



# Novel Approach: Adaptive MR-Guided SABR as an alternative to HDR Brachytherapy Boost in Gynaecological Cancers.

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# Conflicts of interest

- ⑦ No conflicts directly in relation to this work
- ⑦ Consultant Clinical Oncologist at University College London Hospital
- ⑦ Gynaecology Specialist Advisor for Genesis Care
- ⑦ Consultancy/Advisory Boards: GSK, Eisai, MSD, Regeneron
- ⑦ Meeting expenses: MSD
- ⑦ Speaker fees: GSK, MSD, Eisai

# Background

- ⑦ Within the UK per year:
  - ⑦ 3300 new cervical cancer cases (9 every day)
  - ⑦ approx. 850 deaths (2 per day)
- ⑦ Chemo-radiotherapy is standard of care for FIGO 2018 stage 1B3- IVA:
  - ⑦ 45Gy/25#/5 weeks EBRT (+/- SIB to nodes)
  - ⑦ AND cervical brachytherapy
  - ⑦ HRCTV D90 EQD2 85-95Gy
  - ⑦ HRCTV is cervix, residual tumour and grey zones

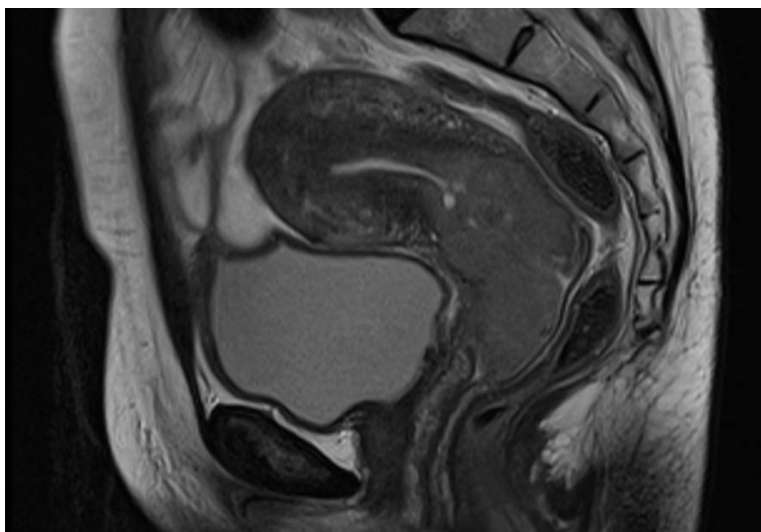
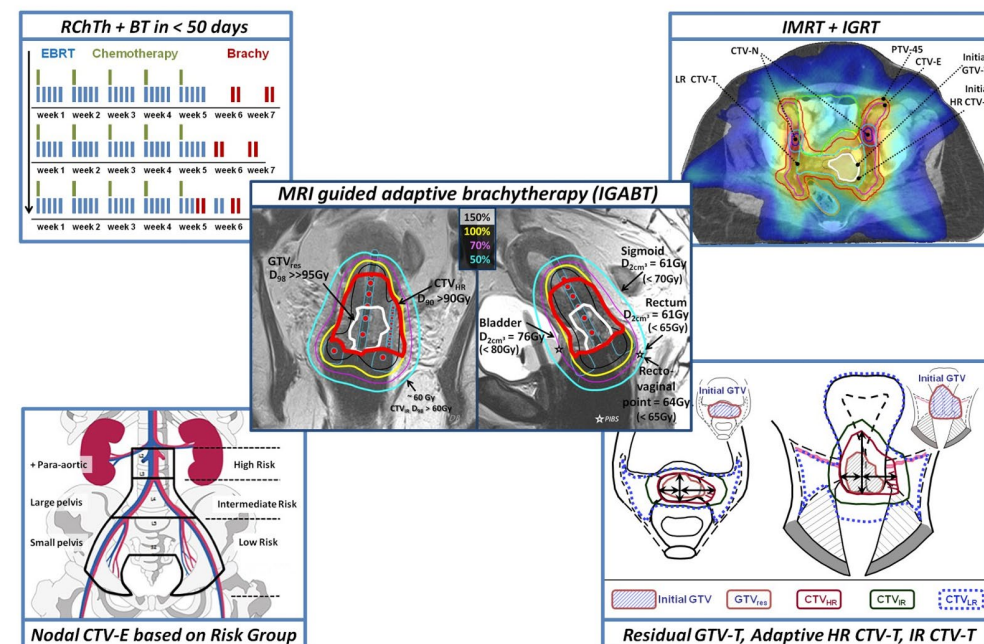


Image guided intensity modulated  
External beam radiochemotherapy and  
MRI based adaptive BRachytherapy  
 in locally advanced Cervical cancer

## EMBRACE-II



# Limitations of HDR brachytherapy

## ⑦ Tumour factors

- ⑦ Poor treatment response
- ⑦ Irregular large volume
- ⑦ Severe fibrosis

## ⑦ Patient factors

- ⑦ Unfavourable anatomy:
  - ⑦ Narrow vagina/minimal access/VI
- ⑦ Comorbidities:
  - ⑦ Anaesthesia risk (spinal OK)
  - ⑦ Bleeding risk
- ⑦ Patient declining

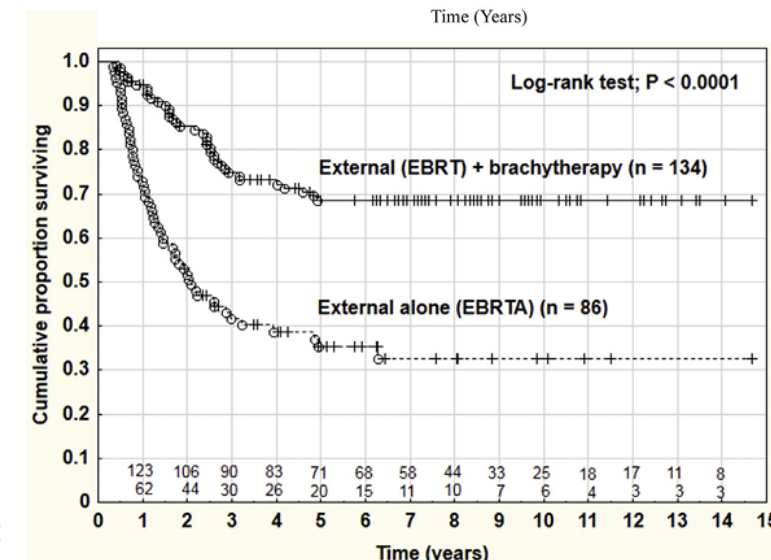
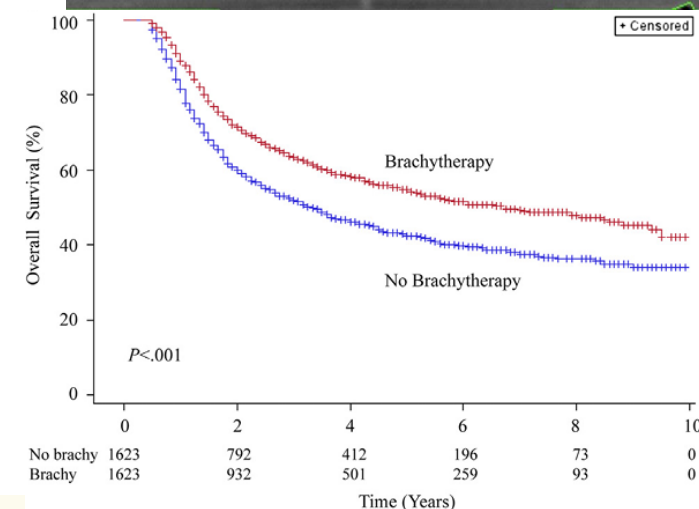
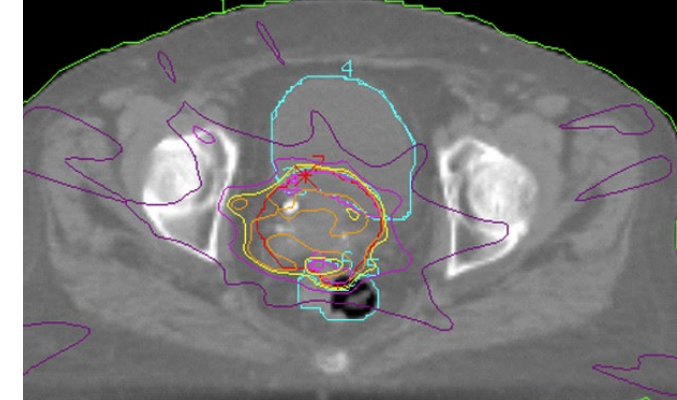
## ⑦ Technical factors

- ⑦ Procedural challenges eg perforation, bleeding
  - ⑦ Resource/logistics (not significant in UK)
  - ⑦ Catheter position changes causing dose deviation
- ⑦ Approx 1-3% of cases not able to undergo brachytherapy



# Alternative to brachytherapy

- ⑦ External beam radiotherapy boost
- ⑦ BUT... EBRT boost leads to inferior outcomes
  - ⑦ 42% reduction in cancer specific mortality in patients who receive BT
  - ⑦ BT higher OS (SEER database review), HR 0.66
- ⑦ Newer RT techniques allow higher focal doses
- ⑦ SBRT can deliver similar doses – 25-30Gy/5#, 28Gy/4#
  - ⑦ 21 pts; 2 yr cancer specific survival 80%
- ⑦ MR guided SMART also feasible
  - ⑦ 10 patients, 2 locally advanced, 8 recurrent
  - ⑦ Median dose 73.6Gy within acceptable OAR dose
  - ⑦ No G $\geq$ 3 tox and only G1 late tox





# Potential advantages of MRL SABR Boosts in Gynae

## Challenge

Significant interfraction variation due to bladder/bowel filling/tumour response

Intrafraction variation due to dynamic filling of bladder and rectal changes

Poor visualisation of target

Difficult to access deep pelvis for fiducials

Close proximity to critical normal tissue limiting target coverage and max dose

Procedural risks and inaccessible target for brachytherapy

## Benefit of MRL

Online adaptive replanning for every daily fraction

Tissue tracking and automatic beam gating

MR provides superior soft tissue imaging

No fiducial marker necessary

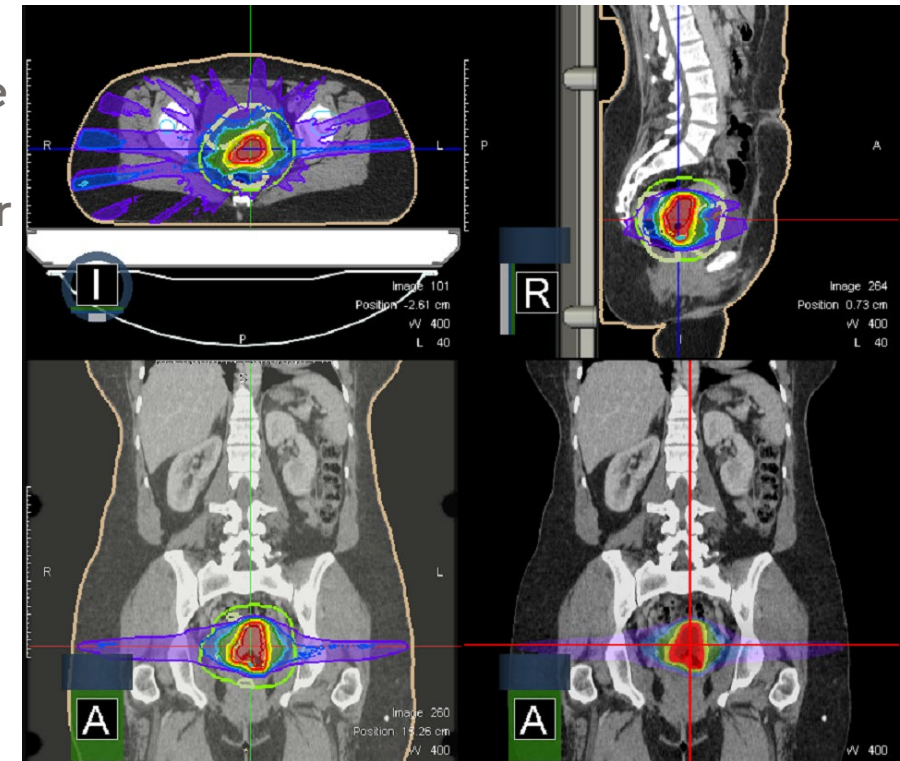
Smaller PTV margins due to imaging quality and online adaptive  
Internal dose escalation possible due to certainty of treatment position and delivery

Non-invasive treatment delivery



# Genesis Planning Project – Cervix Cancer boost with MRL

- ⑦ AIM- to assess if we can achieve a 'radical' dose to HRCTV, in region of 85Gy, using the MRL, whilst maintaining SABR planning and OAR constraints.
- ⑦ Assumption: 45Gy in 25 fractions EBRT given with no OAR recovery.
- ⑦ Organ at risk (OAR) tolerances:
  - ⑦ 2019 SABR consortium re-irradiation and EMBRACE guidance
  - ⑦ D2cc bladder 90Gy, rectum/bowel 70Gy
  - ⑦  $\alpha/\beta$  ratio of 5 for bladder/rectum, 4 for bowel, 10 for tumour
- ⑦ 8 MRI data sets were used
- ⑦ (HR)CTV and OAR outlined, CTV to PTV margin 3mm
- ⑦ Prescription: 30 Gy in 5 fractions to PTV, boosting CTV to 35 Gy
- ⑦ Maximum PTV dose was 1 cc at 150% of 35Gy
- ⑦ Target coverage aims:
  - ⑦ PTVhigh D90 85-95Gy
  - ⑦ PTV D90 $\geq$ 80Gy
  - ⑦ (HR)CTV D90 $\geq$ 90Gy



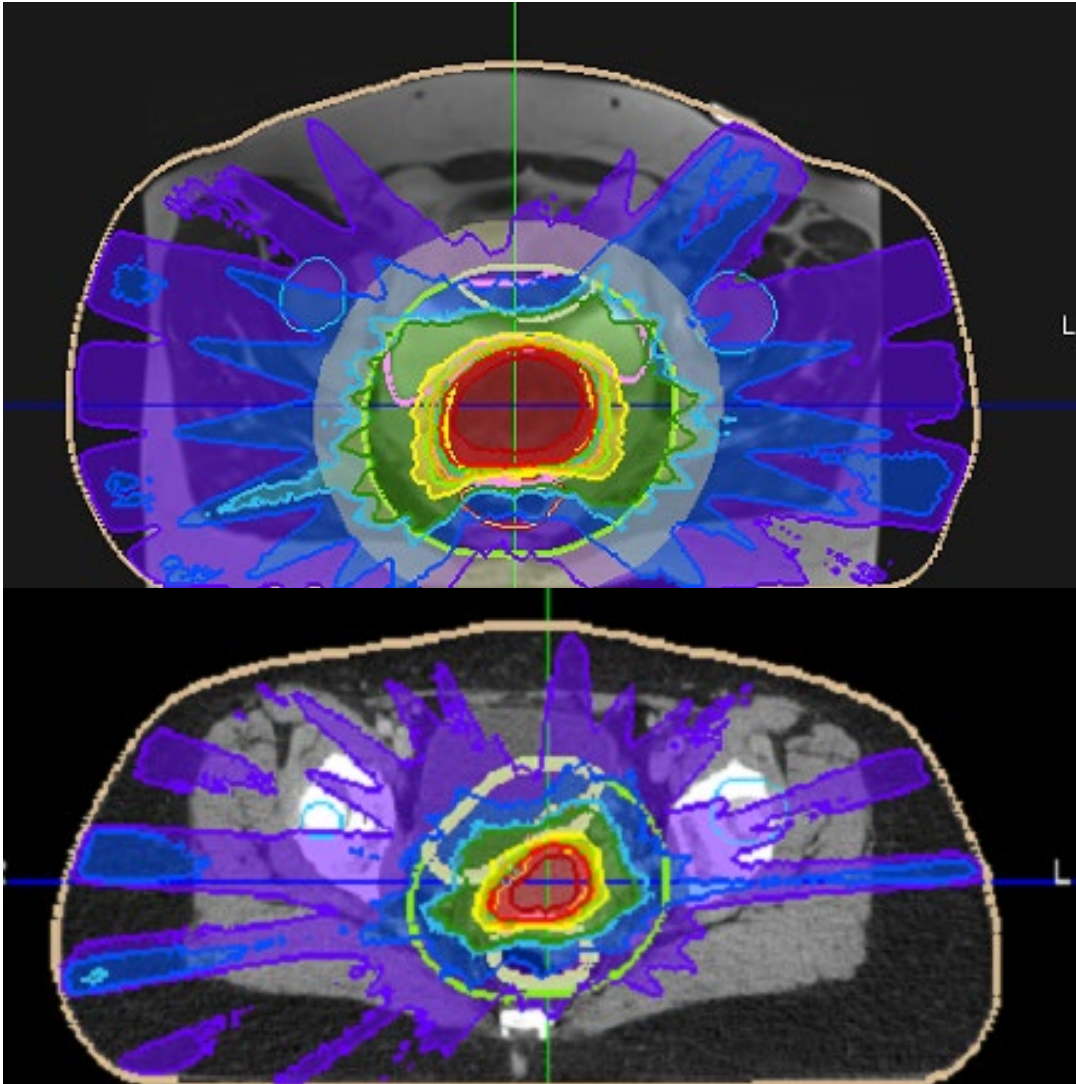
Test No	Px	Vol_CTV (cc)	D98%	D98%	D98%	D90%	D90%	D90%	D90%	Prescription Dose Spillage	Estimated Delivery Time	Global D-Max (Gy)
			Boost CTV EQD2 (Gy)	Boost PTVhigh EQD2 (Gy)	Boost PTV EQD2 (Gy)	Total CTV EQD2 (Gy)	Boost PTVhigh EQD2 (Gy)	Total PTVhigh EQD2 (Gy)	Total PTV EQD2 (Gy)		(minutes)	
1	30Gy/5#	13.1	45.0	35.8	29.3	99.4	42.7	87.0	81.4	1.05	10.5	53.2
	35Gy CTV Boost											
2	30Gy/5#	27.0	40.5	35.9	27.5	93.4	43.2	87.5	79.7	1.03	11.0	54.1
	35Gy CTV Boost											
3	30Gy/5#	40.0	40.8	37.7	28.4	96.4	43.4	87.6	81.1	1.04	9.0	53.1
	35Gy CTV Boost											
4	30Gy/5#	27.9	38.4	39.3	26.4	93.2	47.3	91.6	79.9	1.07	12.0	55.3
	35Gy CTV Boost											
5	30Gy/5#	59.4	35.2	33.6	24.6	84.0	39.7	83.9	73.7	1.05	10.8	53.3
	35Gy CTV Boost											
6	30Gy/5#	31.9	49.8	38.9	28.3	100.9	44.9	89.2	87.4	1.09	8.1	51.3
	35Gy CTV Boost											
7	30Gy/5#	82.3	37.1	36.2	28.2	91.8	41.8	86.0	79.8	1.03	11.8	54.6
	35Gy CTV Boost											
8	30Gy/5#	121.7	35.9	35.1	23.6	91.8	43.1	87.3	78.4	1.06	8.7	53.6
	35Gy CTV Boost											
Mean		50.4	40.3	36.6	27.0	93.9	43.3	87.5	80.2	1.05	10.2	53.6
St Dev		36.0	5.0	2.0	2.0	5.3	2.2	2.2	3.8	0.0	1.5	1.2



# Genesis Planning Project – Organs at risk

⑦ Rectum was the dose limiting structure

Combined EQD2 doses (Gy)	Bladder	Rectum	Bowel (small bowel/sigmoid )
Aim	Mandatory <90 Optimal <80	Mandatory <75 Optimal <65	Mandatory <75 Optimal <70
Mean	79.29	69.70	64.28
Maximum	84.62	69.85	69.49



# Conclusions

- Adaptive MR-Guided SABR Boost in gynaecological cancer is clinically feasible
  - Good target coverage: PTV high D90 83.9-91.6Gy
  - Acceptable OAR constraints (EMBRACE II)
  - Boosting to 175% prescription (not as high as brachytherapy)
- Useful alternative to EBRT boost in cases where brachytherapy not feasible as MRL facilitates more similar distribution to brachytherapy
- This protocol can be applied to cervical cancer or other gynaecological cancers if brachytherapy not feasible eg vaginal or recurrent cases

# Thank you

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