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Survey Overview
Proton SBRT/Hypofractionation for Liver

NRG Proton SBRT Working Group

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Liver Survey Overview

- Survey designed by NRG Proton SBRT Working Group
- Sent to all US proton centers participating in NRG trials in Summer 2021
- 66 survey questions, covering 5 categories
  - Vendors, Delivery Techniques, and TPS (1-4)
  - Patient Selection (5-13)
  - Simulation and Motion Management (14-19)
  - Treatment Planning and QA (20-52)
  - Motion and IGRT (53-66)

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Response Overview

- Response Rate: 66% (19/29)
- 18 centers treat liver SBRT and/or Hypofractionation with protons
- 1 center will implement in the near future (Beaumont)

Institution	Liver Q
Penn	x
MDA	x
MGH	x
UFPTI	
OKC	
Northwestern	x
LLUMC	x
NJ Procure	x
Hampton	
SCCA	x
Wash U	x
CA Protons	
Provision	x
Willis Knighton	x
RWJ	x
TX CPT	
Maryland	
Mayo Rochester	
Mayo AZ	x
UF Orlando	x
CASE	
Cincinnati	
Beaumont	x
Miami Cancer Inst	
Emory	x
NYPC	x
UOHSC	x
Johns Hopkins	x
Inova Schar	x

Vendors, Delivery Techniques, and TPSs

Vendors	Count	Rate	Techniques	Count	Rate	TPS	Count	Rate
IBA	9	47%	PBS	14	70%	Raystation	11	58%
Mevion	4	21%	Passive Scatter	5	25%	Eclipse	6	32%
ProBeam	2	11%	Uniform scanning	1	5%	others	2	11%
Hitach	3	16%	Total	20		Total	19	
Optivus	1	5%						
Total	19							

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Patient selection

Survey Question	Answers	# Responses	% Responses
Both primary and metastases	Technically/medically inoperable	17	94%
	No answer	1	6%
How many lesions are treated?	less 3	18	100%
What is the maximum tumor diameter allowed?	No limit	12	67%
	GI003 12cm	2	11%
	5cm	1	6%
	15cm	1	6%
	No answer or other	2	11%
How much uninvolved liver is acceptable?	700cc	16	89%
Do you perform SBRT/hypofraction reirradiation?	Yes	13	72%
	No	4	22%
	No answer	1	6%

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Patient selection

Survey Question	Total dose/# fx	# Responses	% Responses
Rx for primary liver cancers?	45 Gy / 5 fx	3	11%
	50 Gy / 5 fx	11	39%
	60 Gy / 3 fx	1	4%
	67.5 Gy / 15 fx	3	11%
	70.2 Gy / 15 fx	1	4%
Rx for metastases?	70 Gy / 10 fx	1	4%
	75 Gy / 25 fx	1	4%
	63 Gy / 15 fx	1	4%
	GI003 for diff dose level	1	4%
	30 Gy / 5 fx	2	7%
	Depends on histology, size, DVH, etc.	1	4%
	45-67.5 Gy / 15 fx	1	4%
	NTCP based model	1	4%

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Simulation and motion management

Questions	Answer	Rate	Answer	Rate	Answer	Rate	Answer	Rate
What CT scan slice thickness is typically used for liver SBRT/hypofractionation?	<1.5mm	26%	2 mm	32%	2.5 mm	32%	3 mm	11%
Which protocol do you follow for target delineation?	Internal	39%	NRG	50%	Not specify	11%		
How do you evaluate target motion?	4DCT	78%	BH repeat	17%	Not specify	6%		
What motion management methods are used? If multiple, please comment (**tot 41 answers**)	4DCT	22%	DIBH	32%	Abdominal compression	27%	Recanning	20%

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Treatment planning and QA

Questions	Answer	Rate	Answer	Rate	Answer	Rate	Answer	Rate
Do you use analytical algorithm or MC for planning dose calculation ?	Analytical	44%	MC	56%				
Setup and range uncertainty in robust optimization?	YES	94%	NA	6%				
On which targets is robust optimization utilized?	CTV/ITV	78%	PTV or others	22%				
What robust optimization **setup** uncertainty is used?	3mm	28%	5mm	61%	others	6%	NA	6%
What robust optimization **range** uncertainty is used?	3%	28%	3.50%	67%			NA	6%
Do you use robust evaluation for plan evaluation?	YES	94%	NO	6%				
What is robust criterion for target and OARs?	worst case	50%	second worst	11%	others	39%		
What is the dose volume criterion for target evaluation for robustness analysis?	D95>95Rx	78%	others	22%				
What is the inhomogeneity dose allowed in the target?	≤110%	33%	115%	28%	>125%	17%	No/not specify	22%

Treatment planning and QA

Questions	Answer	Rate	Answer	Rate	Answer	Rate	Answer	Rate
What is the typical beam arrangement for planning?	3-5fields	100%						
Do you perform 2nd dose calculation check?	YES	67%	NO/not specify	33%				
If yes, is the 2nd check algorithm analytical or MC?	MC	25%	Analytical	58%	No specification	17%		
What kind of patient QA is performed?	patient specific QA	89%	others	11%				
What is the patient QA analysis criteria?	**3%/3mm>90%**	50%	**3%/2mm**	11%	**2%/2mm**	11%	**3%/3mm>95%**	6%

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Motion management and IGRT

Questions	Answer	Rate	Answer	Rate	Answer	Rate	Answer	Rate
Is DIBH used?	DIBH	67%	No or not specify	33%				
If yes, what equipment is used for DIBH?	SDX	42%	RPM	25%	OSMS	8%	ABC	25%
Is gating used?	YES	11%	NO	89%				
Is rescanning used?	Rescanning	56%	NO	44%				
If rescanning is used, is it in-layer or volumetric?	Volumetric	80%	In-layer	20%				
If use volumetric, is done automatically or manually?	Auto	30%	Manually	70%				

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Motion management and IGRT

Questions	Answer	Rate	Answer	Rate	Answer	Rate
Tumor tracking?	NO	100%				
Are structures used for IGRT alignment?	YES	72%	NO structure	28%		
Are fiducial markers used for IGRT alignment?	YES	61%	NO	39%		
What types of IGRT are used?	CBCT	39%	kV only	56%	CT on rail	6%
Are kV images taken for each field?	YES	61%	NO	39%		
Is CBCT used before and after treatment?	Before	86%	Not specify	14%		
Do you do an evaluation or QA CT prior to the 1st treatment?	YES QA CT	56%	NO QA CT	44%		
Is any dose recalculation performed during the course of treatment?	Sometimes	39%	YES	33%	No	28%

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Acknowledgment

NRG proton SBRT work group members!

Thank You for Your Attention!

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Discussion Point: physics consideration

1. Motion managements (DIBH, abdominal compression, repainting…)
2. Analytical algorithm or MC for planning dose calculation, and the 2nd dose calculation is necessary?
3. Robust planning and evaluation
4. The role of IGRT in liver SBRT
5. The future improvement for proton liver SBRT(planning, motion, IGRT…)

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