Nationellt möte om sjukhusfysik 2016

Vildmarkshotellet Kolmården

16-18 november

SVENSKA SJUKHUSFYSIKER FÖRBUNDET

SVENSK FÖRENING FÖR RADIOFYSIK
SWEDISH SOCIETY OF RADIATION PHYSICS
(Member of IOMP)

Vi tackar våra utställare

SIEMENS Healthineers

visionrt

C-RAD

MICROPOS MEDICAL

VARIAN medical systems A partner for life

ELEKTA

TESIKA Teknik AB Test Simulering Kalibrering

RaySearch Laboratories

Mallinckrodt Pharmaceuticals

MEDIEL

Scanflex | Medical

Your Rad Din radioterapileverantör

BRAINLAB

gammadata

ScandiDos

AGFA Agfa HealthCare

Radeq Radiotherapy equipment

Program: Nationellt möte om sjukhusfysik 2016

Vildmarkshotellet, Kolmården

Tisdag 15/11

11.30 Lunch

12.30 Kurs: Radiologi för sjukhusfysiker *(Gorillan)*

13.00 Kurs: Programmering för sjukhusfysiker *(Schimpansen)*

19.00 Middag

Onsdag 16/11

08.00 Fortsättning kurs: Radiologi för sjukhusfysiker *(Gorillan)*

08.00 Fortsättning kurs: Programmering för sjukhusfysiker *(Schimpansen)*

11.30 Lunch

12.30 Välkommen! ***Marie-Louise Aurumskjöld och Anders Tingberg***

Session 1 *(Lejonet)*
12.45 - 14.45 *Moderator: Marie-Louise Aurumskjöld*

12.45	**Svenska Sjukhufysikerförbundet 40 år - En resa från 1976 via nuläget och in i framtiden**	
	Från 1976 till nu: förändring i yrke, organisation, lön och kön	*Birgitta Hansson*
	Sjukhusfysikerns roll i framtiden ur en enhetschefs perspektiv	*Jakobína Grétarsdóttir*
	Sjukhusfysikerns framtid ur ett akademiskt perspektiv	*Lars E. Olsson*
	Är vi bäst? - Sjukhusfysikerns utbildning och roll i Europa	*Stig Palm*
	Nya lagar och föreskrifter - hur påverkar det vårt yrke?	*Anders Frank*

14.45 Kaffe och utställning

Session 2 *(Lejonet)*
15.30 - 17.00 *Moderator: Karin Åberg*

15.30	Nätbaserat utbildningsmaterial inom sjukhusfysikerprogrammet - en möjlighet till kvalitetshöjning och samarbete?	*Jonna Wilén*
15.45	Stråletisk bedömning av multicenterstudier - en samlad nationell bedömning	*Agnetha Gustafsson*
16.00	*SSFF:s specialinbjudne föreläsare:* Kontroversiella studier om kost	*Fredrik Nyström*

17.00 Svenska Sjukhusfysikerförbundets årsmöte *(Lejonet)* / **Cheffysikermöte** *(Gorillan)*

20.00 Middag

Torsdag 17/11

Session 3a: Strålterapi *(Tigern)*
08.00-09.30 *Moderator: Sofie Ceberg*

Skandionkliniken före och efter klinisk start - reflektioner från en rotationsfysiker
Marika Enmark

Extracorporeal irradiation of bone in patients with locally advanced sarcoma
Julia Söderström

Motion induced interplay effects for VMAT radiotherapy of liver tumors
Anneli Edvardsson

HDR brachyterapi för prostatacancer - en dosplaneringsjämförelse mellan KS och Linköping
Frida Dohlmar

Vår kliniska erfarenhet: Implementering och utvärdering av Deep Inspiration Breath Hold med Surface Guided Radiotherapy och visuell guidning
Lovisa Berg

Measurements of absorbed dose to the skin and its relation with micro circular changes in breast cancer radiotherapy
Chahed Yacoub

Investigation of the prognostic value of CT and PET-based radiomic image features in oropharyngeal squamous cell carcinoma
Mohammed Said

Session 3b: MR *(Giraffen)*
08.30-09.30 *Moderator: Karin Åberg*

Myokardiell kvantifiering av T1- och T2-relaxationstider med 3DQALAS - validering och klinisk användbarhet
Sofia Kvernby

Aktuellt inom den kliniska MR-världen: runda bordssamtal:
- EMF-författningen (AFS 2016:3) - status på implementering i klinikerna
- QA
- Säkerhet

Session 3c: Röntgen *(Lejonet)*
08.30-09.30 *Moderator: Johan Sjöberg*

Automated evaluation of size-specific dose estimates (SSDE)
Morgan Nyberg

The addition of mechanical imaging to mammography - results and revelations
Magnus Dustler

Breast dosimetry simulation using volumetric localisation of dense breast tissue from breast tomosynthesis data - current status
Hannie Petersson

Strålskärmningsbehov för intraoral röntgen: enkel beräkningsmetod på distans
Nils Kadesjö

Session 3d: Nuklearmedicin *(Snöleoparden)*
08.30-09.30 *Moderator: Michael Ljungberg*

Accuracy in determination of split renal function in ^{99m}Tc-MAG3 renography: A Monte Carlo study based on a virtual patient
Irma Ceric

Kontroll av internkontamination med gammakamera
Jenny Oddstig

IDAC Star - a standalone program to easily Monte Carlo estimate the effective dose from internal or external contamination
Martin Andersson

Characterisation of scatter in GE Discovery 530c using Monte Carlo simulations
Michael Ljungberg

09.30 Kaffe och utställning

Session 4a: Nuklearmedicin och röntgen *(Lejonet)*
10.15-11.15 *Moderator: Anja Almén*

EPA (USA) cancer risk models as an alternative to effective dose to estimate the radiation risk for individual patients in health care
Martin Andersson

Creating Monte Carlo dose risk estimations based direct on CAD output files and validating the estimation using a 3D printer
Martin Andersson

Behandling av neuroendokrina tumörer med ^{177}Lu-Dotatate anpassad till individuell patientdosimetri
Katarina Sjögreen Gleisner

Developing a web portal for radiation protection data communication
Josef Lundman

Session 4b: Strålterapi och MR *(Tigern)*
10.15-11.15 *Moderatorer: Karin Åberg och Sofie Ceberg*

Gentle radiotherapy - Experience from a national consortium on integrating MRI in radiotherapy
Lars E. Olsson

Methodology and recommendations for using MRI in radiotherapy - a Skonsam Strålbehandling / Gentle Radiotherapy project
Christian Gustafsson

A novel method to assess dosimetric impact of system specific distortions in a MRI only radiotherapy workflow
Christian Gustafsson

Clinical utility of MRI for HDR brachytherapy of the prostate
Daniel Förnvik

A multi-center/multi-vendor validation of MRI only prostate treatment planning using synthetic CT images
Emilia Persson

11.15 Svensk förening för radiofysiks årsmöte *(Lejonet)*

12.00 Lunch och utställning

Session 5 *(Lejonet)*
13.00 - 14.40 *Moderator: Anders Tingberg*

13.00	*Kalle Vikterlöf-föreläsare:* Eurovision dosimetry contest - vi har ett resultat!	*Katarina Sjögreen Gleisner*
13.35	*Kurt Lidén-pristagare:* Ska en strålande mamma sluta att amma eller gör det detsamma?	*Sigrid Leide Svegborn*
14.10	*Holger Sköldborn-pristagare:* Every breath you take, every move you make, I'll be watching you	*Sofie Ceberg*

14.40 Kaffe och utställning

Parallella workshops *(A: Lejonet, B: Tigern + Snöleoparden)*
15.15 - 17.00

A. Framtiden är nu! Möt Sjukhusfysik 2020→ *Johan Sjöberg m. fl.*
Världen förändras, och vi med den. Den digitala revolutionen förändrar samhället i en omfattning som vi inte kan föreställa oss. För sjukvården väntar nya organisationer, verktyg och arbetssätt runt hörnet. Låt oss ta tillfället i akt och börja bygga framtiden tillsammans i denna utmanande, och kanske något annorlunda workshop.

B. Framtidens strålsäkerhet i sjukvården *Anja Almén m. fl.*
Omvärlden förändras och vi med den - eller?
Kom och diskutera aktuella strålskyddsfrågor med dina kollegor i ett konstruktivt diskussionsklimat.
Behövs fler fortbildningskurser, behöver vi arbeta mer tillsammans eller ska vi helt enkelt låta andra professioner ta över?
Vilka frågor är hetast? - Du bestämmer.

18.30 Gemensam aktivitet och fördrink
Samling i hotellets foajé med klädsel anpassade för en kortare utomhuspromenad!

20.00 Konferensmiddag med dans och underhållning

Fredag 18/11

Session 6 *(Lejonet)*
09.00 - 10.00 *Moderator: Sofie Ceberg*

09.00	*Bästa examensarbete 1*: Systematic evaluation of tumor response to treatment based on repeated FDG PET images for head & neck cancer patients	*Marta Lazzeroni*
09.15	*Bästa examensarbete 2*: Assessment of radionuclide content in waste barrels using the Canberra In-Situ Object Counting System (ISOCSTM)	*Marcus Persson*
09.30	*Bästa examensarbete 3*: Optimisation of injected activities of ^{18}F-FDG to adult patients scanned on a Siemens Biograph mCT	*Rassul Yunussov*
09.45	*Swears Shooting Star*: DNA damage and repair in U2OS cells exposed to mixed beams of alpha particles and X-rays	*Alice Sollazzo*

10.00 Kaffe och avslutning på tipspromenaden

Session 7 *(Lejonet)*
10.30 - 11.30 *Moderator: Michael Ljungberg*

10.30	*Inbjuden föreläsare:* Synchrotron Radiation X-ray imaging and applications to bio/medical samples	*Martin Bech*

11.30 Avslutning *(Lejonet)*
- SSFF's pris till bästa föreläsning
- Vinnare i tipspromenaden

Marie-Louise Aurumskjöld och Anders Tingberg

12.00 Lunch och hemresa

SVENSKA SJUKHUSFYSIKER FÖRBUNDET

SVENSK FÖRENING FÖR RADIOFYSIK

Nätbaserat utbildningsmaterial inom sjukhusfysikerprogrammet – en möjlighet till kvalitetshöjning och samarbete?

J Wilén[1*], C Ceberg[2]

[1]*Institutionen för strålningsvetenskaper, Umeå universitet, Umeå, Sverige*

[2]*Medicinsk strålningsfysik, Lunds universitet, Lund, Sverige*

Institutionen för strålningsvetenskaper vid Umeå universitet och avdelningen för medicinsk strålningsfysik vid Lunds universitet har i ett gemensamt projekt, initialt på uppdrag av Varian Medical System, utvecklat ett nätbaserat undervisningsmaterial som kan användas inom sjukhusfysikerutbildningen.

Materialet har tagits fram av en grupp erfarna lärare och sjukhusfysiker, som utöver författarna har bestått av Heikki Tölli, Anders Garpebring, Tufve Nyholm, Jörgen Olofsson, Josef Lundman och Mikael Karlsson (Umeå), samt Sofie Ceberg, Per Engström och Tommy Knöös (från Lund).

Materialet består av ca 50 st lektioner i form av PowerPoint bilder med inläst speakertext och enklare kunskapskontroller till varje lektion. Lektionerna täcker in de mer elementära delarna av kärnfysik, växelverkan, dosimetri, strålningsbiologi, strålskydd, tillämpad dosimetri och radioterapi och till viss del röntgen, PET och MR. Vi kommer under presentationen att demonstrera kortare delar av materialet och också ge exempel på hur det kan implementeras i sjukhusfysikerutbildningen.

Vår förhoppning är att detta material ska kunna komma våra studenter till del och på sikt höja kvaliteten på vår undervisning. En av våra tankar är att komplettera den lärarledda undervisningen med nätbaserat material, framförallt på relativt elementära moment i kurserna för att på så sätt frigöra mer lärarledd tid till komplexa frågeställningar och studentaktiva moment. Vi föreställer oss också att materialet kan utvecklas vidare i ett vidgat samarbete som kan inkludera alla undervisningsorter i landet.

[*]*Presenting author: jonna.wilen @umu.se*

Skandionkliniken före och efter klinisk start - reflektioner från en rotationsfysiker

Marika Enmark

Den 31 augusti 2015 behandlades den första patienten på Skandionkliniken i Uppsala, Nordens enda protonklinik. Nu, drygt ett år senare, har mer än 160 patienter förberetts på sina hemmakliniker och behandlas på Skandionkliniken med gemensam kompetens och i samarbete med alla Sveriges landsting med universitetssjukhus.

Ur ett fysikerperspektiv har detta varit ett intensivt arbete, där många kontakter knutits, nya arbetskollegor vunnits och kompetenser blandats. Vi involverades tidigt i projektet. Utbildning, acceptanskontroller, inmätning och klinisk uppstart har avlöst varandra sedan 2013.

Nu i klinisk drift, är vi ett tiotal rotationsfysiker som växelvis åker till Uppsala och Skandionkliniken för att arbeta i kliniken tillsammans med de fasta fysikerna. Men arbetet tar också andra former. Flera olika fysiker- och multidisciplinära nationella grupper arbetar med att utforma riktlinjer, behandlingsprotokoll, kvalitetssäkring, förvaltning och annan utveckling av verksamheten i Skandionsamarbetet.

Hur är det då att vara en ”distribuerad fysikerkompetens”?
- Ja, det tänker jag reflektera över.

Extracorporeal irradiation of bone in patients with locally advanced sarcoma

J Söderström[*1], A Hesla[2], P Wersäll[3], T Pommer[1]

[1] *Department of Medical Physics, Karolinska University Hospital, Stockholm, Sweden*

[2] *Department of Orthopaedic Surgery, Karolinska University Hospital, Stockholm, Sweden*

[3] *Department of Oncology, Karolinska University Hospital, Stockholm, Sweden*

Introduction: Extracorporeal irradiation (ECIR) of bone is a technique where a tumor-burdened bone segment is removed from a patient during surgery, irradiated outside of the body and then immediately re-implanted into the patient. The first study of ECIR was published in 1977 (Belgium) where the bone segments were given a dose of at least 300 Gy. In 1996 the technique was introduced in Australia where it has shown to be successful, this time by irradiating to a dose of 50 Gy. In November 2015 the first patient was treated with ECIR at Karolinska University Hospital, Sweden. The purpose of (ECIR) of the bone was to treat patients with locally advanced sarcomas where the location of the disease made the conventional approach of surgical removal of the bone and insertion of a non-autographed prosthesis less beneficial.

Materials and Methods: Three patients with locally advanced sarcomas located at femur (one case) or tibia (two cases) have been treated with ECIR at Karolinska University Hospital. During surgery a bone segment of the diseased bone was removed from the patient and transported to the Department of Radiotherapy where it was given a dose of 50 Gy in a single fraction. The bone segment was fixed in a water phantom which was the filled to a pre-determined level and irradiated by two equal weighted opposing fields. Immediately after the irradiation the bone segment was re-implanted into the patient. Treatment planning was done in Eclipse (Varian Medical Systems). Dose verification was performed by placing a farmer chamber at the position of the bone in the water phantom.

Results and Conclusions: Two of the three patients have responded well to the treatment. One patient suffered from a skin infection due to the surgery and the bone segment thereby had to be removed. Longer follow-up is necessary before further conclusions can be drawn.

[*] *Presenting author: julia.soderstrom@karolinska.se*

Motion induced interplay effects for VMAT radiotherapy of liver tumors

Anneli Edvardsson*[1], Fredrik Nordström[2], Crister Ceberg[1], Sofie Ceberg[3]

[1]*Medical Radiation Physics, Department of Clinical Sciences Lund, Lund University, Lund, Sweden*
[2]*Department of Medical Physics and Biomedical Engineering, Sahlgrenska University Hospital, Gothenburg, Sweden*
[3]*Department of Hematology, Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden*

Purpose
The mutual movement of the tumor and treatment delivery during volumetric modulated arc therapy (VMAT) might cause hotspots and coldspots in the dose distribution, so-called interplay effects. The purpose of this study was to investigate interplay effects for VMAT treatment of moving liver tumors.

Methods
For three liver metastases, VMAT treatment plans were created in a treatment planning system (TPS) and divided into smaller sub-arc using an in-house developed software. The isocenter for each sub-arc was shifted to simulate sinusoidal motion in the superior-inferior direction. Different patient and machine specific parameters, such as amplitude (5, 15, 25 mm), period time (3, 5, 7 s), initial breathing phase (0, 25, 50, 75 %), dose rate (600 and 1400 MU/min) and plan modulation complexity (increasing number of MU/Gy; MU_0, MU_1, MU_2), were simulated. The resulting sub-arcs were calculated in the TPS, which generated a sum dose distribution that included the effects of motion. To isolate the interplay effect from dose blurring, the original dose distribution was convolved with the motion pattern and subtracted from the sum dose distribution. From the resulting dose distribution, the percentage of voxels with a dose difference larger than 5 % for the target volume was calculated, representing overdosed ($V_{>5\%}$) and underdosed ($V_{<-5\%}$) volumes.

Results
A trend towards larger $V_{>5\%}$ and $V_{<-5\%}$ was observed for longer period times and higher amplitudes and both $V_{>5\%}$ and $V_{<-5\%}$ varied considerably with initial breathing phase. In particular, both the mean $V_{>5\%}$ and $V_{<-5\%}$ increased with increased dose rate and plan modulation complexity (table 1) and the maximum $V_{>5\%}$ and $V_{<-5\%}$ observed were 22.5 and 26.3 %, respectively.

Table 1 Mean (maximum) percentage of voxels with an absolute dose difference larger than 5 % ($V_{>5\%}$ or $V_{<-5\%}$) of the 36 different combinations of amplitude, period time and initial breathing phase, presented for the two different dose rates (600 and 1400 MU/min) and increasing plan modulation complexity (MU_0, MU_1, MU_2).

	$V_{>5\%}$ (%)	$V_{<-5\%}$ (%)
600 MU/min / MU_0	0.1 (2.8)	0.1 (1.7)
1400 MU/min / MU_0	1.0 (22.5)	0.9 (20.1)
1400 MU/min / MU_1	2.4 (21.7)	2.1 (26.3)
1400 MU/min / MU_2	3.8 (16.0)	3.4 (17.1)

Conclusion
Large interplay effects may occur for VMAT treatments of moving liver tumors, and the extent depend on the breathing pattern, dose rate and plan modulation complexity. The interplay effects result in both over-and underdosage of the target volume, which might lead to reduced tumor control probability.

* *Presenting author: anneli.edvardsson@med.lu.se*

HDR brachyterapi för prostatacancer – En dosplaneringsjämförelse mellan KS och Linköping

F Dohlmar[*1], S Johansson[2] and Å Carlsson Tedgren[2,3]

[1]*Radiofysikavdelningen, Linköpings universitetssjukhus, Region Östergötland, Linköping, Sweden*

[2]*Karolinska universitetssjukhuset, Stockholms läns landsting, Stockholm, Sweden*

[3]*Radiofysik, Institutionen för medicin och hälsa (IMH), Linköpings universitet, Linköping, Sweden*

Brachyterapi som en boost till extern strålbehandling är ett behandlingsalternativ enligt det svenska vårdprogrammet för prostatacancer. I Sverige ges 50 Gy (2 Gy x 25) externt och därtill vanligtvis 20 Gy (10 Gy x 2) med brachyterapi. Tekniken för dosplanering vid brachybehandlingar skiljer sig en del från klinik till klinik. En jämförelse mellan KS och Linköpings dosplaner har gjorts. Jämförelsen är en del i förberedelserna till en planerad klinisk utvärdering av nya optimeringsverktyg grundade i matematiska optimeringsmetoder som utvecklas i Linköping, där även onkologer planeras att medverka.

Fem patientbildunderlag valdes ut från KS och fem från Linköping. KS har gjort dosplaner på alla tio underlag med manuell optimering av källtiderna och Linköping har gjort med invers optimering (AVOL) av källtiderna. Källpositionerna har för KS dosplaner aktiverats från nollposition i jämna steg om 5 mm, alltså på samma avstånd från nålspetsen för alla nålarna. I Linköpings dosplaner har källpositionerna optimerats automatiskt, så att första och sista positionen har anpassats efter PTV. Källpositionerna är placerade med 5 mm emellan. Dosplanerna har jämförts utifrån DVH-parametrar. För riskorganen har KS och Linköping olika doskriterier, rectum < 7 Gy/fraktion respektive < 6 Gy/fraktion och urethra < 11 Gy/fraktion respektive < 10 Gy/fraktion. Alla dosplaner har gjorts i BrachyVision version 13.6 (Varian).

Preliminära resultat visar på att KS använder fler nålar än Linköping, vilket medför större högdosområden i PTV ($V_{200\%}$) för Linköpings dosplaner. KS har bättre täckning av PTV ($D_{95\%}$ och $V_{100\%}$) än Linköping, men KS behandlar mer frisk vävnad än Linköping ($V_{100\%}$ för normalvävnad). Doskriterierna för riskorganen uppfylls enligt respektive kliniks doskriterier.

[*] *Presenting author: frida.dohlmar@regionostergotland.se*

Vår kliniska erfarenhet: Implementering och utvärdering av Deep Inspiration Breath Hold med Surface Guided Radiotherapy och visuell guidning

L. Berg[*1], M. Kügele[1, 2], P. Ambolt[1], A. Edvardsson[2], C. Andersson Ljus[1], S. Alkner[1] and S. Ceberg[1].

[1]*Hematologi, Onkologi och Strålningsfysik, Skånes Universitetssjukhus, Lund, Sverige*

[2]*Medicinsk Strålningsfysik, Lunds Universitet, Lund, Sverige*

Syfte: Att implementera och utvärdera gatingtekniken Deep Inspiration Breath Hold (DIBH) med Surface Guided Radiotherapy (SGRT) och visuell guidning för strålbehandling av vänstersidiga bröstcancerpatienter.

Metod: Innan tekniken sattes i kliniskt bruk gjordes ett omfattande multidisciplinärt arbete med att ta fram nya metodbeskrivningar, utveckla kvalitetskontroller samt att utbilda berörd personal. Skånes Universitetssjukhus har erbjudit bröstcancerpatienter gating sedan 2007, dock är tekniken att använda SGRT i form av optisk ytscanning för att monitorera andningen och styra beam on/off nytt sedan hösten 2015. Alla patienter behandlas i behandlingsrum med tillgång till ett Catalyst 3-kamera system (C-RAD positioning AB, Uppsala, Sverige). Flera projekt pågår för att utvärdera tekniken, här följer tre: 1) Kontroll av att inter-/intra-fraktionell rörelse i skarven dels detekteras korrekt av Catalyst och dels håller sig inom fördefinierade marginaler. Endast de patienter med körtelengagemang, och som behandlas med skarvad fältsättning, är med i denna kontroll. 2) Analys av eventuell hävningsrisk under behandling, s.k. ”fake breathing”, som i sin tur medför risk för förhöjd dos till riskorgan. Avståndet mellan sternum och kota jämförs i CT-referens och under behandling. 3) Utvärdering av eventuell dosvinst till riskorgan med DIBH genom dosplaneringsstudie med 40 patienter, både med och utan körtelengagemang, som erhållit dubbla CT-underlag (gating och icke-gating).

Resultat: Preliminära resultat ifrån 1) visar att DIBH-patienterna har en stabil andning med rörelse i skarvområdet inom satta marginaler, samt att rörelse stämmer överens med Catalyst. 2) Preliminära data visar på mycket låg hävningsrisk, utvärdering pågår fortfarande. 3) I dosplaneringsstudien för vänstersidiga bröstcancerpatienter utan körtelengagemang beräknades en minskning i medeldos till hjärtat från 1.5 ± 0.8 Gy (1 SD) för konventionell behandling i normalandning till 0.8 ± 0.3 Gy för DIBH. För LAD beräknades medeldosen minska från 9.6 ± 7 Gy under normalandning till 3.9 ± 3 Gy med DIBH. Arbete pågår för patienter med körtelengagemang.

Diskussion: Implementeringen av DIBH med SGRT och visuell guidning har varit ett stort multidisciplinärt projekt. Sedan första patienten startade i september 2015 har över 120 patienter erhållit strålterapi med denna behandlingsteknik i vår klinik. Samarbetet mellan olika yrkeskategorier har gått bra och tillsammans har metoder testats och utvärderats för att få fram bästa möjliga arbetsflöde. Preliminära resultat visar att DIBH med SGRT och visuell guidning är en fullgod andningsanpassad gatingteknik för patienter med vänstersidig bröstcancer.

[*] *Presenting author: Lovisa.Berg@Skane.se*

Measurement of absorbed dose to the skin and its relation with microcircular changes in breast cancer radiotherapy

C Yacoub[*1], E Adolfsson[1] and E Tesselaar[1]

[1]Radiation Physics, Department of Medical and Health Sciences, Linköping University, Linköping, Sweden

Radiation therapy has been shown to increase local and regional control as well as overall survival with breast cancer, but the vast majority of patients develop acute skin reactions, which are in part related to microvascular changes. These reactions vary between different skin sites. The aim of this work is to determine the absorbed dose to the skin by measurements and investigate if there is a correlation between the absorbed dose at different areas of the breast and the local changes in microcirculation in the skin after breast cancer radiotherapy. The study includes characterisation of the Gafchromic EBT3 film and Epson Perfection V600 Photo scanner which are used for absorbed dose determination. The measurements were done both on an anthropomorphic female phantom and on a patient undergoing breast cancer radiotherapy. Twenty-one pieces of film (2x1 cm^2) were placed on the surface of the breast (both for the phantom and patient) and irradiated with a prescribed dose to the target of 2.66 Gy with two opposed fields using 6 MV beam.

It was observed that mainly 45-64 % of the prescribed dose was deposited at the surface, both for the phantom and patient. Using laser speckle contrast imaging and polarised light spectroscopy, the regional changes in mean blood perfusion and in mean red blood cell concentration (RBCC) at the end of the treatment with a total prescribed dose of 42.6 Gy, compared to baseline, were measured in both the treated and untreated breast of the same patient. Although marked increases in perfusion were seen in different areas of the treated breast, there was no significant correlation between the changes in perfusion and the absorbed dose at these areas. However, a statistical correlation was found between the changes in RBCC and the absorbed skin dose at the same areas. To further elucidate the relation between the changes in skin microcirculation and the absorbed radiation dose during breast cancer radiotherapy, future studies using a larger number of patients are needed.

[*] *Presenting author: Chahed.Yacoub@regionostergotland.se*

Investigation of the prognostic value of CT and PET-based radiomic image features in oropharyngeal squamous cell carcinoma

Mohammed Mosad Said[*1, 2], Crister Ceberg[1] and Per Nilsson[1, 2]

[1]*Medical Radiation Physics, Department of Clinical Sciences Lund, Lund University, Lund, Sweden*

[2]*Department of Hematology, Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden*

Background: Medical data in the form of radiographic routine scans is steadily accumulating. The analysis of such data through automated quantitative methods is believed to produce new information which would allow for more personalization of therapy. The present thesis investigated the use of such methods in head and neck cancer.

Material and methods: Pretreatment CT and PET scans from 74 patients present with oropharyngeal squamous cell carcinoma were analyzed quantitatively and a total of 92 image-based features were calculated. The features attempt to describe the shape and size of the tumor, as well as the heterogeneity within. The prognostic value of these features and other clinical variables was investigated for tumor recurrence and disease-specific mortality, respectively. Additionally, prediction of treatment failure was attempted using an artificial neural network.

All patients received intensity-modulated radiation therapy and treatment plans were available in addition to PET/CT scans. The non-uniformity of the dose distribution was studied using custom features that measure the number of disconnected regions receiving either too low or too high of a radiation dose.

Results: One PET- and two CT-based features were found to significantly differ between responders and non-responders. The PET-based feature was the correlation ($p = 0.0011$), which is a texture feature describing the irregularity in radiotracer uptake on a voxel-to-voxel basis and results suggest that non-responders have more irregular patterns of uptake. The CT-based features were the variance ($p = 0.0012$) and skewness ($p = 0.0027$), where the former was found to be significantly larger among responders and the skewness more negative. Nonetheless, image-based features performed poorly in treatment failure prediction, as compared to clinical variables, which had an AUC of 0.87 (95% confidence interval, 0.73-0.96) for primary tumor recurrence and 0.73 (95% confidence interval, 0.52-0.87) for disease-specific mortality. Three image-based features did, however, contribute significantly when included to the model utilizing clinical variables, which suggests that they may contain additional information that is likely to be of value. Of the five custom features calculated on the dose distribution, the one emphasizing differences in the number of disconnected regions was observed to be significantly higher among non-responders.

Conclusion: Quantitative analysis of routine scans may provide additional information regarding tumor phenotype, which is likely to be of value when used in conjunction with clinical variables. Additionally, texture analysis of the dose distribution reveals differences between treatment plans that are not captured by dose-volume histogram metrics. The methods are, however, relatively new in use on medical data and there are certain details that require further investigation.

[*] *Presenting author: mohammed.said@skane.se*

Myokardiell kvantifiering av T1- och T2-relaxationstider med 3D-QALAS – validering och klinisk användbarhet

Sofia Kvernby[1*], Marcel Warntjes[1], Carl-Johan Carlhäll[2], Jan Engvall[3] and Tino Ebbers[1]

[1]Linköpings Universitet, IMH/CMIV, Linköping
[2]Linköpings Universitet, IMH, Linköping
[3]Region Östergötland, Klinisk Fysiologi, Linköping

[*] *Presenting author: sofia.kvernby@liu.se*

Background

Quantification of the longitudinal- and transverse relaxation time in the myocardium has shown to provide important information in cardiac diagnostics. Several methods are currently available for cardiac relaxation time mapping but they generally demand a long breath hold to measure either T1 or T2 in a single 2D-slice. These long scan times hamper clinically applicability.
Recently, we proposed a new method for simultaneous myocardial T1- and T2-relaxation times mapping of the whole left ventricular myocardium in a single breath hold, 3D-QALAS [Kvernby et al. JCMR 2014]. The aim of this study is to investigate the in-vivo precision and clinical feasibility of 3D-QALAS.

Methods

Ten healthy subjects and 23 patients with different cardiac pathologies underwent cardiovascular MRI examinations including a 3D-QALAS acquisition, as well as T1-MOLLI and T2-GraSE for comparison. Precision was investigated in the healthy subjects between independent scans, between dependent scans and as standard deviation of eight consecutive scans. Clinical feasibility of 3D-QALAS was investigated for native and contrast enhanced myocardium in patients.

Results

All healthy volunteers and patients completed the study and data were successfully acquired. Myocardial relaxation times measurements with 3D-QALAS correlated very well with reference methods (Figure 1). Average myocardial relaxation time values and SD from eight repeated acquisitions within the group of healthy subjects were 1178±18.5ms for T1 with 3D-QALAS, 52.7±1.2ms for T2 with 3D-QALAS, 1145±10.0ms for T1 with MOLLI and 49.2±0.8ms for T2 with GraSE.

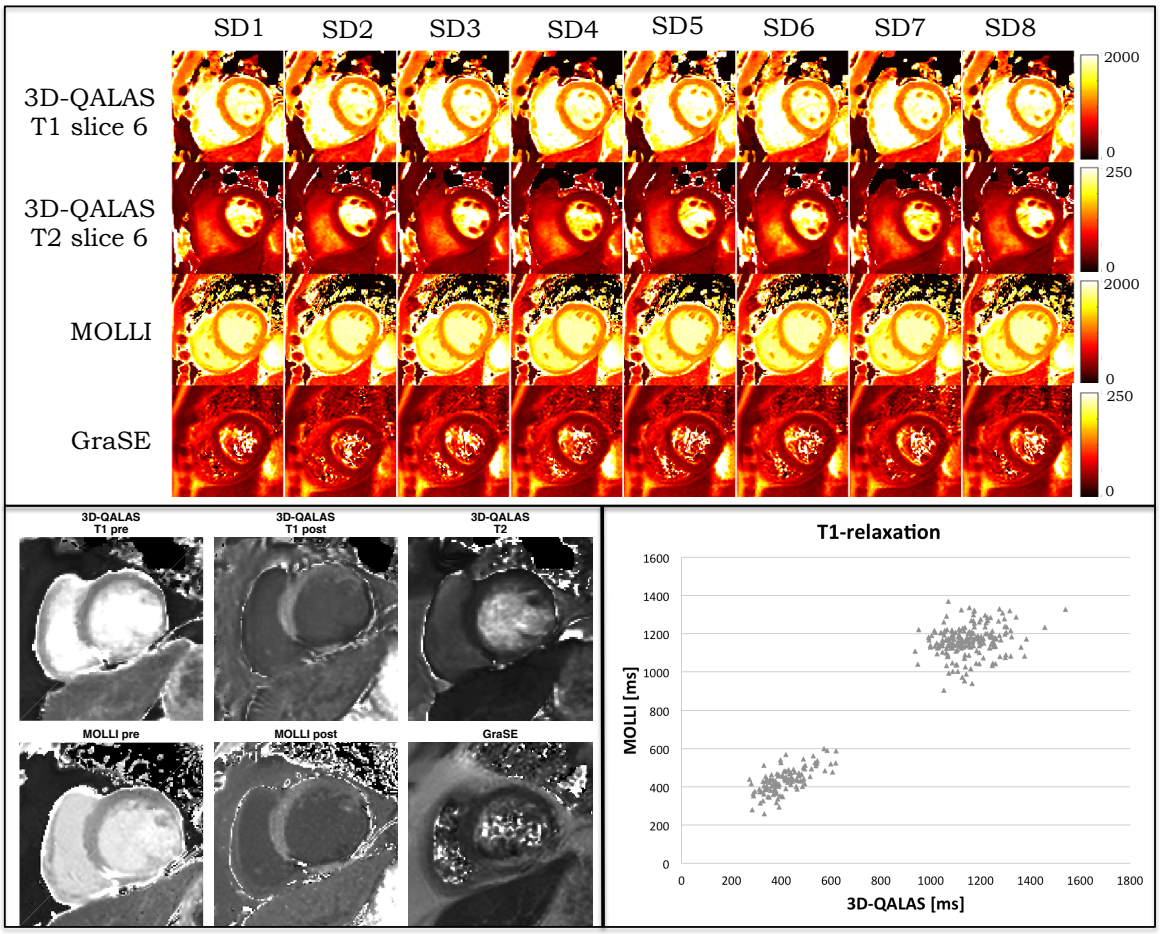


Figure 1. Upper: Relaxation times maps from eight consecutive scans (SD1-SD8) of a healthy volunteer. Lower left: Native and post contrast T1- and T2 maps with 3D-QALAS and the reference methods from a patient with ischemic cardiomyopathy. Lower right: Illustration of longitudinal relaxation times values with MOLLI and 3D-QALAS on a segmental basis for the six mid-ventricular segments.

Conclusions

This study shows that 3D T1 and T2 mapping in the left ventricle is feasible in one breath hold for patients with different cardiac pathologies using 3D-QALAS. Repeated independent and dependent scans together with the intra-scan repeatability, demonstrated all a very good precision for the 3D-QALAS method.

Automated evaluation of size-specific dose estimates (SSDE)

M Nyberg[*1], J A Lundman[2] and J S Andersson[2]

[1]*Department of Medical Physics, Sundsvall Hospital, SE-856 43 Sundsvall, Sweden*

[2]*Department of Radiation Sciences, Radiation Physics, University of Umeå, SE-901 85 Umeå, Sweden*

Patient dose for a particular computed tomography (CT) examination can be described as a function of radiation output in a standard geometry ($CTDI_{vol}$) and patient size. Currently, patient dose for CT examinations is evaluated by the $CTDI_{vol}$ either for a standardized "head" or "body", i.e. with little to no patient specificity. To account for the individual patient's size in applied CT dosimetry, AAPM TG 204 have proposed size-specific dose estimates (SSDE) that employ the $CTDI_{vol}$ and correction factors derived from Monte Carlo simulations and measurements in various geometries. The correction factors, as given in the report of AAPM TG 204, may be determined either from axial images or scan projection radiographs. Furthermore, the individual patient may be characterized either by physical size or a more robust attenuation based metric, i.e. the water equivalent diameter (WED), as described by AAPM TG 220.

In the spring of 2016, we began developing OpenSSDE, a software for extracting patient size parameters and calculating SSDE. In OpenSSDE, patient size parameters, such as anteroposterior (AP) and lateral (LAT) dimensions, as well as WED and equal area diameter are estimated using automated image analysis of the axial scans. Corresponding dimensions are extracted from scan projection radiographs. These are then used for determination of SSDE.

The software has been evaluated, regarding both speed and accuracy, on clinical patients and phantoms with known dimensions and compositions. The evaluation has been performed on image data from three different CT systems, Siemens Definition Flash, Philips Brilliance CT Big Bore, and GE LightSpeed VCT.

Preliminary results show excellent agreements in estimated patient size by the various parameters evaluated for axial scans. Localizer scans are less standardized in regard to pixel intensity normalization and the resulting patient size estimation is so far, at most, adequate.

[*] *Presenting author: morgan.nyberg@lvn.se*

The addition of mechanical imaging to mammography – results and revelations

M Dustler[1], P Timberg[1], S Zackrisson[2] and A Tingberg[1]

[1]*Medical Radiation Physics, Lund University, Malmö*

[2]*Diagnostic Radiology, Lund University, Malmö*

This paper will describes the usage of pressure sensors to measure the distribution of the compression force on the surface of the breast, both for compression optimization and to investigate the diagnostic use of the pressure sensors as a mechanical imaging system. The results are based on numerous studies conducted by the authors since 2010.

Compression of the breast is seen as a requirement for a high quality mammogram and as a means of reducing the radiation dose. No optimal compression level has been determined. Studies have shown that pain from compression is one of the main factors for screening non-attendance.

Of women recalled from mammography screening for further clinical work up, as many as 90% are false positives. Interventions that could provide further data with which to characterize suspicious findings at the initial screening stage would thus be very valuable, both economically for the healthcare system and for the psycho-social well-being of the women.

Our studies have shown that compression of the breast is inefficient mainly due to the presence of stiff and thick tissue close to the chest wall. Results have shown that in most cases, this juxtathoracic tissue – of which the pectoral muscle is a prominent component – is subject to very high pressures. Studies by other groups have suggested a mean breast pressure of 10 kPa, but our results across several studies consistently show average pressures of 3-4 kPa on the breast, with the distribution being highly heterogeneous; less than 1/3 of the applied force is distributed to the breast itself. Pressure on the breast is not substantially affected by reducing the force by 50%, and neither is breast thickness. Using flexible compression paddles provide an improved compression by redistributing force from the juxtathoracic area.

The increased stiffness of malignant tumours compared to benign lesions and normal breast tissue is known, and our studies clearly show that this can be difference can be characterized by mechanical imaging. Implementation of this as an adjunct to mammography screening could potentially reduce recalls without impairing sensitivity, with results suggesting a reduction of 36%.

* *Presenting author: magnus.dustler@med.lu.se*

Breast dosimetry simulation using volumetric localization of dense breast tissue from breast tomosynthesis data – current status

H Petersson*, P Timberg, D Förnvik, A Tingberg and M Dustler

Medical Radiation Physics Malmö, Department of Translational Medicine, Lund University, Skåne University Hospital Malmö, 205 02 Malmö, Sweden

Breast tomosynthesis (BT) is an imaging technique that has been introduced recently as an alternative or complement to standard mammography in breast cancer screening. In mammography the radiation risk is traditionally evaluated using the average glandular dose. This quantity may be useful for population statistics and to compare exposure techniques and systems but it does not provide a good measure of the individual radiation risk. To evaluate the individual risk, the assessment should take into account the individual glandular amount and distribution. This requires 3D-localisation of the glandular tissue within the breast which is possible with 3D imaging techniques such as BT. The local energy absorption can then be estimated from Monte Carlo simulation for individual cases. However, the method has to be simple and fast enough to be useful in the daily clinical practise.

The aim of this work is to use a method for volumetric localization of dense breast tissue from BT data, and a simulation routine based on the Penelope Monte Carlo code system, to estimate the local energy absorption in breasts with different amount and distribution of glandular tissue.

To evaluate the routine, digital breast phantoms with different amount of glandular tissue is created based on a voxel breast phantom developed at the University of Pennsylvania. The simulation procedure is used for generation of BT projection images and simulation of local energy absorption. The projection images are used to reconstruct image volumes and a previously developed method is used to estimate the localization of glandular tissue in these volumes. Digital breast phantoms are recreated and the simulation procedure is used to estimate the energy absorption to glandular tissue. Finally, the glandular energy absorption in the original breast phantoms is compared with the glandular energy absorption in the recreated breast phantoms.

Eventually, the steps of the routine will be evaluated and simplified as much as possible in order to optimize the method and make it fast enough for clinical use.

This is a work in progress and preliminary results will be presented.

* *Presenting author: hannie.petersson@med.lu.se*

Strålskärmningsbehov för intraoral röntgen: enkel beräkningsmetod på distans

N Kadesjö[*1,2], K Sandqvist[3]

[1]*Institutionen för Odontologi, Karolinska Institutet, Huddinge, Sverige*

[2]*VO Sjukhusfysik, Karolinska Universitetssjukhuset, Stockholm, Sverige*

[3]*Praktikertjänst AB, Stockholm, Sverige*

Syfte: Tandvården har under de senaste åren hamnat under Strålsäkerhetsmyndighetens granskade öga, vilket har resulterat i ett antal viten och förelägganden. Ett av problemen som branschen brottas med är dokumentation över befintlig strålskärmning, eftersom många tandläkarpraktiker ligger i lokaler som har använts som tandläkarmottagningar i många årtionden. Flera av dessa har dessutom inte uppdaterats till nuvarande lagkrav, utan följer den äldre föreskriften SSI FS 1991:2 där det specificeras 0,25 mm bly för väggar. Därför finns det ett behov av en enkelt metod för att bedöma huruvida befintlig utformning av lokalen är tillräcklig i lagens mening. För att förenkla för tandläkare och fysiker så har vi sammanställt en metod för att beräkna strålskärmningsbehovet i en lokal som används för intraoral bildtagning, utan att behöva besöka varje tandläkarmottagning.

Metod: Beräkningsmetoden bygger på att inga särskilda stråldosmätningar ska behöva utföras. Nödvändiga uppgifter begärs in från tandläkaren: antal patienter per år, antal bilder per år, exponeringslista, storlek och längd på kollimator, utgångsdos vid kollimator, rumsritning och behandlingsstolens orientering. Värden för spridningsfaktorer och transmission av primärstrålning kan tas från litteraturen. Det möjliga dosbidraget, både från spridd strålning och från transmitterad primärstrålning efter patienten, beräknas för fyra riktningar omkring patienten samt vid behov även för golv och tak.

Resultat: Ett beräkningsblad med metodbeskrivning har tagits fram. Den möjliga stråldosen, och därmed strålskärmningsbehovet, skiljer sig mycket beroende på riktningen från patienten, eftersom bidraget från den transmitterade primärstrålningen dominerar. Vid beräkningar för en exempelpraktik där patientens fötter är riktade ut mot korridoren/manöverplatsen så krävdes det en strålskärmning av 1 st gipsskivor á 13 mm mot manöverplatsen, 2 st gipsskivor á 13 mm mot fikarum, 5 st gipsskivor á 13 mm mot annat behandlingsrum och ingen strålskärmning i fönster mot gångväg. Alla beräkningar gjordes för 2 m avstånd från strålkällan.

Slutsats: Det går att utföra en strålskärmsberäkning för intraoral röntgen utifrån värden som tandläkaren själv kan mäta upp och ta från röntgenutrustningens manual.

[*] *Presenting author: nils.kadesjo@karolinska.se*

ACCURACY IN DETERMINATION OF SPLIT RENAL FUNCTION IN ^{99m}Tc-MAG3 RENOGRAPHY; A MONTE CARLO STUDY BASED ON A VIRTUAL PATIENT

I Cerić[*1], J Bartosik[1], M Ljungberg[2], G Brolin[2], M Sydoff[1]

[1]*Department of Clinical Physiology and Nuclear Medicine, Helsingborg General Hospital, Helsingborg, Sweden*

[2]*Department of Medical Radiation Physics, Lund University, Lund, Sweden*

Purpose: Renography has been used as a diagnostic tool for kidney diseases for over 2 decades. Its extensive use calls for a thorough investigation of the methods used to determine the split renal function (SRF) and especially regarding background subtraction and type of algorithm used. Previous studies on this subject have been performed mainly on patient image data with the drawback in that true values have not been possible to determine. In this study, we have used realistic scintillation camera images from virtual patients obtained from Monte Carlo simulations in the analysis for the purpose of determining the most accurate method for quantitating the split renal function.

Methods: A comparison of three different calculation algorithms for determining the SRF were made, namely the integral method (IN), the Patlak-Rutland method (PR) and the blood pool compensation (BPC) method. For the IN and PR method, three different ROI:s where applied to the images: (1) perirenal distant ROI (PDR), (2) adjacent perirenal ROI (APR) and (3) adjacent lateral ROI (ALR). Nineteen simulated images where used showing a split renal function ranging from 5% to 95% in steps of 5%. The results were then compared to the true values defined in the simulated patient. For IN and PR, the combination of background ROI and calculation algorithm gave the most accurate results, (IN(PDR) and PR(APR)) both regarding an intercomparison and compared with the BPC method.

Results: The deviation from the true values were less than 5% for all three methods, IN(PDR), PR(APR) and BPC. However, the smallest deviation was found to occur for the IN (PDR) method with a largest deviation of 1,5%. This can be compared to 2,2% and 3,5% for PR(APR) and BPC respectively.

Conclusion: We conclude that of all methods tested in the present study, the IN(PDR) method produced the most accurate results when calculating the split renal function.

[*] *Presenting author: irma.ceric.308@student.lu.se*

Kontroll av internkontamination med gammakamera

E Larsson, A Stenvall, L Jönsson, C Hindorf and J Oddstig
Enheten för nuklearmedicinsk fysik, Skånes Universitets sjukhus, Lund

Bakgrund

I strålsäkerhetsmyndighetens föreskrift åläggs vi att för alla som arbetar med radioaktiva ämnen göra internkontaminationskontroll. Målet med detta arbete var att utveckla en enkel metod med hög tillgänglighet för de nuklearmedicinska avdelningarna genom att använda en gammakamera utan kollimator.

Metod

Mätningar i studien är gjord på en GE Discovery 670 SPECT/CT, utan kollimator. Energifönster avpassat för respektive radionuklid användes, ^{99m}Tc (141 keV ± 10 %), ^{111}In (171 keV ± 10 % + 245 keV ± 10 %) och ^{123}I (159 keV ± 10 %). Mätningar för känslighetsbestämning genomfördes genom att en spruta med aktivitet placerades på britsen, fritt i luft, mitt emellan de två de två kamerahuvudena ställda anteriort-posteriort. Mätningarna upprepas med aktiviteten placerad i ett vattenfyllt Jaszczak-fantom (diameter 20 cm). En bakgrundsmätning utförs och antalet bakgrundssubtraherade pulser beräknas.

Aktiviteten uppskattas enligt: $A = \frac{N_{geo,bkgsub} * e^{\mu \frac{T}{2}}}{känslighet}$, där $N_{geo,bkgsub}$ är det bakgrundssubtraherade geometriska medelvärdet, μ är attenueringskoefficienten och T tjockleken.

Aktiviteten kan även bestämmas noggrannare utifrån listmodedata som möjliggör attenuering- och spridningskorrektion samt ett bakgrundssubtraherat spektra. Dessutom kan en tidsupplöst räknehastighet monitoreras vilket möjliggör korrektion för exempelvis patienter som passerar gammakameran.

Personal som skall kontrolleras för internkontamination byter till rena arbetskläder, tvättar händer och armar och ställer sig med armarna i kors och hakan i höjd med övre kanten på detektorn mellan de två detektorerna med en insamlingstid på 3 minuter. 28 personer ur personalen kontrollerades.

Resultat

Känslighetsmätningarna för ^{99m}Tc, visar en relativt jämn känslighet på 11,3 kcounts/kBq upp till 1 MBq varefter känsligheten sjunker för att ha halverats vid 10 MBq. Minsta detekterbara aktivitet är < 1 kBq. Känsligheten för ^{111}In var 16,9 kcounts/kBq och för ^{123}I 7,7 kcounts/kBq.

Fantommätningarna med ^{99m}Tc visar att kvoten mellan uppmätt korrigerad aktivitet och sann aktivitet visar med den enklare metoden att aktiviteter under 1 MBq överskattas med 40-50%. Från beräkningar av listmodedata minskar överskattningen till <10%. Vid aktiviteter högre än 1 MBq bör helkroppscan med kollimator göras.

Kontrollmätningarna på personalen visade en högsta uppmätt aktivitet på 25 kBq efter arbete med Technegas. Vid antagande att detta intag upprepas 227 arbetsdagar per år, blir årsintaget 5,7 MBq vilket ger en effektiv dos under ett år på 0,1 mSv och en absorberad dos till lungorna på 0,6 mGy.

Konklusion

Vi har utvecklat en enkel metod för kontroll av internkontamination med hjälp av gammakamera. Resultaten visar att metoden är känslig och tillförlitlig.

IDAC star -a standalone program to easily Monte Carlo estimate the effective dose from internal or external contamination

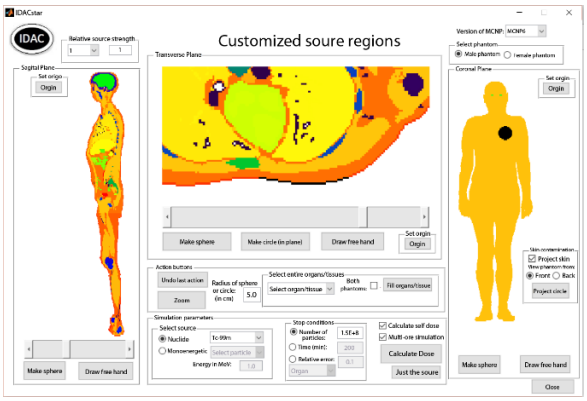
Martin Andersson*, Ünal Ören
Department of Translational Medicine, Medical Radiation Physics, Malmö, Sweden

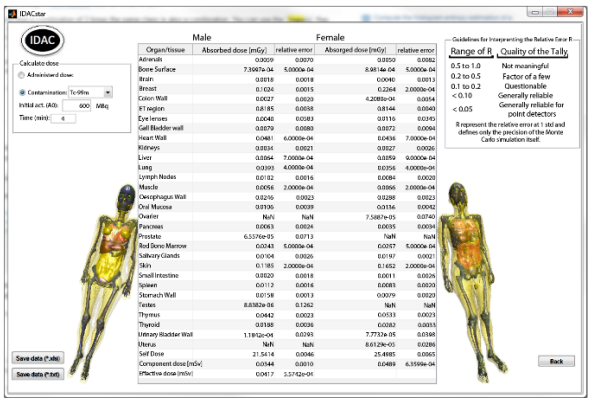
Aim and background: With the use of voxelized standard reference phantoms in nuclear medicine there is now a possibility to perform more realistic dose estimations. To facilitate this a computer program was developed to create customized source regions using the ICRP/ICRU adult reference voxel phantoms. This will enable arbitrary dose calculations, where the activity is assumed to be deposed locally, which is the case for e.q. external skin contamination or extravasations. The purpose of the program is to create a user friendly graphical interface, which produces a functional MCNP input file, runs the simulation and extracts the results back into the program. The aim of this project was to allow a module that easily could estimate the radiation induced risk for contaminations for users that has no experience with vowelized Monte Carlo simulations.

Material & Methods: IDAC star is an executable standalone MatLab program. All components are incorporated into one file. Both the male and female voxel phantoms are shown graphically, where the user can create their own source regions and calculate the effective dose from these regions. The program can also show the projection of the front or back of the adult phantoms enabling external dose estimation. The simulations requires an MCNP version that IDAC star runs and executes. After the run, absorbed doses and effective dose is presented in a table together with the relative error of each estimated dose. For simulations with the radionuclides there is also a possibility to insert the initial activity and the estimated contamination time and the doses are recalculated for that specific case.

Results: The program was applied on a case where a 600 MBq Tc-99m contamination occurred for 4 min on the upper left torso. The effective dose was estimated to be 0.042 mSv using the assumption that the activity was uniformly distributed among all voxels assumed to be contaminated.

Conclusions: IDACstar was developed to allow users, without MCNP experience to perform easy and realistic estimations of the radiation induced risk that occurs with contaminations.





Figures. The left image is the graphical interface for IDACstar. The right image shows the results view.

Reference: Ören, Ü., Hiller, M., Andersson, M. 2016 IDACstar: a MCNP application to perform realistic dose estimations from internal or external contamination of radiopharmaceuticals Radiat. Prot. Dosim. DOI:10.1093/rpd/ncw221

* *Presenting author: martin.andersson@med.lu.se*

EPA (USA) cancer risk models as an alternative to effective dose to estimate the radiation risk for individual patients in health care

M ANDERSSON*[1], K ECKERMAN[2] and S MATTSSON[1]

[1]*Department of Translational Medicine, Medical Radiation Physics, Malmö, Sweden*

[2]*Center for Radiation Protection Knowledge, Oak Ridge National Laboratory, Oak Ridge, TN, USA*

Aim and background: The quantity effective dose was derived by ICRP to represent the potential risk to a population of stochastic effects of ionizing radiation. The ICRP recognize that there are significant differences in risk between males and females (particularly for breast) and in respect to age, but ICRP prefers a general system of protection, which is simple and sufficiently robust. Therefore, the policy is to use nominal risk coefficients for the whole population and not for individuals. An alternative to the effective dose is the risk models given by the American Environmental Protection Agency (EPA), which give the lifetime attributable risk (LAR) similar to the approach used in BEIR VII. The risk models approximates the premature probability of a cancer or cancer death that can be attributed to radiation exposure. The EPA risk estimations are generated from four different variables (age, gender, attained age and age at exposure) to predict the risk.

Material & Methods: Both the ICRP and the EPA base the risk estimation mainly on the data from the life span study of A-bomb survivors. The ICRP detriment-adjusted nominal risk coefficient given in ICRP publ. 103 is 5.5 % per Sv for the whole population. The figure is based on both lethal and non-lethal data. The ICRP judges that cancers should be weighted not only by lethality but also for pain, suffering and any adverse effects of cancer treatment. To achieve this, a factor is applied to the non-lethal fraction of cancers to produce an adjusted lethality fraction. The EPA risk model only predicts the risk of premature cancer death or incidence from radiation exposure. In connection with medical use, the age at exposure is known and time after exposure is integrated to 110 years to estimate the total attributable risk from one exposure.

Results: The effective dose is a good and robust quantity to use for risk estimations valid for populations. This quantity is however often used for more specific and even individual cases in hospitals than it is recommended for. For risk estimations where gender and age is of concern, the EPA risk estimation is preferable; for instance if a physician wants to inform a patient about the cancer risk associated with a medical examinations. The LAR estimations can be used in the selection process for e.g. large clinical trials, which subjects are more suitable to be included in a trial based on the differences in cancer risk of the attained age and sex.

Conclusions: The EPA risk estimations are more suitable for use in health care where individual patients or specific groups of patients are of concern instead of the more general effective dose estimation. The reason is that EPA risk estimation is gender and age specific, allowing risk recommendations based on relative risk variations of subject's age and gender. This gives the possibility to create suitable subgroups within a population and for which cancer risk is estimated. The EPA risk coefficients are only valid for cases where the outcome of receiving a new cancer is independent of an existing/previous cancer (if radiation is connected to a cancer examination)

References:

ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4).

Environmental Protection Agency. Radiogenic Cancer Risk Models and Projections for the U.S. Population 402-R-11-001 April 2011, 175 pp

NRC. Health Risks from Exposure to Low Levels of Ionizing Radiation — BEIR VII. Washington, DC: The National Academies Press; 2006.

* *Presenting author: martin.andersson@med.lu.se*

Creating Monte Carlo dose risk estimations based direct on CAD output files and validating the estimation using a 3D printer

Martin Andersson* and Lars Herrnsdorf

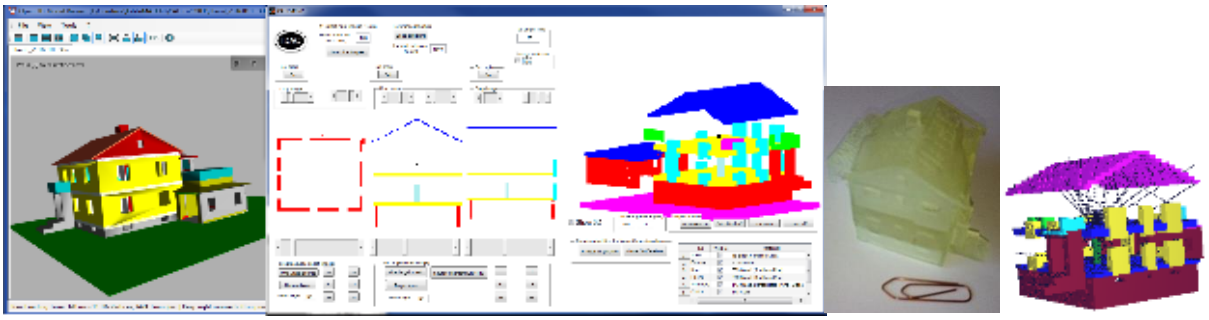
Department of Translational Medicine, Medical Radiation Physics, Malmö, Sweden

***Aim and background*:** The aim of this project was two folded. First, to create a feasible way to perform dose calculations from Computer-aided design (CAD) files and to incorporate them into a Monte Carlo simulation program and second, to connect this simulation with a 3D printed version of the CAD structure. CAD output is often in the form of an electronic file for printing, machining, or other manufacturing operations. The ability to perform Monte Carlo calculations gives the user freedom to simulate arbitrary radiation source to a specific voxel phantom or structure. As a pilot project CAD drawings of a house were used to determine the different radiation risk levels from an x-ray tube of 60 keV and a Tc-99m source. The house was also created by a 3D printer in a uniform plastic material, just to show the possibility to connect the geometries.

Material & Methods: The house was created in Picture by PC version 3.4, a CAD program by Schott Systeme and every different material was saved in separate 3ds-files, with a joint reference structure. A MatLab standalone program was developed to create a voxel geometry with the possibility to insert source regions and the ICRP reference voxel phantoms to enable effective dose estimations. The CAD-file was also connected to a 3D-printer and printed out connecting the Monte Carlo-simulation to a physical structure of the CAD file.

Results: In the first simulation the X-ray tube was positioned in an adjacent room to the ICRP phantom while in the second simulation the Tc-99m source was placed in the attic and the phantom in the living room in the CAD file geometry. An effective dose according to ICRP Publication 103 was estimated for both simulations.

Conclusion: An easy method was developed to use CAD output files to perform voxelized Monte Carlo simulations. The method also included a 3D printout of the structure to be able to connect a detailed Monte Carlo structure with a physical plastic geometry, creating a validation tool to the simulate structure. The limitation of the method is that the voxelization method has a maximum dimension restriction of 1024 on one direction for Mac and PC (4096 for Linux) and this restriction means that the resolution of a 10 m^3 structure will be 1 cm^3. The ability to connect CAD geometries with Monte Carlo simulations and 3D printers can be applied in many different fields.



Images from left to right. First image the CAD drawing of the house, second the in-house MatLab program, third a 3D-printed version of the house and the fourth a MCNP simulation of the house.

* *Presenting author: martin.andersson@med.lu.se*

Developing a web portal for radiation protection data communication

J A Lundman[*1], J Andersson[1] and C Granberg[1]

[1]*Centrum för Medicinsk Teknik och Strålningsfysik (CMTS), Strålningsfysik, Västerbotten County Council, Umeå, Sweden*

Every year, Västerbotten County Council (VLL) collects data pertinent to radiation protection. After an inspection by the Swedish Radiation Safety Authority in 2012, it became clear that a new platform for gathering, evaluating and communicating such data was needed. Also, recently introduced digital reports from the personnel dosimetry provider presented an opportunity for the creation of an accessible and easy-to-use evaluation platform for all VLL personnel.

In 2015, CMTS was given access to a local server on the VLL intranet. Using the content management system (CMS) Drupal, a homepage was created on the VLL intranet. Several modules were developed for data evaluation and communication. To handle corrupt or faulty input data, a MySQL database structure for cleaning up data was implemented, where necessary.

The system now includes scripts and views for gathering and displaying the evaluation of personnel dosimetry measurements, fluoroscopy times, as well as mammography and MRI quality assurance. The data gathered is stored in separate tables in the MySQL database of the CMS. Authorized personnel can access the data through database queries, and thereby utilize the data in scripts for automatic evaluations.

Personnel dosimetry data is presented in plots and tables, visible to all VLL personnel in an anonymised format. Each employee can check and compare their own dosimetry measurement results through their assigned code.

Fluoroscopy times are presented as a yearly summary, compared to the previous year. Automatic reports are created for each department with statistics for each operator and examination area. The data is visible to all VLL personnel as an incentive for discussion between specialities, clinics, and hospitals. A trend over time for fluoroscopy times and number of examinations for each examination area is also provided by the system. Furthermore, a trend analysis is supplied for use in the yearly activities report on fluoroscopy times, as requested by the Swedish Radiation Safety Authority.

[*] *Presenting author: josef.lundman@vll.se*

Gentle Radiotherapy – Experience from a national consortium on integrating MRI in radiotherapy.

LE Olsson[*1], T Nyholm[2,3], M Karlsson[2]

[1]*Department of Medical Radiation Physics, Translational Sciences, Lund University, Malmö, Sweden*

[2]*Department of Radiation Physics, Radiation Sciences, Umeå university, Umeå Sweden*

[3]*Department of Immunology, Genetics and Pathology, Medical Radiation Science, Uppsala University, Uppsala, Sweden*

The use of imaging is a crucial part of radiotherapy (RT), and it is used to localize both tumours and sensitive organs. Imaging is also the input to treatment planning calculations and for patient set-up. Magnetic resonance (MR) imaging provides excellent soft tissue contrast, and it also offers functional information of the tissues. In Sweden, we address the task of integrating MR in RT, by a national network called the "Gentle Radiotherapy", which was initiated in 2014 (ending Dec 2016). The aims of the project are to facilitate a fully integrated MR in the workflow of RT, and to promote the use of MR in clinical studies. The project is supported by the "Swedish Innovation Agency" (VINNOVA). The members of the consortium are six University Hospitals and six industrial partners. The work is divided into five dedicated work packages (WP): 1) Optimisation of sequences and protocols for RT applications, 2) MR-based treatment planning, 3) Image registration and automatic segmentation, 4) Q/A of MR-only workflow, and 5) 'Functional MRI' and clinical studies. About 50 researchers and clinicians are actively working in the five work packages, but the total number of scientists involved are even higher. The mixture of clinical practice, academic science and industrial innovation creates a vibrant research environment. The national consortium meetings provide a framework for education and training. The expected final outcome of the project is clinical procedures, scientific research as well as new industrial products. The present status of the national Gentle radiotherapy project will be reviewed and examples of the results and deliverables will be presented. Potential benefits of working in national consortia in other areas of medical physics than radiotherapy will be discussed. In addition, the potential next step of Gentle radiotherapy – "Implementation of MR-only RT" 2017-2019 will be outlined.

[*] *Presenting author: Lars_E.Olsson@med.lu.se*

Methodology and recommendations for using MRI in radiotherapy - a Skonsam Strålbehandling / Gentle Radiotherapy project

C GUSTAFSSON[1,2], M SOHLIN[3]

1) Department of Hematology, Oncology and Radiation Physics, Skåne University Hospital, Lund Sweden

2) Department of Medical Physics, Lund University, Malmö, Sweden

3) Department of Medical Physics and Biomedical Engineering, Sahlgrenska University Hospital, Gothenburg, Sweden

A VINNOVA financed national project called Skonsam Strålbehandling / Gentle Radiotherapy is aiming to integrate MRI into the radiotherapy workflow. One of the goals in the Gentle Radiotherapy project was to create a comprehensive material which covered methodology and recommendations for target and organ at risk delineation using MRI in radiotherapy.

Images and clinical MRI acquisition protocols for brain, head and neck and prostate, dedicated for radiotherapy, was collected from multiple clinics in Sweden using a survey. The acquisition protocols were divided between different MRI vendors and field strengths. A written material covering the needs and recommendation for using MRI in radiotherapy was composed, fused with the acquisition protocol information from the survey and published online.

Steps for patient preparations, choice of MRI acquisition protocols and MRI coils, fixation methods and scanning coverage is presented for the anatomies brain, head and neck and prostate. The aspects of marker visualization in MRI vs CT, and recommendations for QA in MRI for radiotherapy is also discussed.

Clinics with no earlier experience of MRI in RT should with the help of this material be able to set up all the necessary steps, routines and MRI acquisition protocols for implementing MRI in radiotherapy. The material can be downloaded as a PDF but will also be available on a dedicated website in 2017.

Presenting author: christian.k.gustafsson@skane.se

A novel method to assess dosimetric impact of system specific distortions in an MRI only radiotherapy workflow

C GUSTAFSSON[1,2], F NORDSTRÖM[3], E PERSSON[1], J BRYNOLFSSON[4] and L E OLSSON[2]

1) Department of Hematology, Oncology and Radiation Physics, Skåne University Hospital, Lund Sweden

2) Department of Medical Physics, Lund University, Malmö, Sweden

3) Department of Medical Physics and Biomedical Engineering, Sahlgrenska University Hospital, Gothenburg, Sweden

4) Spectronic Medical AB, Helsingborg, Sweden

Purpose/objectives. Dosimetric errors in a magnetic resonance imaging (MRI)-only based radiotherapy workflow can be caused by geometric distortions from MRI. The aim of this study was to evaluate the impact on planned dose distribution to prostate patients and the impact on delineated prostate radiotherapy structures, originating from system specific geometric distortions. A vendor independent novel method, based on the transformation of computer tomography (CT) images using a mapping of the MRI-distortion field, was developed.

Methods. Using a phantom designed for measuring geometric accuracy, the 3D-displacement maps for a non-optimized and an optimized MRI-only prostate treatment planning sequence, was measured in a 3T MRI-system.

To simulate the distortion aspects of a synthetic CT, the 3D-displacement maps were applied to CT-images, referred to as distCT-images. A Volumetric Modulated Arc prostate treatment plan was created and applied to the original CT-images and distCT-images, creating a reference and a distCT dose distribution.

By applying the inverse of the 3D-displacement map to the distCT dose distribution, a planned dose distribution in the same geometry as the original CT-images was created. The dose difference between the reference dose distribution and inverse distCT dose distribution was analyzed in isodose level bins. These steps were repeated for 10 prostate cancer patient CT data sets.

Results. Using the optimized MRI sequence, the dose differences for all isodose level bins were smaller or equal to 0.02% and the radiotherapy structure volume deviations were <0.3%. Corresponding values for the non-optimized MRI sequence were 0.1% and <2%.

Conclusions. The novel method can quantifiy the dosimetric effects of MRI system specific distortions for a prostate MRI only radiotherapy workflow. No clinically relevant dose difference or structure deformation was found, provided that 3D-distortion correction and high acquisition bandwidth was used. The method had potential to be used for any MRI sequence together with any anatomy of interest.

Presenting author: christian.k.gustafsson@skane.se

Clinical utility of MRI for HDR brachytherapy of the prostate

D Förnvik[*1], C Gustafsson[1] and L Lundgren[1]

[1]*Haematology, Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden*

Currently at our clinic, treatment planning in HDR brachytherapy of the prostate is based on ultrasound images with 5 mm spacing. Given that accuracy in brachytherapy is largely dependent on the planning image quality, the rationale is strong to investigate the potential of MRI in brachytherapy. The purpose of this exploratory study is to investigate the clinical utility of MRI for HDR brachytherapy of the prostate.

Roughly 30 consecutive patients underwent MRI using a 3T GE Discovery scanner the day before their planned brachytherapy. A T2-weighted fast recovery fast spin echo (FRFSE) sequence was used for treatment planning, additional sequences were used for matching purposes. At brachytherapy, 1 mm ultrasound images were acquired of the prostate instead of the usual 5 mm images in order to visualize the implanted gold markers. The ultrasound and MR images were matched based on the gold markers.

Three oncologists specialized in HDR brachytherapy of the prostate reviewed the ultrasound and MR images regarding visualization of the prostate and organs at risk. The target volume was outlined in both image sets by the oncologists. The volume of the prostate was compared between the two image sets. In addition, intra- and interobserver variation was evaluated.

Preliminary or full results will be presented at the conference.

[*] *Presenting author: daniel.fornvik@med.lu.se*

A Multi-center/multi-vendor validation of MRI only prostate treatment planning using synthetic CT images.

E Persson[1], C Gustafsson[1], F Nordström[1, 2], M Sohlin[3], A Gunnlaugsson[4], K Petruson[5], L Blomqvist[6], B Zackrisson[6], T Nyholm[6], LE Olsson[7], C Siversson[8], J Jonsson[6]

1) Department of Medical Physics, Skåne University Hospital, Lund, Sweden
2) Department of Medical Physics, Lund University, Lund, Sweden
3) Department of Medical Physics and Biomedical Engineering, Sahlgrenska University Hospital, Gothenburg, Sweden.
4) Deparment of Oncology, Skåne University Hospital, Lund, Sweden
5) Department of Oncology, Sahlgrenska University Hospital, Gothenburg, Sweden.
6) Department of Radiation Sciences, Umeå University, Umeå, Sweden
7) Department of Medical Physics, Lund University, Malmö, Sweden
8) Spectronic Medical AB, Helsingborg, Sweden

Purpose. An important prerequisite for MRI only radiotherapy is the generation of a synthetic CT (sCT) from MRI-data. Recently, the Statistical Decomposition Algorithm (SDA) was proposed for this purpose (MriPlanner^{TM}, Spectronic Medical AB, Sweden), which is able to calculate sCT from conventional T2-weighted MR-images (Siversson et al. 2015). This study aims to validate the use of the MriPlanner software and technology, in an MRI only workflow for 170 prostate cancer patients. The study is performed within the Swedish consortium Gentle Radiotherapy, enabling a multi-center/multi-vendor framework for this MR-Only Prostate External RAdiotherapy (MR-OPERA) study.

Methods. The four participating centers had MriPlanner^{TM} installed as a cloud based service. A T2-weighted MRI, covering the body contour, was added to the clinical protocol. The MR-images were sent directly from the MR-scanner workstation to the MriPlanner^{TM} platform. The sCT was automatically returned to the treatment planning system. MR-scanners included in the study were 3T GE Discovery 750w, 3T GE Signa MR/PET, 1.5T Siemens Aera and 3T Siemens Skyra.

A clinically approved treatment plan was created based on the CT and local practice of each center. For each patient, the generated sCT was rigidly registered to the CT, and the treatment plan from the CT was recalculated on the sCT. The dose distributions from the CT-plan and the sCT-plan were compared based on a set of DVH-parameters and with gamma evaluation. Treatment techniques included VMAT, IMRT and conventional treatment. Treatment plans were created with Eclipse treatment planning system (Varian Medical Systems, Palo Alto, CA) or Oncentra (Elekta, Stockholm, Sweden). Final dose calculation was made using the Anisotropic Analytical Algorithm or a pencil beam algorithm.

Results. The overall (multi-center/multi-vendor) mean difference between sCT and CT dose distributions were below 0.3% for all points evaluated. Gamma evaluation showed a mean pass rate above 98% (2%/2mm global).

Conclusions. The results of the MR-OPERA study are promising, with minimal differences between sCT and CT dose distributions for target and relevant risk organs. The small differences seen are consistent between centers, indicating that an MRI only workflow using MriPlanner^{TM} is robust for a variety of field strengths, vendors and treatment techniques.

Emilia Persson: Emilia.Persson@skane.se

Nationellt möte om sjukhusfysik, Vildmarkshotellet Kolmården 16-18 november 2016

Agnetha Gustafsson	Universitetssjukhuset i Linköping
Albert Sundvall	Karolinska Universitetssjukhuset
Alejandro Sanchez Crespo	Karolinska Universitetssjukhuset
Alexander Englund	Akademiska sjukhuset
Alice Sollazzo	Stockholms Universitetet
Anders Frank	Strålsäkerhetsmyndigheten
Anders Magnusson	Akademiska sjukhuset
Anders Olsson	Tesika Teknik AB
Anders Tingberg	Skånes Universitetssjukhus
André Søndergaard	Vision RT
Andreas Forsberg	Sunderby sjukhus
Andreas Johansson	Mälarsjukhuset, Eskilstuna
Angeliki Karambatsakidou	Karolinska Universitetssjukhuset
Anja Almén	Skånes universitetssjukhus
Anja Taschner	IBA Dosimetry
Anna Carlander	Unilabs
Anna Ärlebrand	Akademiska sjukhuset
Anneli Edvardsson	Lunds Universitet
Annie Bjäreback	Karolinska Universitetssjukhuset
Annika Hall	Skandionkliniken
Annika Melinder	Praktikertjänst Röntgen AB
Antti Löytynoja	MathWorks AB
Axel Carlbring	Södersjukhuset
Barbara B. Balwa	Mälarsjukhuset, Eskilstuna
Barbro Vikhoff Baaz	Sahlgrenska Universitetssjukhuset
Berit Wennberg	Karolinska Universitetssjukhuset
Birgitta Hansson	Pensionär
Camilla Bysell	ScandiDos
Caroline Adestam Minnhagen	Sahlgrenska Universitetssjukhuset
Chahed Yacoub	Universitetssjukhuset i Linköping
Charlotta Tilk	Elekta Instrument AB
Christian Gustafsson	Skånes Universitetssjukhus
Christian Göransson	Mälarsjukhuset, Eskilstuna
Christina Vallhagen Dahlgren	Skandionkliniken
Christoffer Granberg	Norrlands universitetssjukhus
Cissi Lundmark	Södersjukhuset
Crister Ceberg	Lunds Universitet
Dan Josefsson	Universitetssjukhuset i Linköping
Daniel Förnvik	Skånes Universitetssjukhus
Daniel Thor	Karolinska Universitetssjukhuset
Dina Tamras	Danderyds sjukhus AB
Eleonor Vestergren	Sahlgrenska Universitetssjukhuset
Elias Dellow	Länssjukhuset i Kalmar
Elin Cederkrantz	Hallands sjukhus
Elin Lidström	Sundsvalls sjukhus
Emelie Adolfsson	Universitetssjukhuset i Linköping
Emelie Lind	Skånes Universitetssjukhus
Emil Johansson	Mälarsjukhuset, Eskilstuna
Emilia Persson	Skånes Universitetssjukhus
Emmelie Sjöholm	RaySearch Laboratories AB
Enmark Marika	Skånes Universitetssjukhus
Erik Mattsson	Länssjukhuset Ryhov
Erik Tesselaar	Universitetssjukhuset i Linköping
Essie Persson	Universitetssjukhuset Örebro
Eva Norrman	Universitetssjukhuset Örebro
Fredrik Celen	Unfors RaySafe AB
Fredrik Wellman	Blekingesjukhuset
Frida Dohlmar	Universitetssjukhuset i Linköping
Frida Svensson	Sahlgrenska Universitetssjukhuset
Gary Schmidt	YourRad AB
Gavin Poludniowski	Karolinska Universitetssjukhuset
Gudrun Alm Carlsson	Linköpings Universitet
Gustav Alfredsson	Mediel AB
Göran Alm	Mallinckrodt Radiopharmaceuticals
Hanna Holstein	Lunds Universitet
Hannie Petersson	Lunds Universitet
Hans-Erik Källman	Landstinget Dalarna
Hans-Olov Rosenbrand	Centralsjukhuset Karlstad
Hector Silva Vidal	Universitetssjukhuset Örebro
Helena Lizana	Norrlands universitetssjukhus
Henrik Eriksson	Scanflex Medical AB
Henrik Holmgren	Centrallasarettet Växjö
Henrik Karlsson	Länssjukhuset i Kalmar
Henrik Sundström	Östersunds sjukhus
Henrik Svensson	Sahlgrenska Universitetssjukhuset
Håkan Hedtjärn	Universitetssjukhuset i Linköping
Ingun Ståhl	Sahlgrenska Universitetssjukhuset
Irma Ceric	Helsingborgs lasarett
Itembu Lannes	Karolinska Universitetssjukhuset
Jakobína Grétarsdóttir	Sahlgrenska Universitetssjukhuset
Jehangir Khan	Sahlgrenska Universitetssjukhuset
Jenny Granström	Elekta Instrument AB
Jenny Oddstig	Skånes Universitetssjukhus
Jenny Öman	Universitetssjukhuset i Linköping
Jerker Edén Strindberg	Danderyds Sjukhus AB
Jessica Billberg	Västmanlands sjukhus Västerås
Johan Knutsson	Mälarsjukhuset, Eskilstuna
Johan Sjöberg	Karolinska Universitetssjukhuset
Johan Wikström	Akademiska sjukhuset
Johanna Kramar	Mälarsjukhuset, Eskilstuna
Jonas Nilsson Althén	Universitetssjukhuset i Linköping
Jonas Söderberg	Centralsjukhuset Karlstad
Jonna Wilén	Umeå universitet
Jonny Nordström	Region Gävleborg
Josef Lundman	Norrlands universitetssjukhus
Julia Söderström	Karolinska Universitetssjukhuset
Jörgen Scherp Nilsson	Karolinska Universitetssjukhuset
Karin Fransson	Länssjukhuset i Kalmar
Karin Sandqvist	Praktikertjänst AB
Karin Åberg	Akademiska sjukhuset
Karolina Lindskog	Akademiska sjukhuset
Katarna Sjögreen Gleisner	Lunds Universitet
Kent Odelli	Agfa HealthCare
Kent Öbrink	C-Rad
Kerstin Ledenius	Skaraborgs Sjukhus
Kerstin Müntzing	Sahlgrenska Universitetssjukhuset
Lars E. Olsson	Skånes Universitetssjukhus
Lars Gunnar Månsson	Sahlgrenska Universitetssjukhuset
Lars Herrnsdorf	Lunds Universitet
Lars Lilja	C-Rad
Laura Antonovic	RaySearch Laboratories AB
Lea Sillfors-Elverby	NU-sjukvården, Trollhättan/Uddevalla
Lina Andersson	Mälarsjukhuset, Eskilstuna
Lisa Ledenvall	MathWorks AB

Nationellt möte om sjukhusfysik, Vildmarkshotellet Kolmården 16-18 november 2016

Lisa Nilsson Isaksen	Elekta Instrument AB
Lizette Engelen	K-Way VBA
Louise Blomkvist	Karolinska Universitetssjukhuset
Love Kull	Sunderby sjukhus
Lovisa Berg	Skånes Universitetssjukhus
Magnus Dustler	Lunds Universitet
Magnus Forss	YourRad AB
Malin Darpö	Danderyds sjukhus AB
Malin Kügele	Skånes Universitetssjukhus
Marcus Krantz	Sahlgrenska Universitetssjukhuset
Marcus Persson	Lunds Universitet
Marcus Ressner	Universitetssjukhuset i Linköping
Marcus Söderberg	Skånes Universitetssjukhus
Maria Duvaldt	Karolinska Universitetssjukhuset
Maria Holstensson	Karolinska Universitetssjukhuset
Maria Larsson	Södra Älvsborgs sjukhus
Marie Sydoff	Helsingborgs lasarett/SUS Lund
Marie-Louise Aurumskjöld	Skånes Universitetssjukhus
Markus Eriksson	Micropos Medical
Markus Fahlström	Akademiska Sjukhuset
Markus Hulthén	Karolinska Universitetssjukhuset
Martin Andersson	Lunds universitet
Martin Bech	Lunds Universitet
Martin Eckerwall	Siemens Healthineers
Martina Arnell	K-Way VBA
Mats Beckman	Karolinska Universitetssjukhuset
Mattias Nickel	Länssjukhuset i Kalmar
Mattias Sandström	Akademiska sjukhuset
Michael Ljungberg	Lunds universitet
Michael Sandborg	Universitetssjukhuset i Linköping
Mikael Folkesson	Landstinget Dalarna
Mikael Gunnarsson	Skånes universitetssjukhus
Mohammed Said	Skånes Universitetssjukhus
Morgan Nyberg	Sundsvalls sjukhus
Nadja Rystedt	Norrlands universitetssjukhus
Narine Geghamyan	Aleris Diagnostik AB
Nicola Detta	Brainlab GmbH
Nils Kadesjö	Karolinska Universitetssjukhuset
Olle Haller	Region Gävleborg
Patrik Dalsjö	Mallinckrodt Radiopharmaceuticals
Per Hållström	Region Gävleborg
Per-Erik Åslund	Akademiska sjukhuset
Pernilla Norberg	Universitetssjukhuset i Linköping
Peter Bernhardt	Göteborgs Universitet
Pontus Timberg	Skånes Universitetssjukhus
Rassul Yunussov	Karolinska Universitetssjukhuset
Rebecka Henrysson	ContextVision
Richard Odh	Karolinska Institutet
Rickard Sjögren	Norrlands universitetssjukhus
Robert Bujila	Karolinska Universitetssjukhuset
Robert Forsberg	Radeq
Sabine Lee	Universitetssjukhuset Örebro
Sandra Sandström	Landstinget Västernorrland
Sara Asplund	NU-sjukvården, Trollhättan/Uddevalla
Sara Bruce	Akademiska sjukhuset
Sara Olsson	Centrallasarettet Växjö
Sara Svensson	Västmanlands sjukhus Västerås
Shahla Mobini	Karolinska Universitetssjukhuset
Sigrid Leide-Svegborn	Skånes Universitetssjukhus
Simone Eriksson	Siemens Healthineers
Sofia Jonsson	Östersunds sjukhus
Sofia Kvernby	Linköpings Universitet
Sofia Skyttner	Karolinska Universitetssjukhuset
Sofia Åkerberg	Centrallasarettet Växjö
Sofia Åström	Sunderby sjukhus
Sofie Ceberg	Skånes Universitetssjukhus
Sofie Wickström	Södersjukhuset
Sonny La	Blekingesjukhuset
Stefan Bergstam	Mälarsjukhuset, Eskilstuna
Stefan Egardt	Mediel AB
Stefan Mårtensson	Gammadata
Stig Palm	Göteborgs Universitet
Sture Eklund	Västmanlands sjukhus Västerås
Sven Bäck	Skånes Universitetssjukhus
Sven Månsson	Skånes Universitetssjukhus
Sven-Göran Fransson	Universitetssjukhuset i Linköping
Søren Møller	Varian Medical Systems Scandinavia AS
Tanny Visanuyanont	Länssjukhuset Ryhov
Ted Nilsson	Karolinska Universitetssjukhuset
Theodoros Chouliaras	Karolinska Universitetssjukhuset
Timo Leivo	Västmanlands sjukhus Västerås
Tobias Hellstrand	YourRad AB
Tomas Jonsson	Karolinska Universitetssjukhuset
Tony Patrén	Mallinckrodt Radiopharmaceuticals
Torsten Cederlund	Strålsäkerhetsmyndigheten
Tove Öhrman	Danderyds sjukhus AB
Tuva Öhman	Universitetssjukhuset i Linköping
Ulrika Dahlén	Karolinska Universitetssjukhuset
Ulrika Estenberg	Karolinska Universitetssjukhuset
Ulrika Lindencrona	Sahlgrenska Universitetssjukhuset
Ulrika Svanholm	Länssjukhuset i Kalmar
Wim Van Riet	Agfa HealthCare / Qaelum
Ylva Hammarström Larsson	Landstinget Dalarna
Ylva Surac	Sahlgrenska Universitetssjukhuset
Yosef Al-Abasse	Sahlgrenska Universitetssjukhuset
Zelga Malke	Karolinska Universitetssjukhuset
Åsa Ärlig	Länssjukhuset Ryhov

Organisationskommitté

Caroline Adestam Minnhagen

Mattias Nickel

Pernilla Norberg

Programkommitté

Karin Åberg

Anja Almén

Johan Sjöberg

Michael Ljungberg

Sofie Ceberg