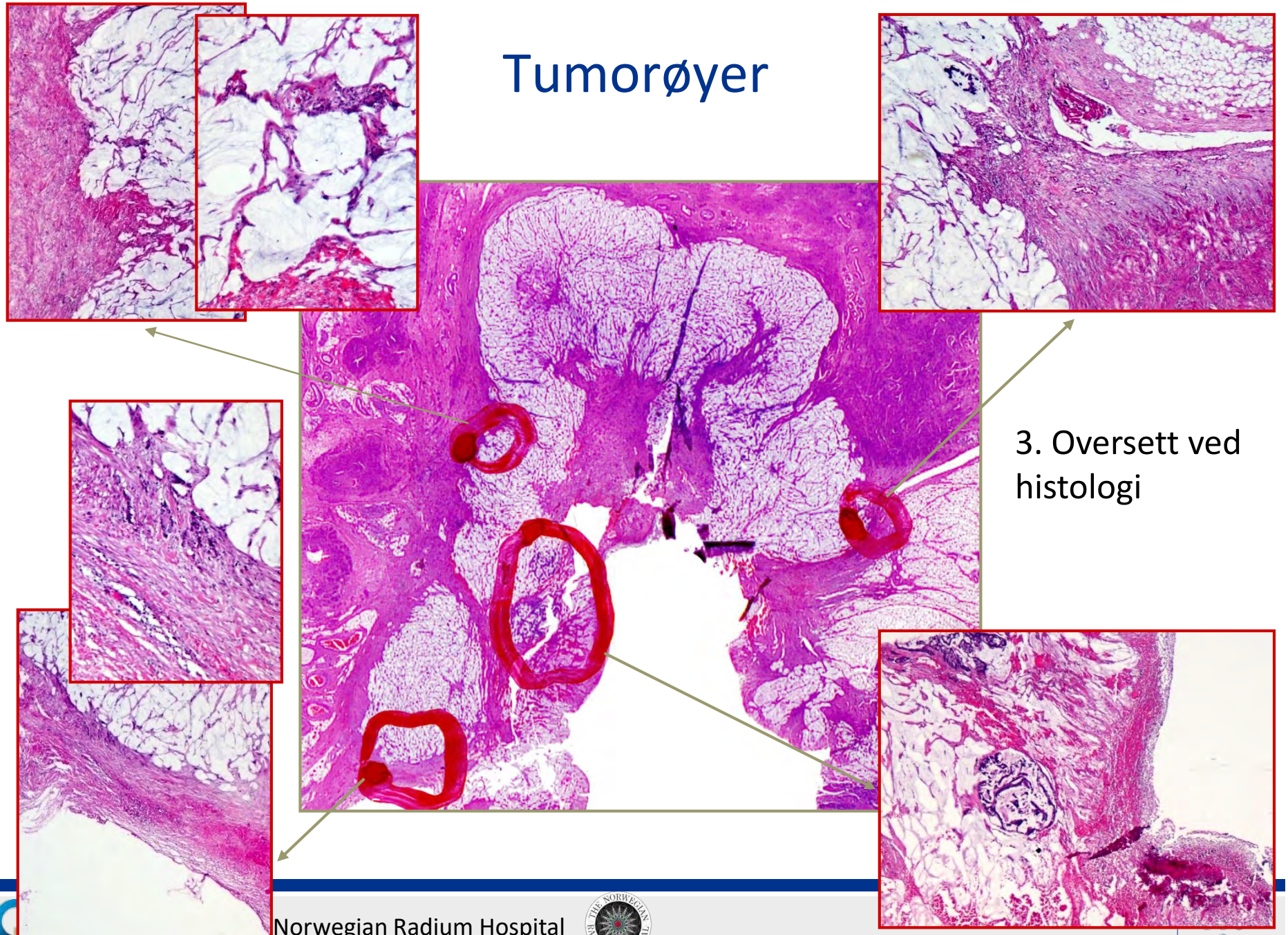


Tumour infiltration in adjacent organs



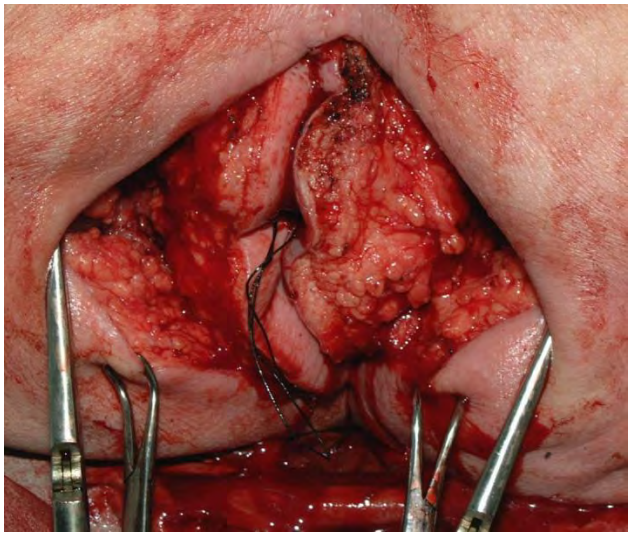
Tumour islets within mucinous infiltration (black arrowheads) of the uterine cervical stroma. (a) Resection specimen slice. (b) Corresponding transversal T2-weighted MRI obtained after radiation theraphy. (c) Corresponding whole-mount histology (haematoxyline and eosine stained). Four islets of tumour where present (red circles). (d) Original magnification x 25 of the largest tumour deposits (white arrowhead).

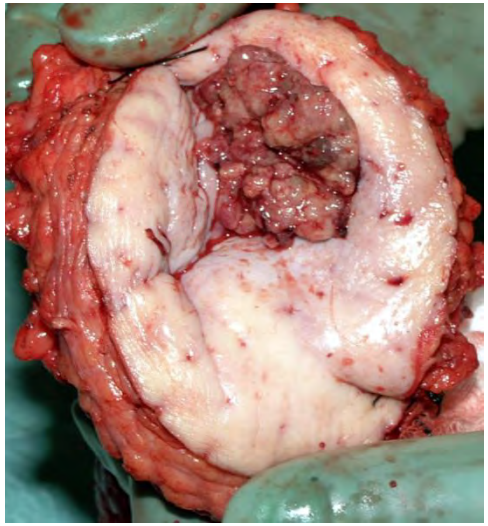
Tumorøyer

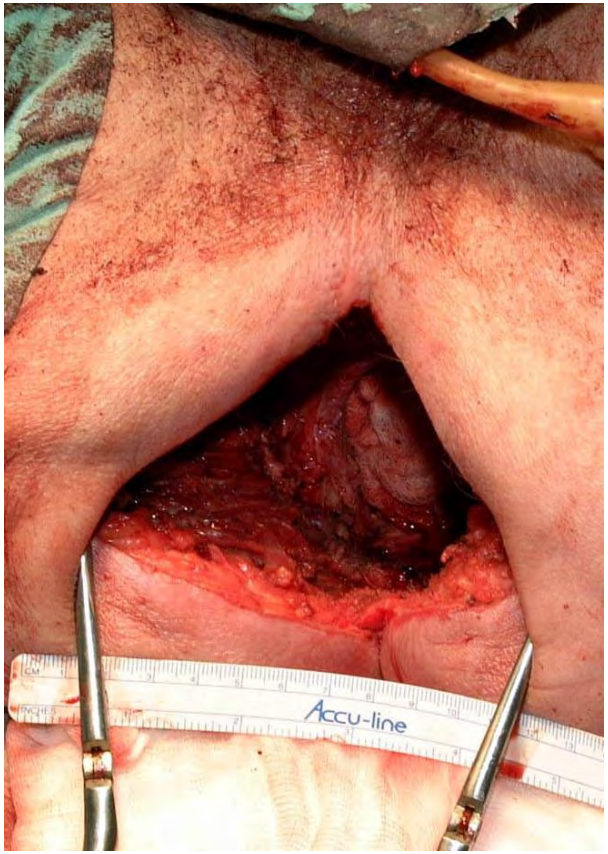


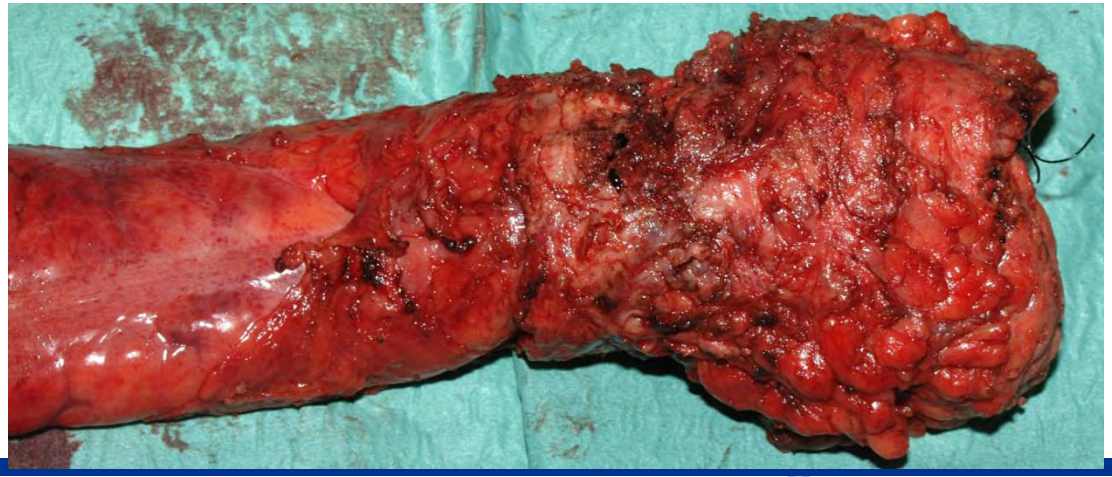
3. Oversett ved histologi

Vevsdefekter



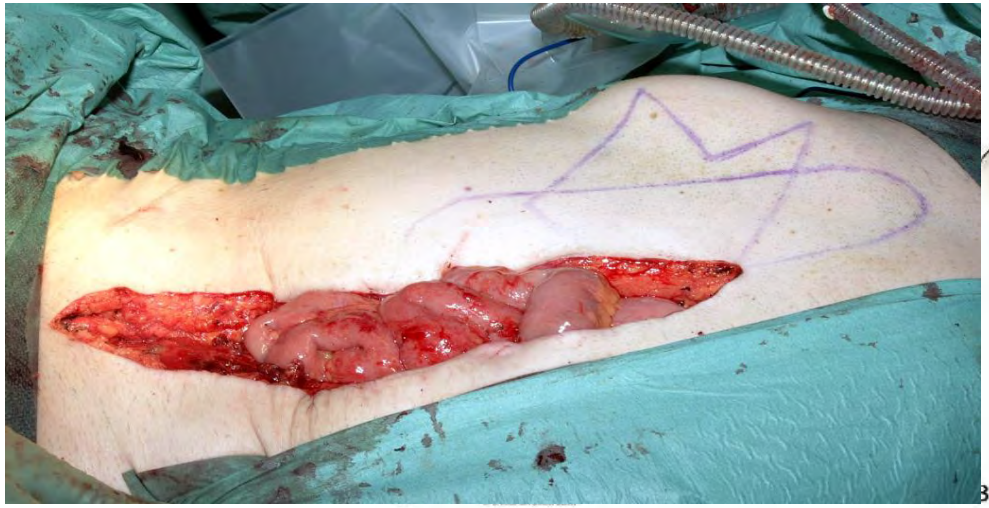


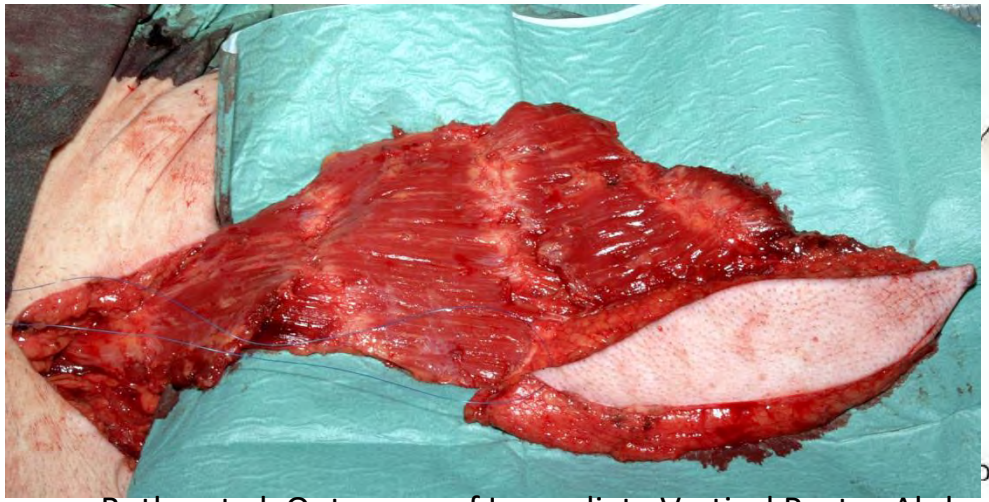




Hva nå?

Nytte av muskellapper (for eksempel VRAM)



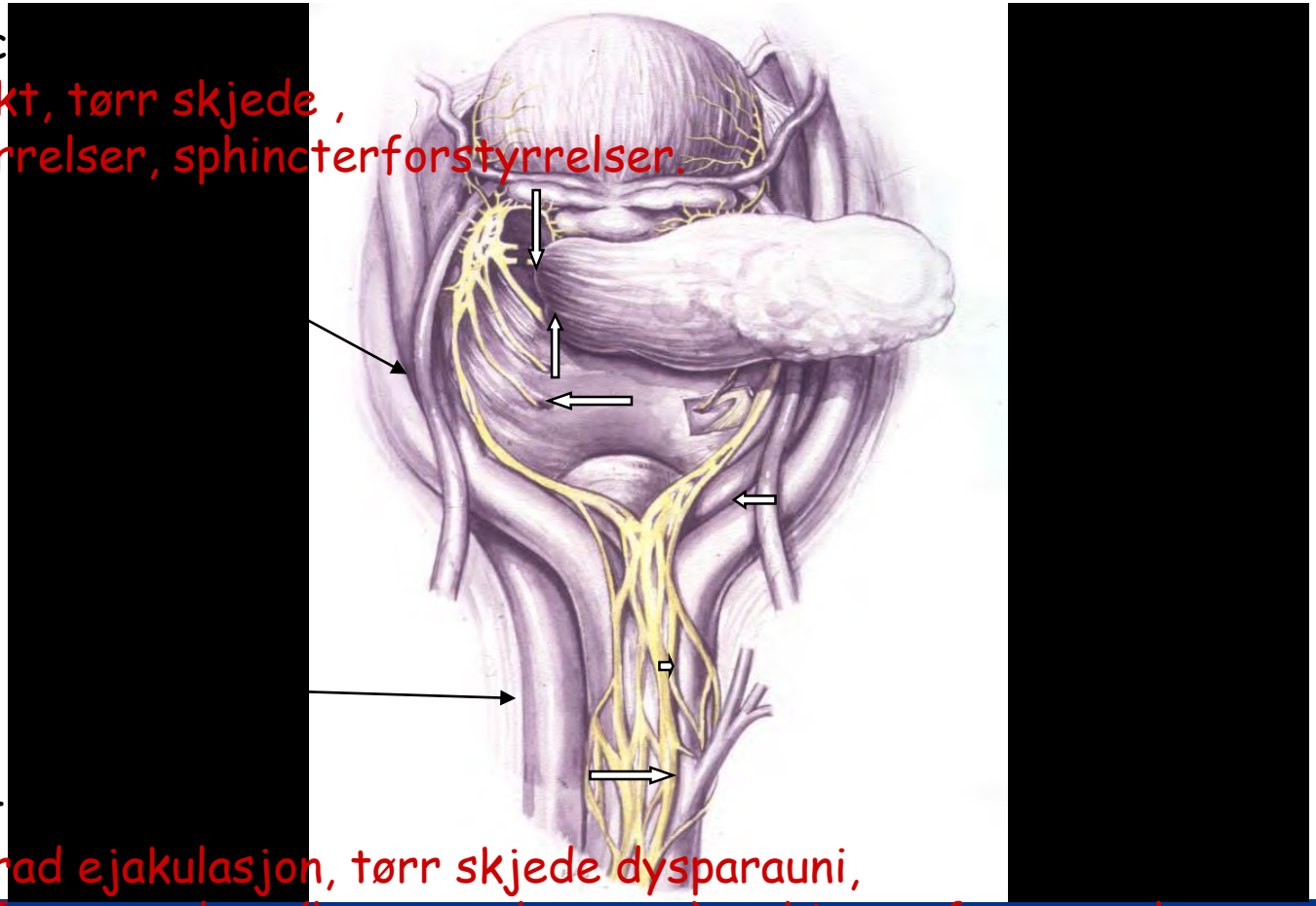


Butler et al. Outcomes of Immediate Vertical Rectus Abdominis Myocutaneous Flap Reconstruction for Irradiated Abdominoperineal Resection Defects , J Am Coll Surg, Vol. 206, No. 4, April 2008

TME: Pelvic autonomic nerves. Areas of caution

Parasympatic

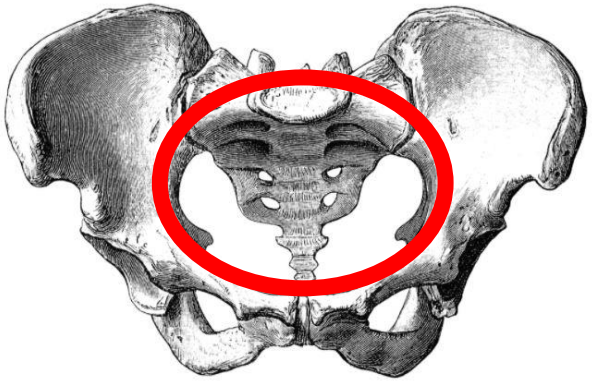
ereksjonssvikt, tørr skjede ,
blæreforstyrrelser, sphincterforstyrrelser.



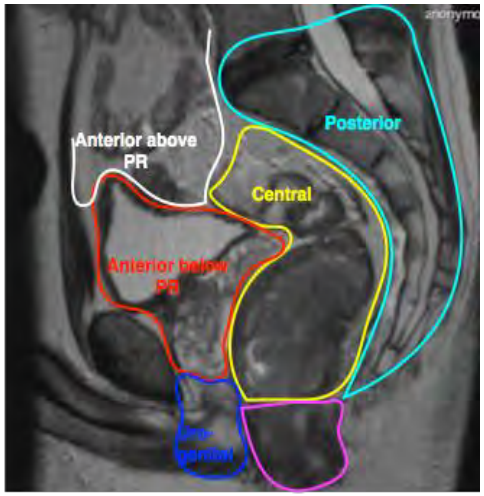
Sympat

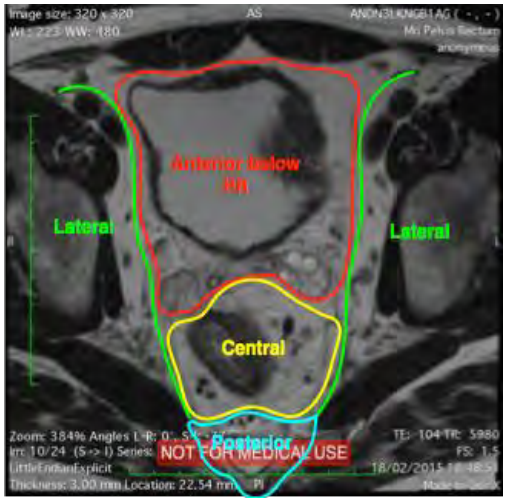
Retrograd ejakulasjon, tørr skjede dysparauni,
blæreforstyrrelser (hemmet detrusor), sphincterforstyrrelser.

- LRRC:
  - Lokalt tilbakefall av kreftceller i det lille bekken etter tidligere fjerning av primær rektumcancer



-anastomoserecidiv
-ny tumor i tidl. tumorområde
-lymfeknuter bekkenvegg og lysker
-drenskanaler
-kirurgiske arr





Beyond TME trial

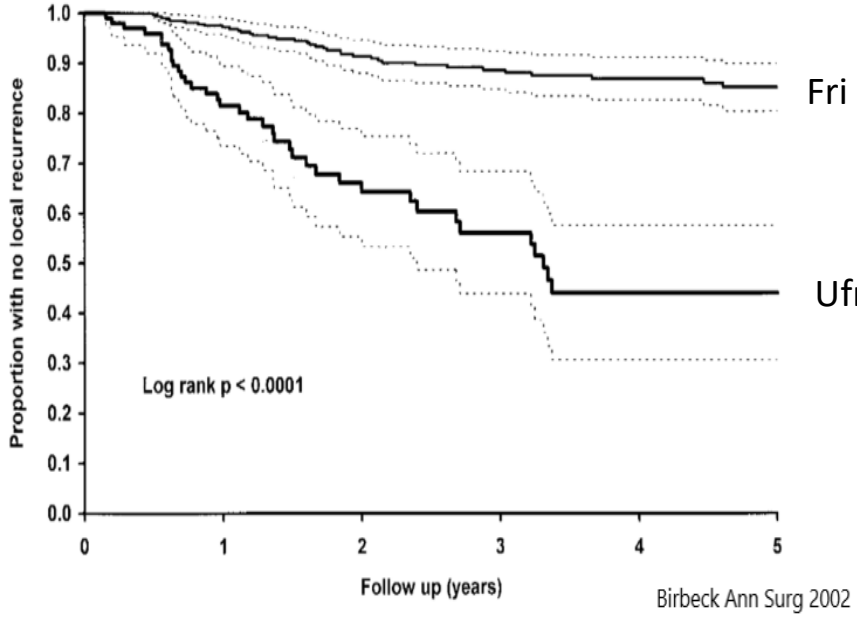
Hvorfor får pas. LRRC?

- Gjenværende kreftceller
  - Ufri margin
  - Tumor/tarmperforasjon
  - Metastaser til lymfeknuter utenfor reseksjonen

  - Anastomoselekkasje

Hvorfor får pas. LRRC?

- Ufri margin øker risiko for LRRC



Hvorfor får pas. lokalt residiv?

- Anastomoselekkasje gir øket risiko for LRRC

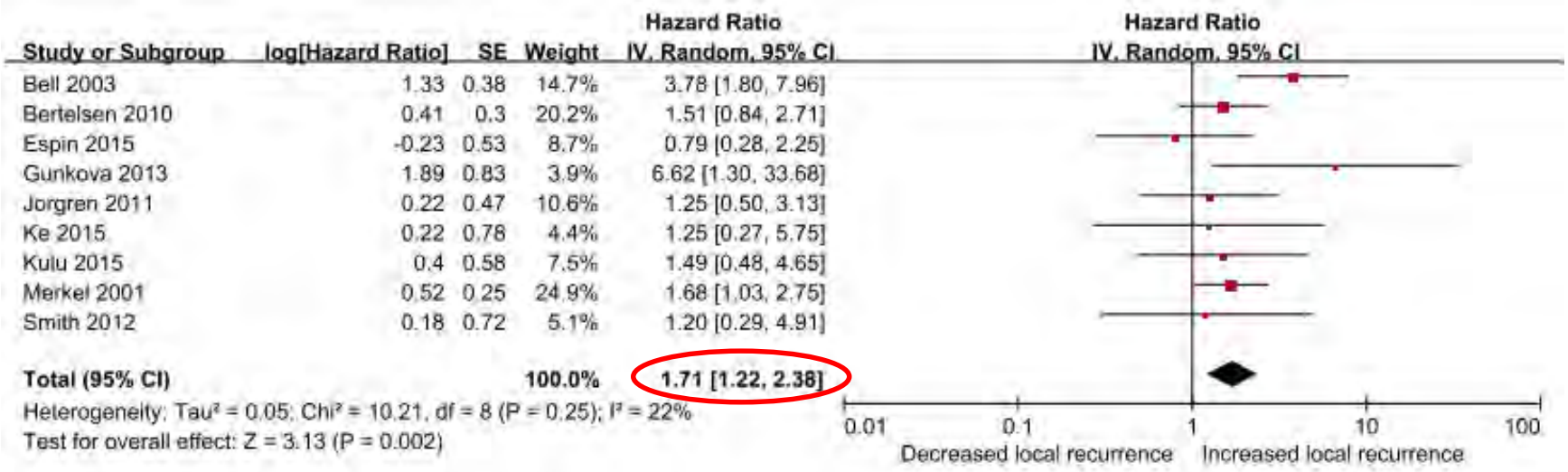


Fig. 2 Effect of anastomotic leakage on the risk of local recurrence of rectal cancer after anterior resection

Wang 2017

Hvordan håndterer vi LRRC?

- Nasjonalt handlingsprogram 2022:
  - Behandles som lokalavansert primær rektumcancer
    - Preoperativ strålebehandling
      - Re-bestråling i enkelte tilfeller
    - Tillegg av kjemoterapi før eller etter stråling kan vurderes
  - Behandlingen bør sentraliseres og registeres
    - Utføres ved sentra som har ekspertise og volum
- Helse Sør-Øst:
  - Onkologisk behandling ved Ullevål og evt. lokalsykehus
    - Neoadjuvant behandling
      - Standard: Kjemoradiasjon (2 Gy x 25 med kapecitabine)
        - Hyperfraksjonert rebestråling (1,2 Gy x 2 x 17 med kapecitabine)
      - TNT i PelvEx II?
        - Randomisering: Kjemoradiasjon vs. induksjonskjemoterapi + kjemoradiasjon
  - Kirurgi ved Radiumhospitalet

Hvor mange residiv opereres årlig?

Helse Sør-Øst: 2,9 mill innbyggere
700 opererte rektumcancere

25-30 residiver henvises til OUS

10 residiver opereres på Radiumhospitalet

omtrentlige tall…

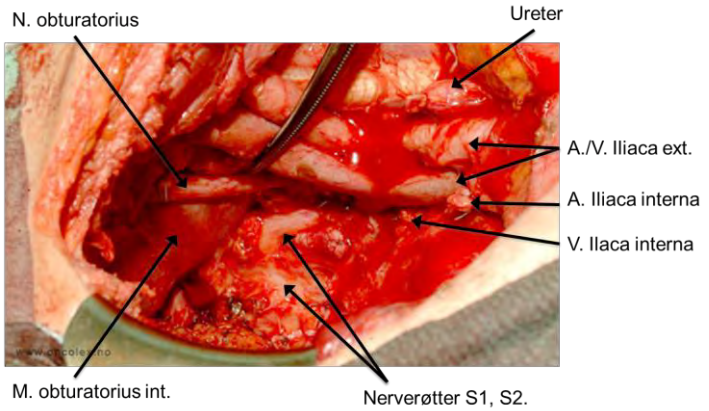
Kirurgi for LRRC

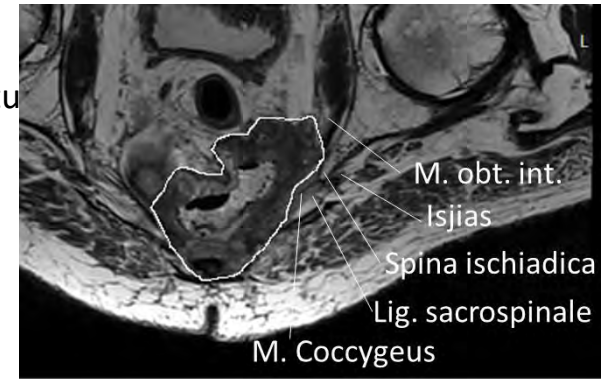
- Planlegging
  - MR
- Kirurgi
    - Reseksjoner
    - Rekonstruksjoner
    - Anestesi
- Postop. oppfølging
  - Mye komplikasjoner

Kirurgi for LRRC

- Oftest multiviscerale reseksjoner
  - Anteriort
    - Hysterektomi
    - Vaginalreseksjon
    - Cystektomi / cystoprostatektomi
  - Lateralt
    - Ureteres
    - Iliaca internakar
    - Ligamenter/muskulatu
    - Bekkenben
    - Isjias
  - Dorsalt
    - Sakrale nerverøtter
    - Sakrumreseksjoner

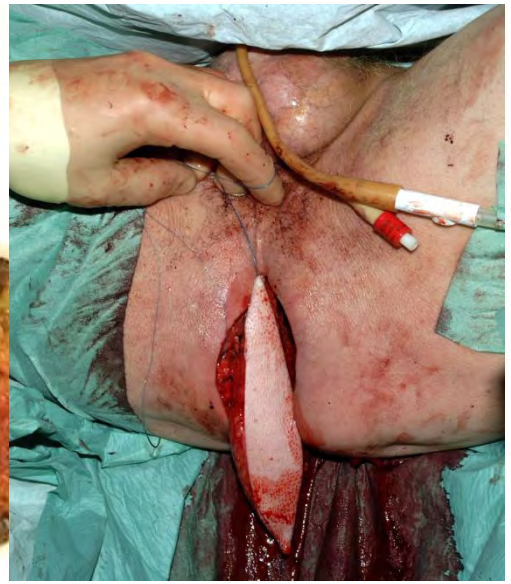
Hø. Bekkenvegg e. avsatt iliaca interna





En-bloc/ multiorgan resections

- Tumours adherent to adjacent organs should be resected *en-bloc* (recurrence 18% vs. 69%) (Hunter 1987)
- Operative strategy based on TME but extended to include suspected tissue outside the mesorectum
- Whole spectre of pelvic surgery should be available
- Support from other surgical disciplins in resection and reconstruction



Hvordan går det med de som opereres for LRRC?

	År	tidsperiode	n	def. R0	R0	5-y re-residiv		5-y mets		median OS	5-y OS		Merknad	Forfatter
						R0	R1	R0	R1		R0	R1		
PelvEx	**2018**	2004-2014	1184	> 1mm	55 %					2,5-3 år	28 %	17 %	100 % multivisceral kirurgi	PelvEx Collaborative
Karolinska	**2022**		126	> 0mm	76 %		38 %		48-74 %		35 %		49 % multivisceral kirurgi	Nordkamp
Eindhoven			251	>0 mm	61 %		58 %				35 %		48 % multivisceral kirurgi	
Sverige	**2018**	1995-2002	121	ikke angitt	53 %	20 %	29 %	30 %	42 %		43 %	14 %		Westberg
Aarhus	**2015**	2001-2010	115	ikke angitt	60 %	30 %		41 %		2,8 år	40 %	16 %		Nielsen
Radiumhospitalet	**2020**	2007-2017	110	> 1mm	57 %		28 %		38 %	3,5 år	40 %		ikke kvalitetssikret	ikke publisert
Rad (Wiig/ Larsen)	2007)	1990-2004	150		44%	27%	63%				52%	14%		

«40 % regelen»

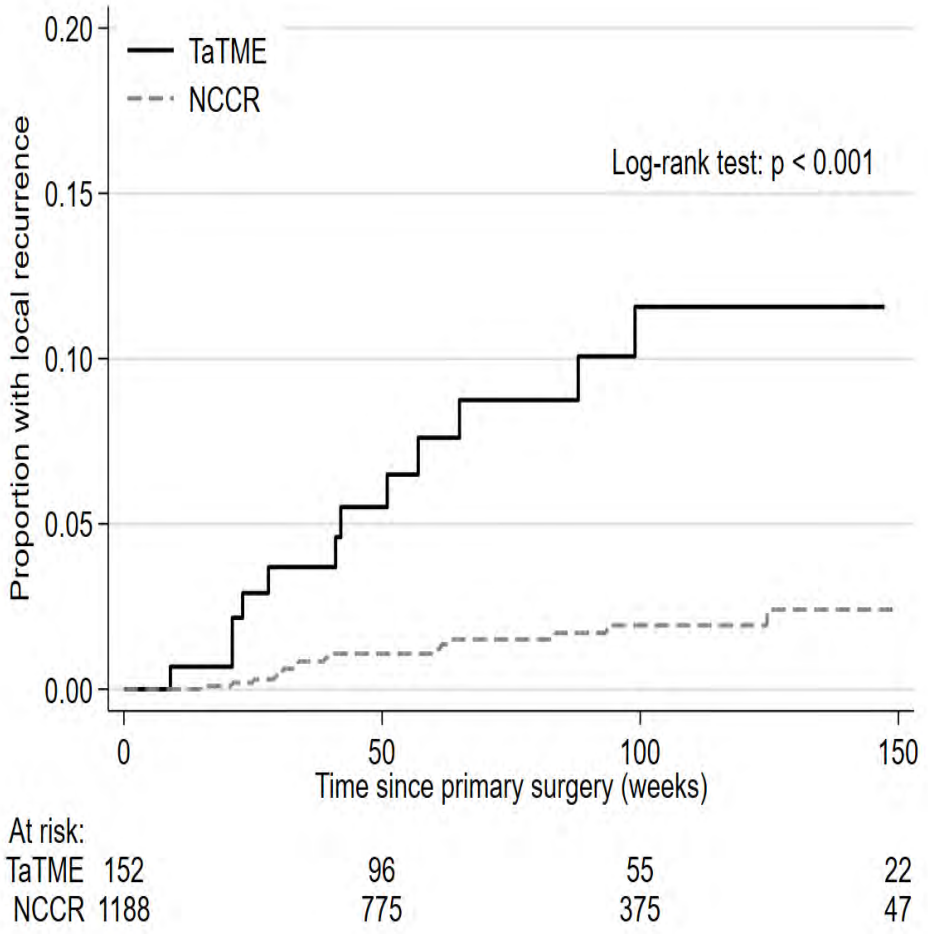
~ 40 % R1

< 40 % re-residiv

> 40 % fjernmetastaser

~ 40 % 5 års overlevelse ved R0

TaTME(via anus) Local recurrences



2.4 - years estimates:

TaTME cohort: 11.7 (Ci 6.7-20.1)

NCCR cohort : 2.4 (Ci 1.4-4.3)

Kasus 2: Hvordan håndterer vi uønskede hendelser?

- Kort kasuistikk:
- Vår 2018. 2 pasienter med store, og omfattende tilbakefall ble henvist regionssykehuset i helse sørøst.
- Begge viste seg å være behandlet med samme, nye kirurgiske teknikk (taTME)
- Tilbakefallene var forbundet med alvorlig prognose

taTME:

Recurrence after 5 months

BJS 2019; **106**: 1120–1121

Leading article

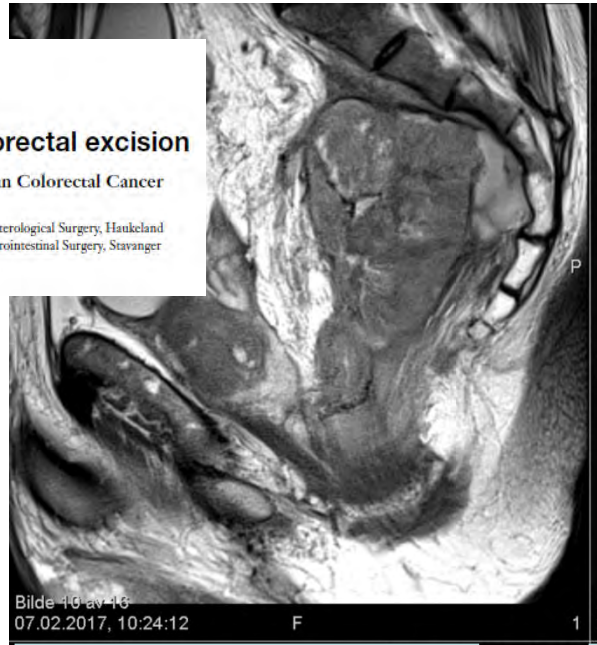
Norwegian moratorium on transanal total mesorectal excision

S. G. Larsen[1,5], F. Pfeffer[2,3,5] and H. Kørner[2,4,5], on behalf of the Norwegian Colorectal Cancer Group

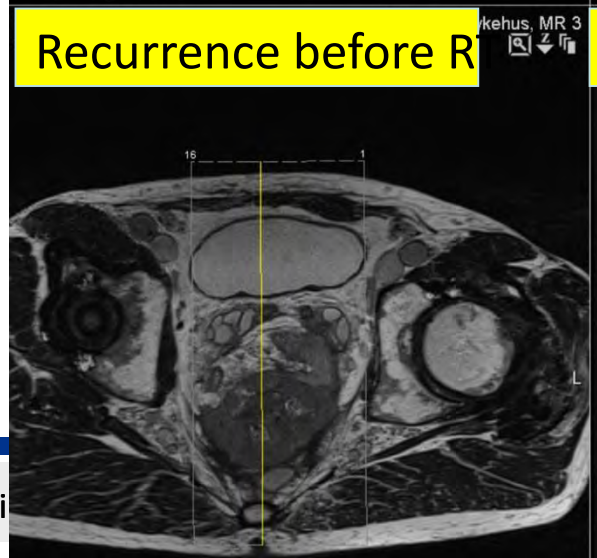
[1]Department of Gastroenterological Surgery, Oslo University Hospital, N-0424 Oslo, [2]Department of Gastroenterological Surgery, Haukeland University Hospital, and [3]Department of Clinical Medicine, University of Bergen, Bergen, [4]Department of Gastrointestinal Surgery, Stavanger University Hospital, Stavanger, and [5]Norwegian Colorectal Cancer Group, Norway (e-mail: stl@ous-hf.no)

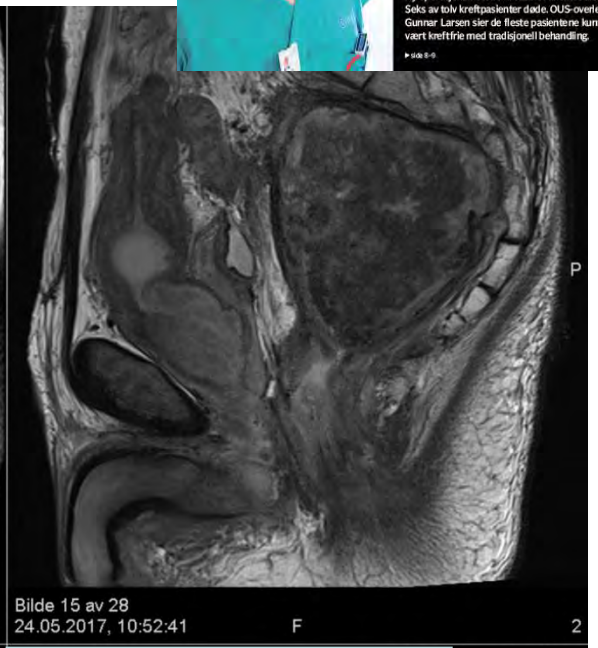
Published online in Wiley Online Library (www.bjs.co.uk). **DOI:** 10.1002/bjs.11287

Primary

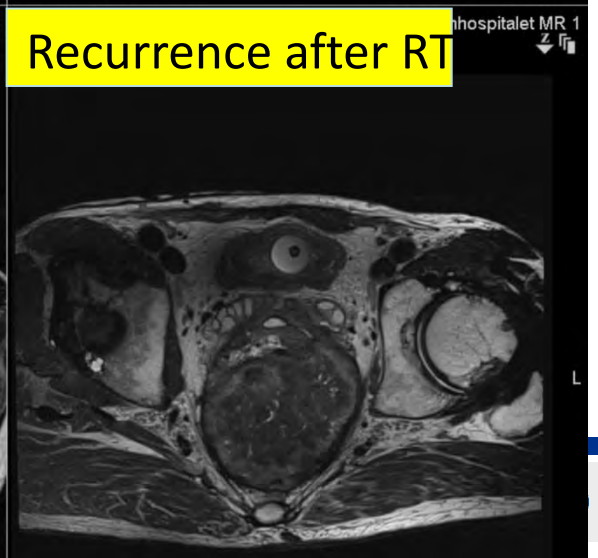


Recurrence before RT



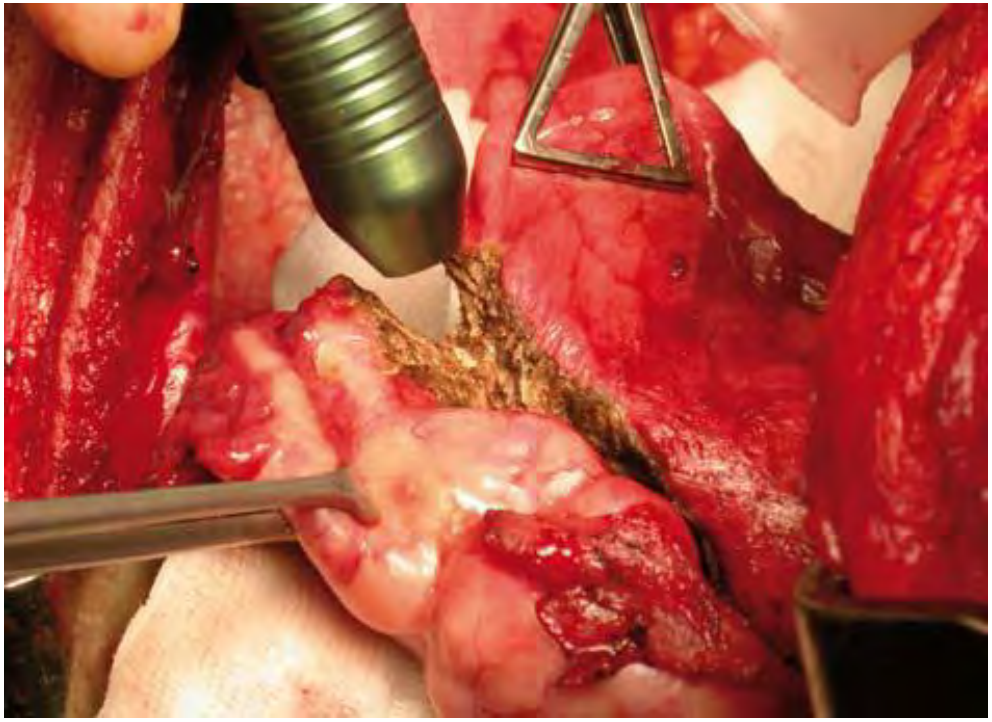


Recurrence after RT



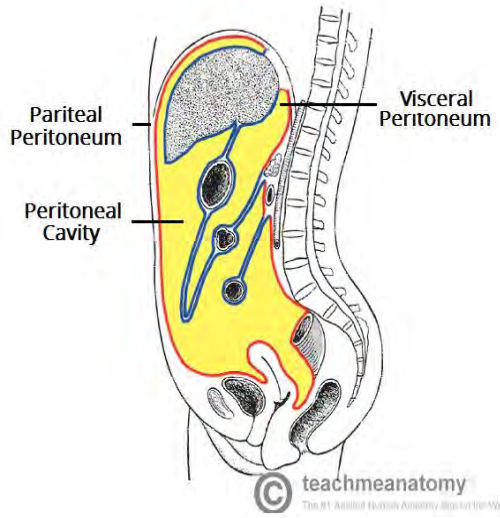
Lungemetastaser

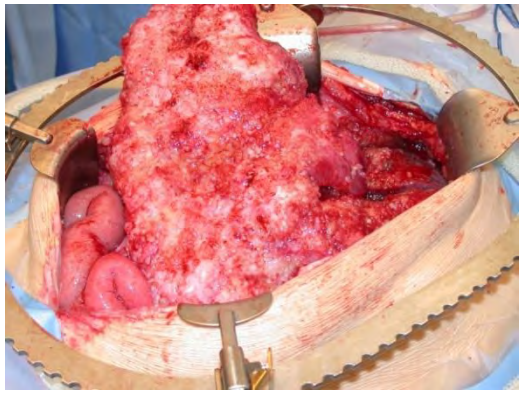
- Ca. 5-10 % utvikler lungemetastaser.
- 50 % 5-års overlevelse
- Kilereseksjoner, segmentectomier, lobectomier
- Ofte bruk av laser for å spare lungevev, eller ……



Peritoneale metastaser fra colorectal cancer (PM-CRC)

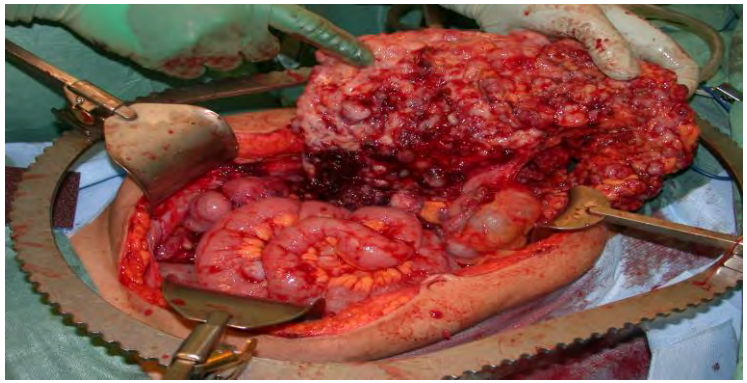
- Hyppighet: 8.3 % synkron PM (Sjo et al, 2011), 4-12 % metakron PM (Sørbye 2013; Abdel-Rahman 2020)
- Ca 6-12 mnd median overlevelse ubehandlet (Sørbye 2013).
- Begrenset PM behandlet som får systemisk kjemoterapi: median overlevelse opp mot 24 mnd i studier.
- Pasienter som opereres med CRS og HIPEC: Økt lang-tids overlevelse og kurasjon, ca 40 % 5-års overlevelse.

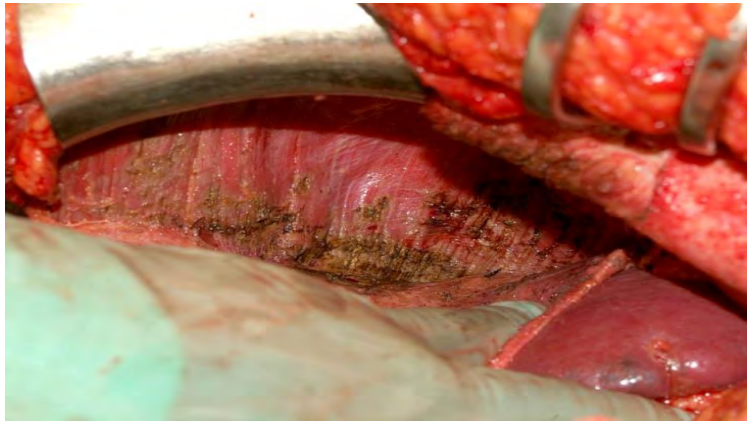




Maksimal cytoreduktiv kirurgi (CRS)

CRP-HIPEC kan gis hvis det er mulig å oppnå «komplett» reseksjon.





Omfatter ofte:

- Oment reseksjon
- Fjerning av affisert peritoneum
- Fjerning av affiserte organer i buken
- Fjerning av ovarier hos kvinner

Historie HIPEC

- EPIC 1994-2003
- Åpen skylling fra 2003-8 (bilder).
- Deretter lukket

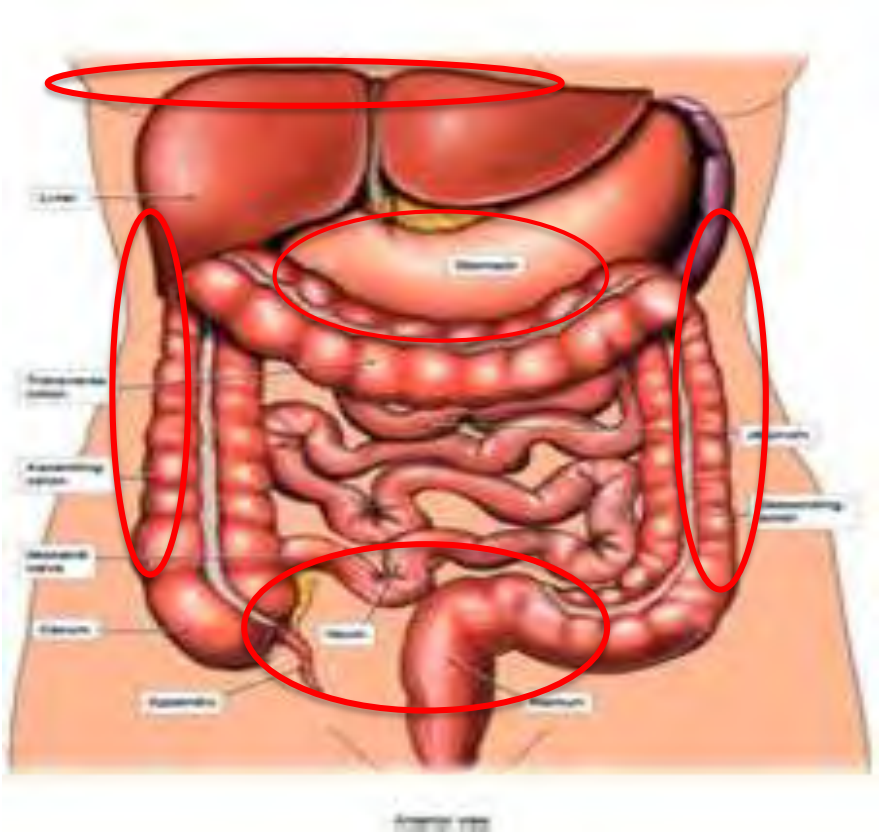
Hyperterm intraperitoneal kjemoterapi (HIPEC)

- Fjerner gjenværende mikroscopisk sykdom
- Eliminerer blodplater, granulocytter og monocytter
- Høy intraperitoneal konsentrasjon med lav systemisk toksisitet

Distribusjon i bukhulen

1:
Oppsuging av væske

-oment
-over lever

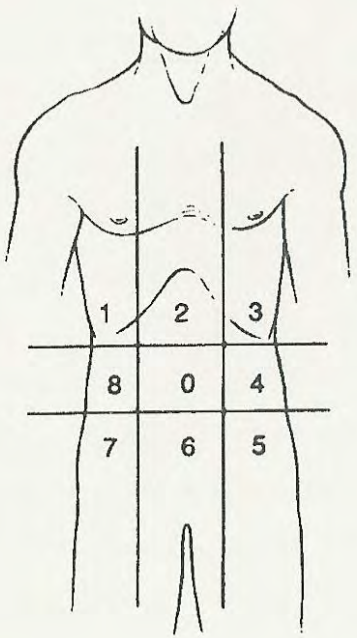


2:
Tyngdekraft

-parakolisk
-bekken

Sparer bevegelige organer lengst (tynntarm)

Peritoneal Cancer Index (PCI) (Esquivel J 1998)

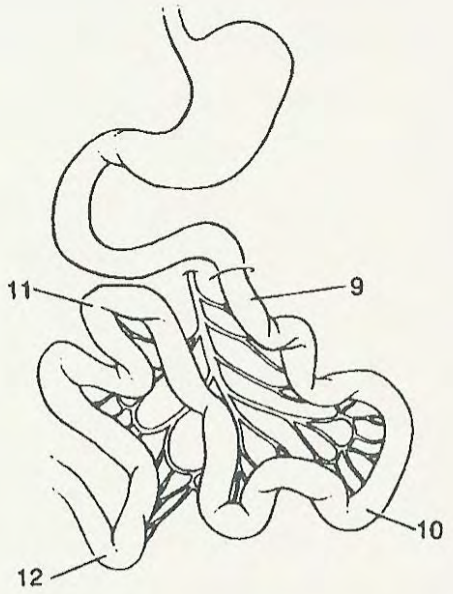


Regions	Lesion Size
0 Central	____
1 Right Upper	____
2 Epigastrium	____
3 Left Upper	____
4 Left Flank	____
5 Left Lower	____
6 Pelvis	____
7 Right Lower	____
8 Right Flank	____
9 Upper Jejunum	____
10 Lower Jejunum	____
11 Upper Ileum	____
12 Lower Ileum	____

PCI ☐

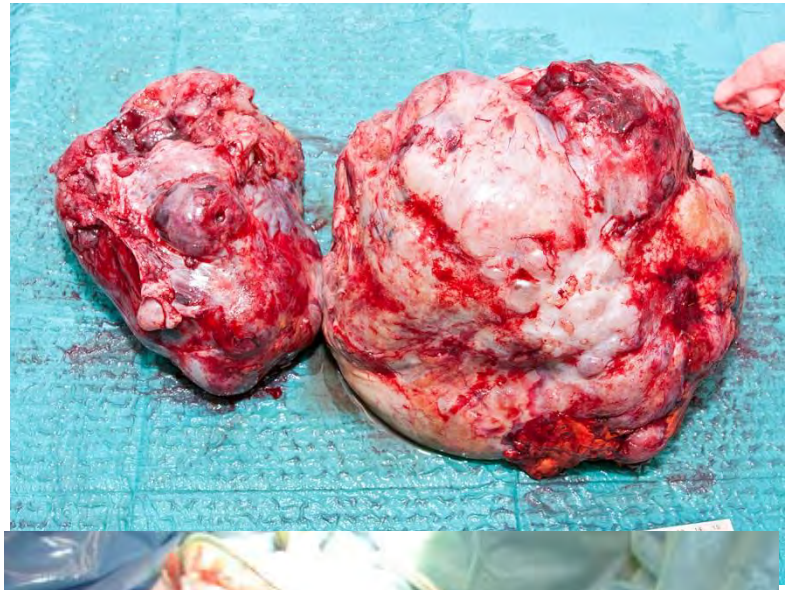
Lesion Size Score

LS 0 No tumor seen
LS 1 Tumor up to 0.5 cm
LS 2 Tumor up to 5.0 cm
LS 3 Tumor > 5.0 cm or confluence



Ovariale metastaser

- 10 – 30 % av svulster i ovarier er metastaser (Evers et. al 2011)
- Ofte colorectalt utgangspunkt
- Halvparten har blitt misoppfattet som ovarial cancer
- Ofte økning i CEA med lav CA-125 (CA-125/CEA < 20-50).



Prognostiske faktorer indicators

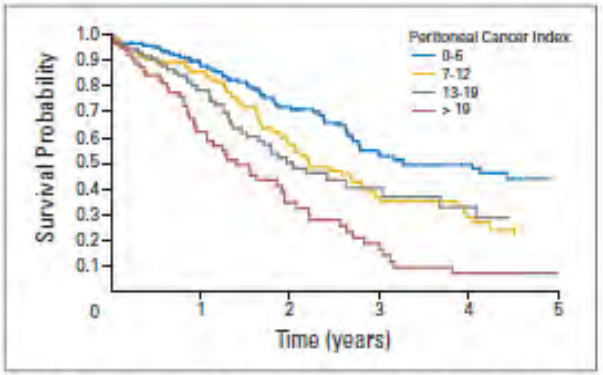


Fig 2. Prognostic impact of the extent of carcinomatosis (ie, peritoneal cancer index; $P < .001$) on overall survival.

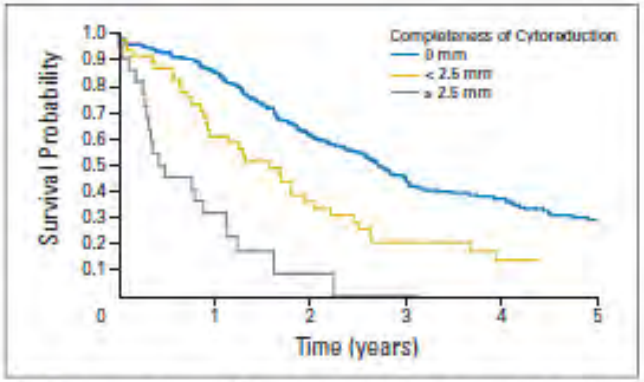
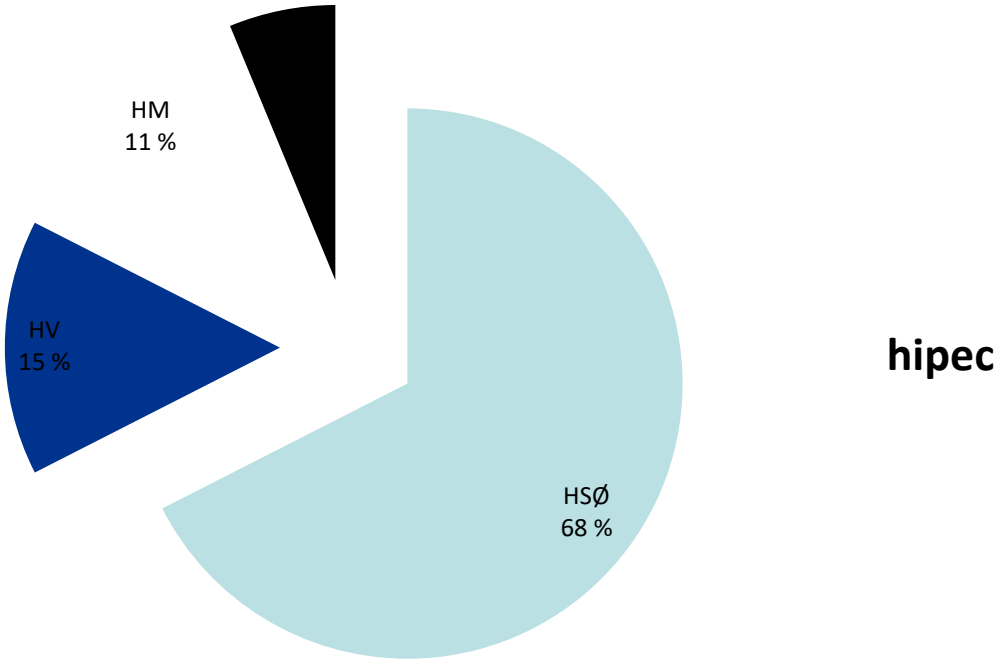


Fig 3. Prognostic impact of the completeness of the surgery ($P < .001$) on overall survival.

Indicator	Value	Med survival (months)	p
PCI	(<10; ≥10-<20; >20)		p<0.001 (Yan T 2008)
•Extent of cytoreduktion	CC-0	32.4	(Glehen 2004)
	CC-1/2/3	8.4	
•N-status at treatment	N0	38	p=0.003 (Chua TC 2009)
	N+	20	
•Histological grading:	high/moderate diff		p<0.001 (Yan T 2008)
	low diff		

Norwegian National Unit for HIPEC Volume 2017

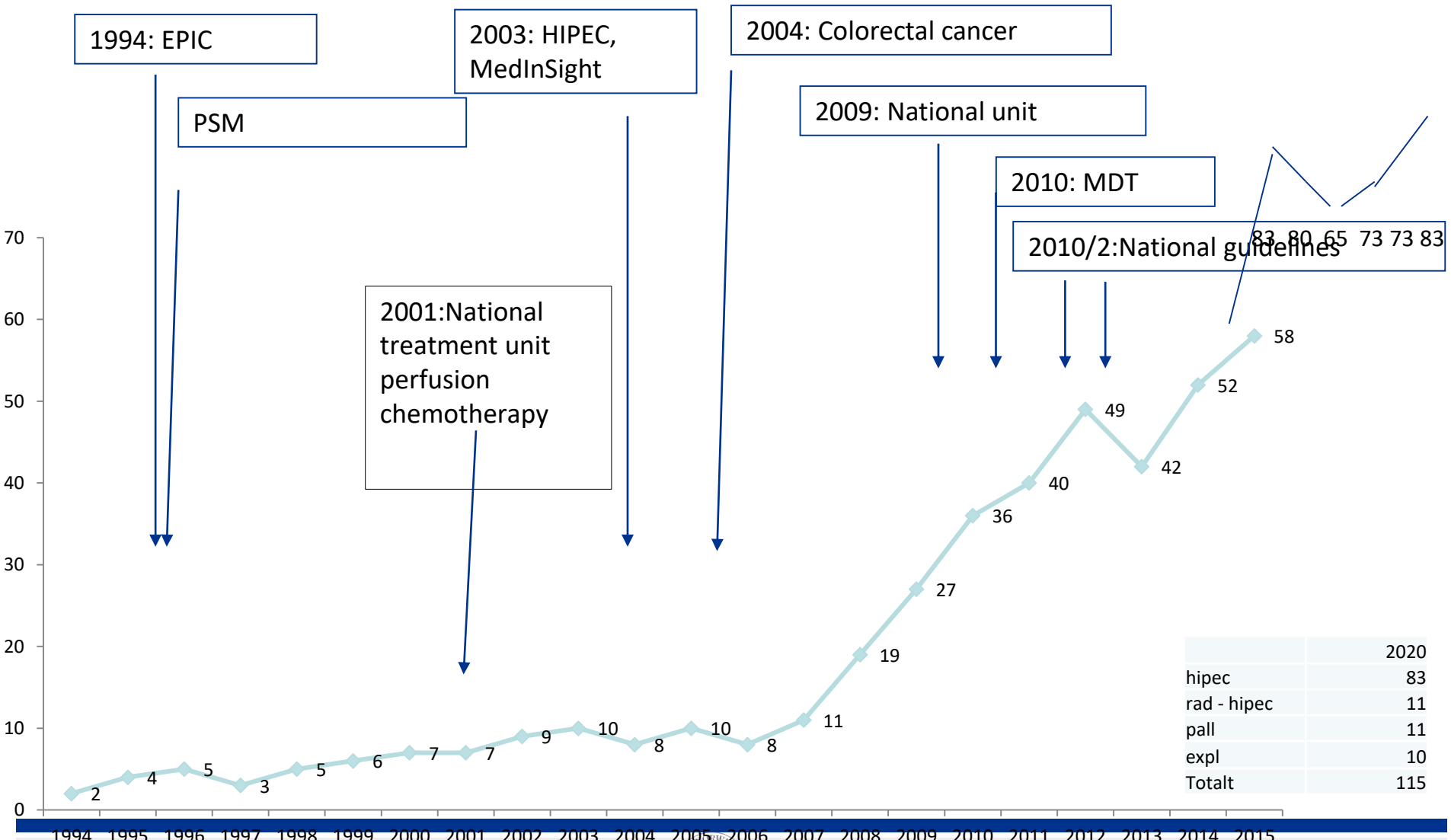
New admissions 282; CRS-HIPEC 80; expl/pall. proc 43



Population of Norway:

South-East Norway: 55.8%; West 20.9%; Mid13.8%; North 9.5%

Utvikling ved Radiumhospitalet 1994 - 2021



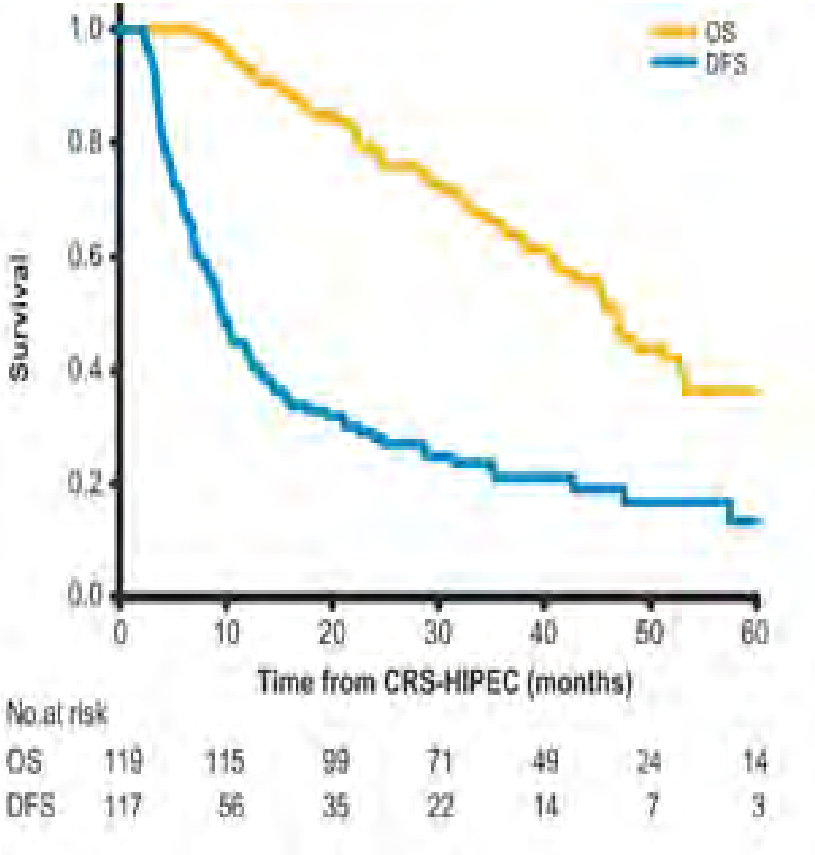
	2020
hipec	83
rad - hipec	11
pall	11
expl	10
Totalt	115

men.....

Journal of Surgical Oncology

Complete Cytoreductive Surgery and Hyperthermic Intraperitoneal Chemotherapy for Colorectal Peritoneal Metastasis in Norway: Prognostic Factors and Oncologic Outcome in a National Patient Cohort

IDA S. FRØYSNES, MD,[1,2] STEIN G. LARSEN, MD, PHD,[3] MILAN SPASOJEVIC, MD, PHD,[3] SVEIN DUELAND, MD, PHD,[4] AND KJERSTI FLATMARK, MD, PHD[3,1,2,*]

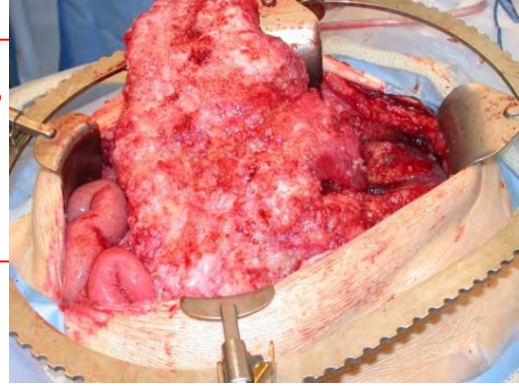


- 40 % 5-års OS etter CRS-HIPEC
- 11-12 mnd DFS etter CRS-HIPEC

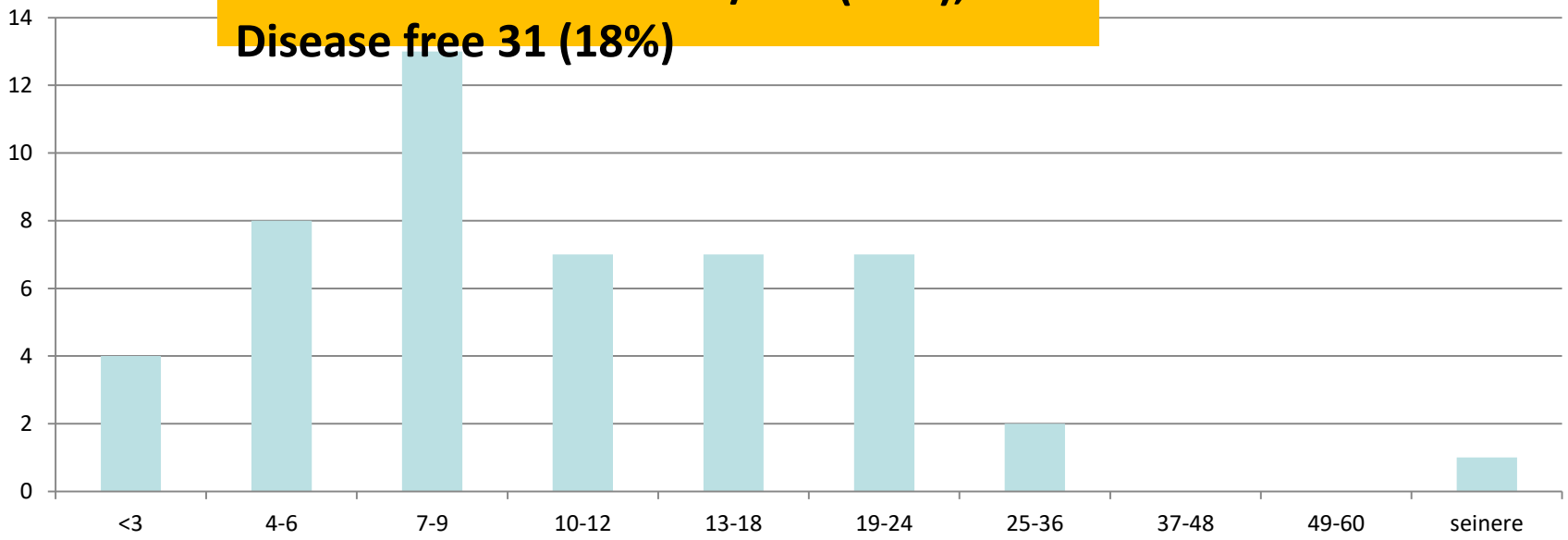
- Halvparten som får rec eller met, får det i bukhulen

Recurrence/ Distant mets.

Oslo cohort 2004-15 (n=177)



Local recurrence (LR) alone in 48 of 177 HIPEC patients (27%)
Both LR and distant mets in 35/177 gets (20%),
Distant mets alone in 63/177 (36%),
Disease free 31 (18%)



Kan en finne tilleggsbehandlinger for å redusere lokale recidiv?

Lovende resultater vist:

- 1 RCT (Vervaal 2008)
- 3 Case-control studier (Elias et al 2009; Franko 2010, Mahteme 2004)
- 1 meta analyse (Mirnezami 2014)
- En del cohort studier (for eksempel Frøysnes 2016)

- Men ikke i PRODIGE 7 (Quenet 2021)

Meta-analytical evaluation of survival outcomes in CRS-HIPEC in Colorectal PM (Mirnezami R 2014)

Study name	Odds ratio	Lower limit	Upper limit	*P*-value	Relative weight
Mahteme *et al*	6.538	0.679	62.987	0.104	8.38
Verwaal *et al*	2.095	0.661	6.642	0.209	32.30
Elias *et al*	7.000	2.510	19.521	0.000	40.87
Franko *et al*	6.120	1.330	28.165	0.020	18.45
FEM	4.599	2.387	8.860	0.001	

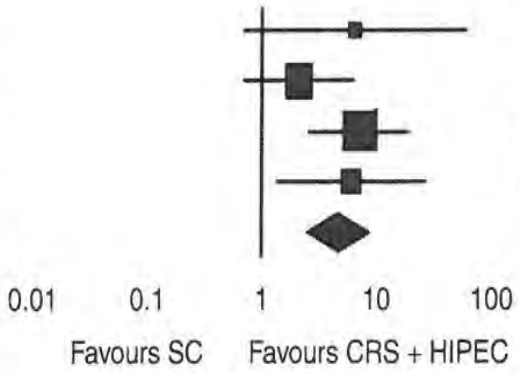
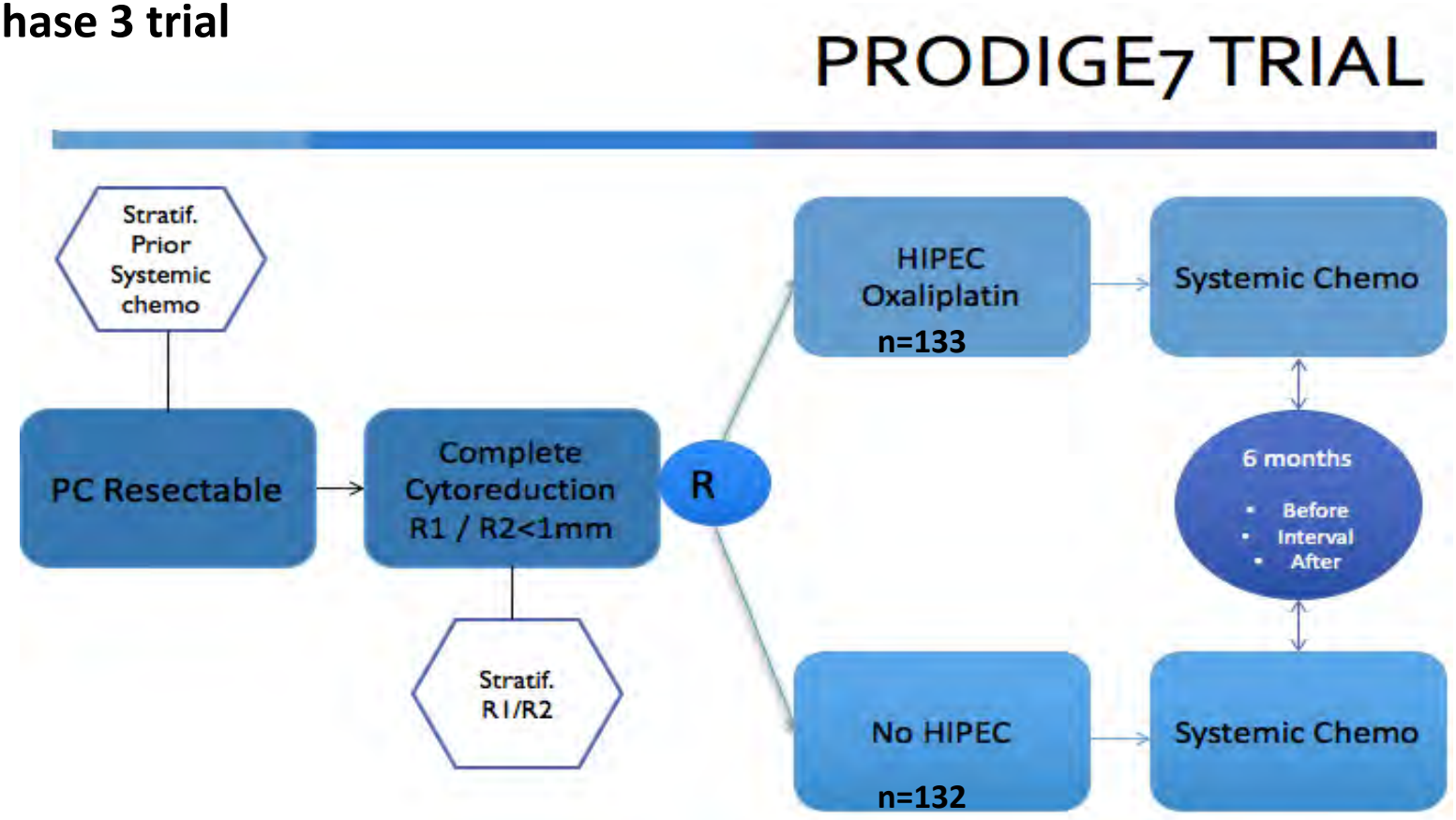


Figure 3. Summary of meta-analysis results for 5-year survival following CRS + HIPEC vs SC alone. The diamond represents the overall treatment effect, and squares are treatment effects for individual studies with 95% CI indicated by horizontal bars.

Clear and significant improval in survival at 2 and 5 years.

Cytoreductive surgery plus hyperthermic intraperitoneal chemotherapy versus cytoreductive surgery alone for colorectal peritoneal metastases (PRODIGE 7): a multicentre, randomised, open-label, phase 3 trial

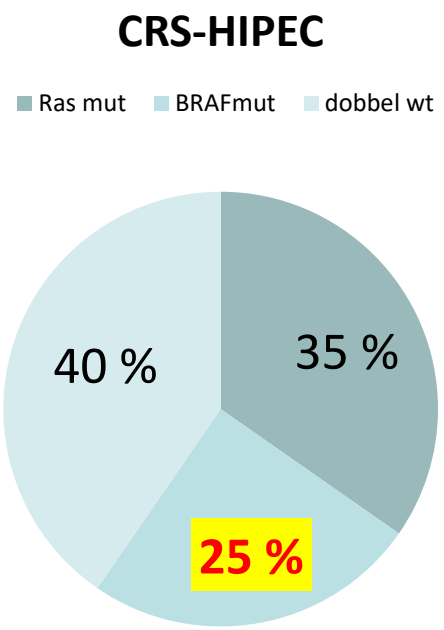
Lancet oncol 2021

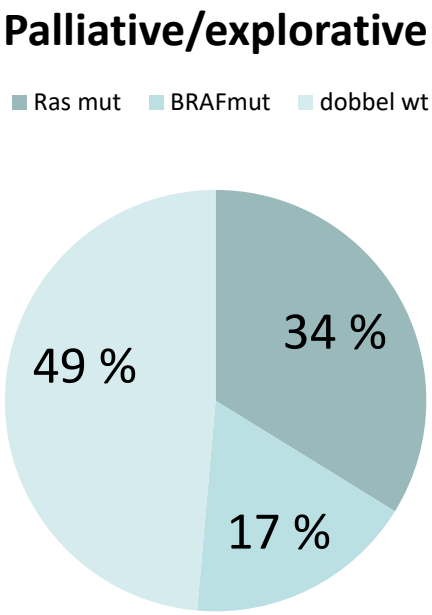


…..men

- Begge grupper 2% 30d mortalitet
- Lik morbiditet, ca 38% Accordion ≥3
- Svært mange kritiske kommentarer:
  -15 pas. Med cross-over fra ikke non-HIPEC til HIPEC
  - Alle hadde fått 6 mnd systemisk oxaliplatin uten progresjon

Andel mut*BRAF* er høy i CRS-HIPEC gruppen





Ann Surg Oncol (2017) 24:1916–1922
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ORIGINAL ARTICLE – COLORECTAL CANCER

Novel Treatment with Intraperitoneal MOC31PE Immunotoxin in Colorectal Peritoneal Metastasis: Results From the ImmunoPeCa Phase 1 Trial

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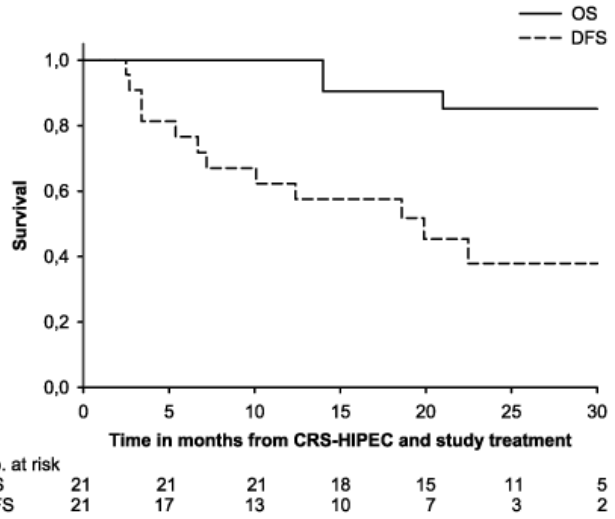
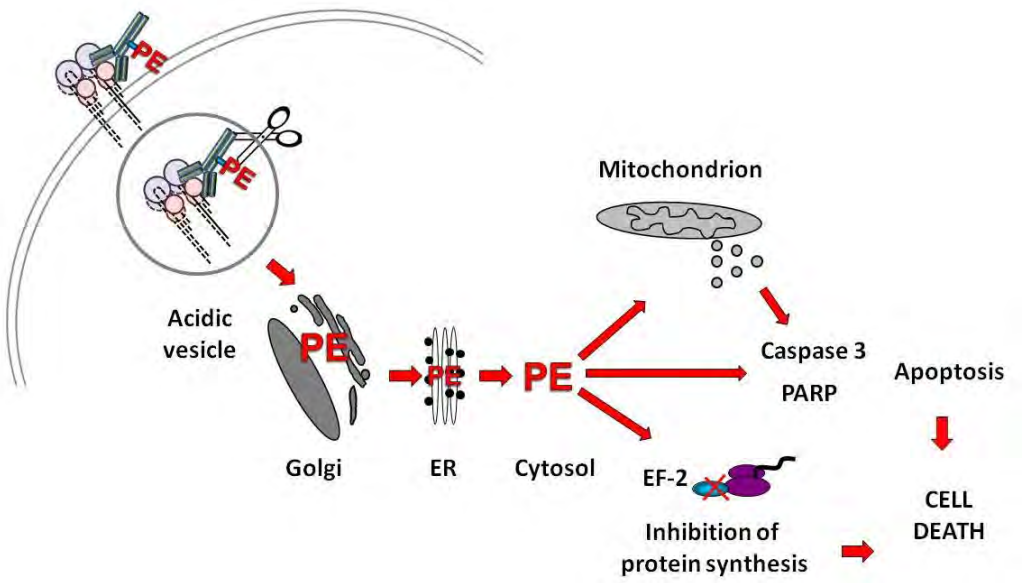


FIGURE 6
Survival curves from the ImmunoPeCa trial showing overall survival (OS) and disease-free survival (DFS). In this phase I/II trial patients with colorectal peritoneal metastasis were treated with CRS-HIPEC and intraperitoneal, perioperative MOC31PE immunotoxin.

Median DFS was 20 months (95% CI 7-34) (Median follow-up time 25 months (95% CI 17-30))

Estimated 3-year DFS 38%

Opportunity:
Clinical intervention studies
The ImmunoPeCa phase I-II trial



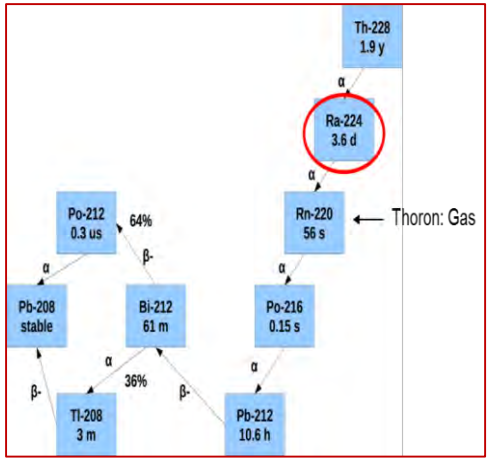
- MOC31PE immunotoxin
  - Developed at ICR
  - Researcher-initiated study
  - Clinical Trials Unit
  - Patients with peritoneal metastases from colorectal cancer

Frøysnes; Ann Surg Oncol; 2017

Radspherin®

α-emitting radionucleotide Radium-224 (^{224}Ra)

- Adsorbed to a suspension of biodegradeable calcium carbonate microparticles
- designed to give short-range radiation to the serosal peritoneal surface
- aiming to kill remaining free cancer cells and small tumor cell clusters



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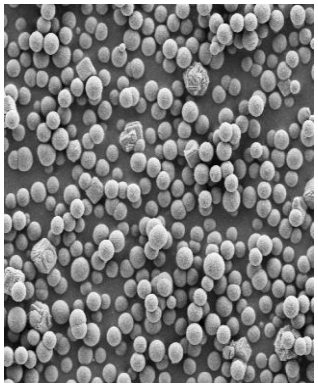

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Thorium-228 half live 1.9 years, Radium-224 3.6 days

Behandling:

- Radspherin installeres 2 dager etter CRS-HIPEC, avbildes med SPECT-CT, og pas. kontrolleres i 12 mnd.
- Eksempel på whole body scintigrafi etter 7 MBq