Schweizerische Gesellschaft für Strahlenbiologie und Medizinische Physik
Société Suisse de Radiobiologie et de Physique Médicale
Società Svizzera di Radiobiologia e di Fisica Medica

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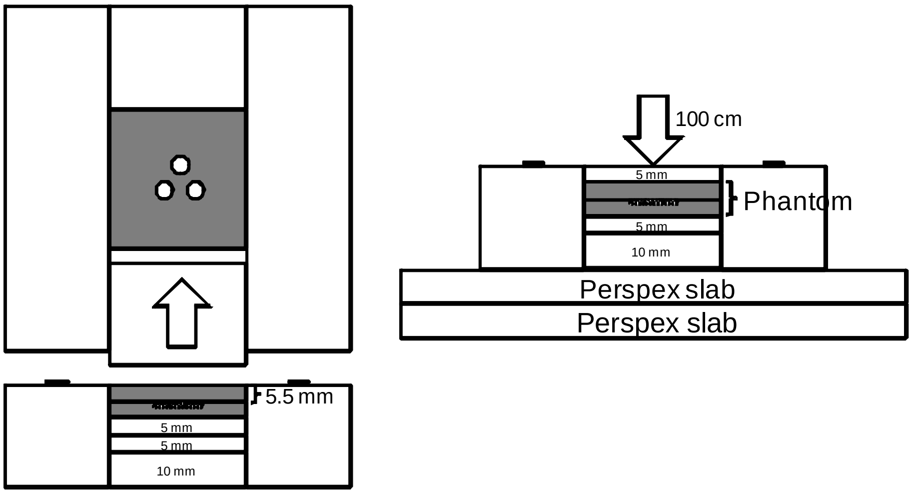

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June 2011

Cover image: Results of the TLD intercomparison 2010,
Figure 1: Top (left) and frontal view (right) of the solid phantom for electron dosimetry.
by W.W. Seelentag and Hans Schiefer

E d i t o r i a l

Dear colleagues,

Summer is here. We wish you happy reading under a tree, on the beach, in the mountains, or in your office. Thank you very much to the authors of the articles and reports. The TLD intercomparison report gives an insight into how much work went into setting up and carrying out the first electron beam intercomparison in Switzerland, and the ORAMED project aimed at improving radiation protection in interventional radiology and nuclear medicine is very topical and interesting. The same is true of the young field of radiation oncology informatics. We look forward to getting your suggestions and invite your contributions for the next issue which comes out at the end of November.
To those of you with summer vacations, happy holidays! And for those of you who will work during summer with fewer colleagues than usual, bon courage!

Sunny greetings from,

Regina Müller and Shelley Bulling

President's letter

Dear colleagues,

After a long process, the implementation of article 74 al 7 of the radiation protection ordinance reached a consensus between the different stakeholders. Our board recently approved the final document that may be downloaded at:

http://www.bag.admin.ch/themen/strahlung/02839/index.html?lang=de in German
http://www.bag.admin.ch/themen/strahlung/02839/index.html?lang=fr and in French.

This document is a consensus guideline, but the way that radiology and nuclear medicine departments will implement article 74 still has to be approved by FOPH. The future will tell us if changes have to be made concerning the time needed by the medical physicist for performing the different duties. Nevertheless, this is an important step in the improvement of radiation protection in the fields of radiology and nuclear medicine. On behalf of the board, I would like to express our gratitude to Francis Verdun and Frédéric Corminboeuf for their work as representatives of SSRMP in the working group.

The 2011 salary survey is ongoing. The more of us who answer, the better the situation will be known. Therefore, I encourage you to participate by clicking on the link sent to you by Stefano Presilla.

Another survey concerning the position of the medical physicist in Switzerland has been finalised. An abstract has been submitted for the Dreiländertagung. I do thank Angelika Pfäfflin, Léon André, Stephan Klöck and Jean-Yves Ray for the time that they spent in preparing and analysing the survey.

A third survey is also ongoing concerning the revision of our Recommendation No. 11. Daniel Frauchiger has sent each centre an email inviting them to participate in the survey. I strongly encourage you to answer that survey, since it will be the starting point for the revision of Recommendation No. 11, which, as you know, is a very important one.

You will also find in this Bulletin the results of the SSRMP annual intercomparison. Twenty six centres participated and 71 and 144 photon and electron beams were checked respectively. As usual, the intercomparison was a success due to an excellent participation, but also due to the fact that it was the first time in Switzerland that an electron beam intercomparison was set up. I would like to deeply thank Hans Schiefer and Wolf Seelentag for their important commitment to the project.

I remind you that this year, our annual meeting will take place in Wien (29.9-1.10) together with our German and Austrian colleagues. You can register at http://www.medphyswien2011.org/ and I look forward seeing you in Wien this fall. SSRMP will offer a support of Frs 400.- to any member under 36 years of age who has an abstract accepted for an oral or poster presentation.

On the 18th of November a farewell meeting will take place in Berne to celebrate the retirement of our eminent colleagues Léon André, Ernst Born, Jean-François Germond, Roberto Mini and Wolf Seelentag. The meeting will be terminated with the annual general assembly of our society. Do not miss the date!

Another important congress will take place in Switzerland in 2013. We have the chance to host the ESTRO meeting in Geneva from the 19th to 23rd of May. This will be a unique opportunity to meet our European colleagues at home and to show how medical physics is active in Switzerland.

As you can see, there are a lot of ongoing activities in our society, involving many colleagues. This is good news because it is a sign of good health and of the growing importance of our profession in the global organisation of health care. I can only thank those of you who are already active in our society and encourage any of you to participate in activities such as the working groups. I would like to acknowledge once again the work of Shelley Bulling and Regina Müller as bulletin editors. They allow you to get much more information in the following pages than my few words. Thank you!

I wish you an excellent summer and in the meantime, enjoy your Bulletin!

Meilleures salutations de Lausanne,

Raphaël Moeckli

Meeting announcement

18 November 2011
Berne

Please save the date for the SGSMP AGM and to celebrate the retirement of Léon André, Ernst Born, Jean-François Germond, Roberto Mini, and Wolf Seelentag

Professional affairs committee news

Salary Survey

Since the last Bulletin, the professional affairs committee has started the collection of salary data for SSRMP physicists for the year 2010.
All known physicists within the SSRMP directories are included, i.e. 157 invitations were sent out.
An email invitation was sent to each known physicist on the starting date with instructions to access and fill out the online form. The data collection will be closed on July 17th 2011. After 9 days of data entry, the situation is as follows:

Total records in this token table:	157
Total with no unique Token:	0 / 157
Total invitations sent:	157 / 157
Total opted out:	5 / 157
Total surveys completed:	26 / 157

To try to maximize the number of participants, it is planned to dispatch remainder emails at regular internals with increasing frequency as we approach the deadline; since people can opt out, we think that this will not annoy the participants with repeated requests.

The SSRMP board uses the greatest possible care to make sure that the survey is completely anonymous. The execution of the survey was outsourced to the small company It-Transforms. The connection between the email addresses and the survey tokens is not visible to anyone on the board and it is only maintained while the survey is active. It will be deleted from the server immediately after closing the survey.
For the data analysis a template will be created using a statistical program and a final document will be produced.
A summary of the results will be published in one of the next SSRMP bulletins. All SSRMP members invited to participate in the survey will receive a complete analysis as soon as possible; hopefully early enough to negotiate your salary for 2012 with your employer, if necessary.
The reason for putting the survey on the web and for using a statistical software tool for analysis purposes is to speed up the whole procedure with two final goals:

1) To make participation in the survey more friendly, so as to try to increase the number of participants (or at least to maintain the high number of participants who responded in 2004-2005)
2) To make it easier for the organizer to run a survey, with the final intent to increase the frequency of surveys (yearly or biannually)

Status of the medical physicist in Switzerland

As requested by Angelika Pfäfflin, we have also analyzed the data from the survey about the position of the medical physicist in Switzerland and submitted an abstract for the "Dreiländertagung" in Vienna. This data will certainly also interest our German and Austrian colleagues. We haven't heard yet if the abstract has been accepted. We thank Angelika for her work defining the survey questions and also for writing the abstract.

Frédéric Corminboeuf

Summary of the AMP meeting Bern, May 2nd, 2011

On May 2nd 2011, an Applied Medical Physics (AMP) meeting took place at University of Bern. In the following, a short summary is provided. This summary is intended to replace the minutes of the AMP meeting.

The central part of the AMP meeting was the discussion about the changes of Article 74 within the radiation protection ordinance. As a reminder, the changes are related to the regular medical physics support for radiodiagnostics with dose intensive procedures and nuclear medicine. These changes are effective by January 1st, 2012.

Frédéric Corminboeuf (Inselspital, Bern) had the lead of this discussion at the AMP. Together with Francis Verdun (CHUV, Lausanne) he has also represented the SSRMP at a corresponding parity working group which was established in 2010 and which aimed to come up with some recommendations and guidelines related to the changes of Art. 74. At the AMP meeting, Frédéric Corminboeuf presented the current state of the activities of this working group. It was mentioned that there is a delay in the development of the guidelines. More important, it had to be realized that within the draft of these guidelines there are some fundamental issues which are not acceptable by the medical physics community. As a consequence, a long and intensive discussion took place at the AMP meeting. Different aspects were analyzed and potential solutions were discussed. One of these aspects was the question about the responsibility associated to the medical physicists who are in charge of the support for diagnostics or nuclear medicine. Another aspect was related to the proposed time allocations for different tasks and duties such as quality assurance or training and education. It was concluded that the next meeting of the parity working group will be very important since it will hopefully be the final one such that the guidelines can be finalized. (Note: In the meantime, the final document is available and it is recommended to read the president's letter of this Bulletin).

The second part of the AMP concentrated on short reports of active working groups of SSRMP. Unfortunately, not all of the chairs of these working groups were present at the AMP meeting and thus some of the reports were not really useful. However, in general, the working groups are active and there is a strong interest in contributing to the activities by the members of SSRMP.

More than 30 persons attended this AMP meeting. From the feedback, it can be concluded that the AMP was very important, particularly with respect to the issue about the changes of Art. 74. By this means, along with the principal aims of the AMP, the AMP meeting provided to be a platform for a stimulating and constructive discussion.

Peter Manser, Chair of AMP

Results of the TLD intercomparison 2010

It was the aim of last year's SSRMP intercomparison to check the absolute dosimetry of photon as well as of electron beams. Since electron beam checks had not been performed before, a suitable measurement method and setup had to be developed. The calibration has been performed in cooperation with Dr. Sándor Vörös, METAS.

Material and Methods

The same TLD's, tempering oven, TLD reader and cobalt machine used for reference measurements have been used as in earlier intercomparisons.

A solid phantom for electron dosimetry with a similar design as the RPC phantom, used for electron measurements, has been constructed in cooperation with PTW Freiburg. It is shown in figure 1.

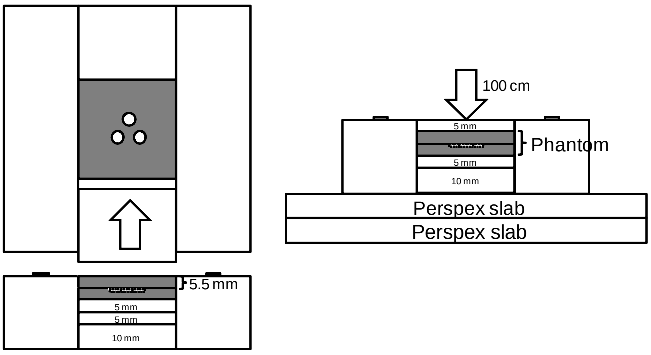

Figure 1: Top (left) and frontal view (right) of the solid phantom for electron dosimetry.

Three TLD's are included in a "mini phantom" which consists of water equivalent RW3 material (PTW Freiburg). Its dimensions are 40 mm x 40 mm x 10 mm. 5 mm and 10 mm thick RW3 platelets are provided to position the TLD's close to the optimum depth. The water equivalent material in the beam path next to the TLD's ensures that the percentage depth dose is the same as in water. The frame which incorporates the "mini phantom" consists of Perspex. Its outer dimensions are 100 mm x 100 mm x 30 mm. At minimum 5 cm backscatter material have to be placed under the Phantom, e.g. Perspex slabs. The measurement setup for electron irradiations in the solid phantom was for all irradiations as follows: Dose to the TLD's as exact as possible 1.00 Gy; field size 10 cm x 10 cm, focus to surface distance 100 cm, TLD's placed as close to the depth of dose maximum as possible, but not in the build up region. Further details on the electron dosimetry setup are shown in the "instructions" which are appended to this report.

As in earlier intercomparisons, the photon beams have been checked in water. The usual setup has been applied.

TLD calibration in the solid phantom

The primary TLD calibration for electron beams has been performed in St.Gallen by a cross calibration: An Elekta synergy linear accelerator with 4, 6, 9, 12, 15 and 20 MeV electron beams has been used. Ionisation chamber measurements have been performed primarily in a water phantom under calibration conditions to define the exact dose in water (100 monitor units, 10 cm x 10 cm field size, 100 cm focus to surface distance, measurement at depth of dose maximum). The TLD irradiations in the phantom have been conducted subsequently with the same measurement geometry and beam parameters as in the water phantom, and as also applied later in the TLD intercomparison. Five TLD irradiations per energy have been performed.

Check of the measurement reproducibility in the solid phantom

In order to check the reproducibility of the TLD measurement in the solid phantom, measurements have been performed with an ionization chamber in a Perspex block following five weekly dosimetry checks. The mean of three ionization chamber measurements (in the order of 1.00 Gy) has been taken as the "stated dose". Two TLD measurements per beam have been performed each time. The ratios between the "stated dose" and the TLD measurements, calculated for all electron beams available in St.Gallen and five weekly checks, has been evaluated.

Irradiations at METAS

The irradiations at METAS have been performed with a M22 microtron accelerator from Scanditronix equipped with a conventional treatment head at 5 different beam energies: 6, 9, 12, 15 and 20 MeV. A dedicated TLD holder for irradiations in a water tank has been constructed for this purpose, ensuring water equivalence in the TLD environment (figure 2).

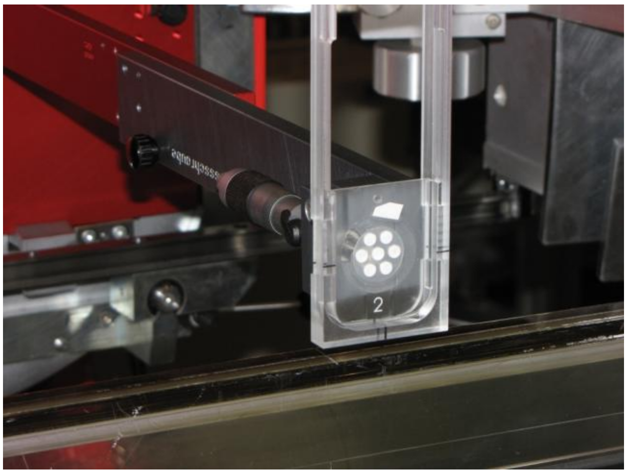

Figure 2: TLD holder for measurements in the water phantom used by METAS.

The measurement setup is shown in figure 3.

Figure 3: Setup for the METAS irradiations

The aim was to check the TLD calibration and to get information about the water equivalence of the measurement setup designed for the electron beam checks.

Altogether 38 irradiations have been completed in two rounds. The evaluation of the TLD irradiations by METAS was carried out with the calibration based on the irradiations performed in St.Gallen.

<u>Completion of the intercomparison</u>

Photons: The photon dosimetry checks have been performed in water with the same measurement setup as in earlier intercomparisons. Up to the dosimetry intercomparison of 2010, every photon beam of all treatment machines was tested. In 2009 for instance, 95 photon beams have been checked. In 2010, only one beam of each beam mode–energy combination has been tested (except if an institution wanted to test additional beams), which reduced the number of checked photon beams compared to earlier years.

Electrons: It was the aim to apply 1 Gy at the depth of maximum dose. The institutions stated the percentage depth dose at the TLD measurement depth (5.5, 10.5, ... , 25.5 mm) and the expected ("stated") dose in the depth of maximum dose in water, D_s. Both values allowed deriving the "measured" dose in the depth of maximum dose in water, D_m, and calculate the D_m/D_s values as a measure for the dosimetry quality.

Results

<u>TLD calibration in the solid phantom</u>

The energy specific calibration factors, indicated relative to the 60-Co calibration factor, are presented in figure 4. The mean energy calibration factor is 1.056 ± 0.008. The mean standard deviation per beam energy is 0.009.

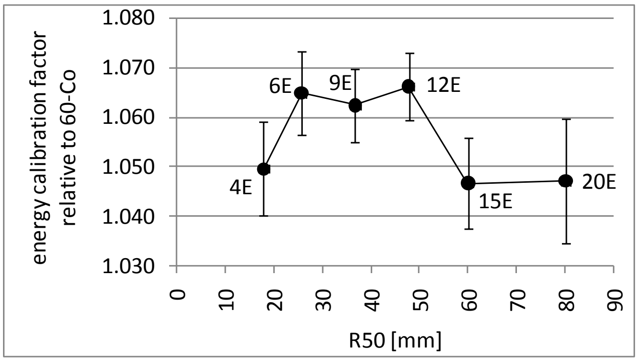

Figure 4: Energy calibration factors for electrons. The beam quality is characterized by the R50 value.

The standard deviation of the mean energy calibration factor (0.008) is in the same order as the mean standard deviation per beam energy (0.009). It has therefore been assumed that the TLD sensitivity does not depend on the electron beam energy. An energy independent calibration factor of 1.056 relative to the 60-Co energy calibration factor has been used for all electron energies and all TLD measurements.

<u>Check of the measurement reproducibility in the solid phantom</u>

The standard deviation of the integral TLD measurement setup for electron beams is presented in figure 5.

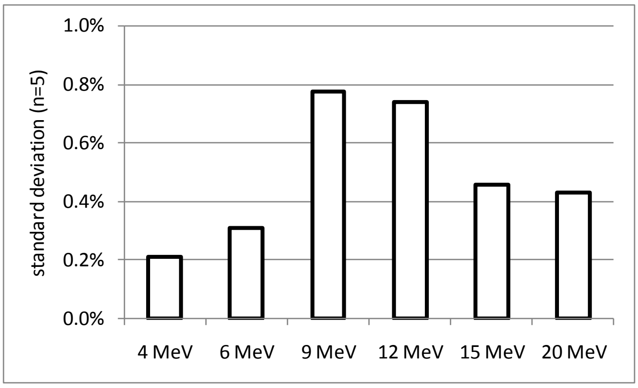

Figure 5: Reproducibility measurements for all beam energies available in St.Gallen

Due to the higher dose gradient in the depth of measurement, it should have to be expected that the reproducibility is poorer for lower energy beams. This does surprisingly not apply. The observed values are even smaller for 4 MeV and 6 MeV beams. Since only five measurements have been completed, this behaviour has been regarded as randomly. The mean standard deviation for all beam energies amounts to 0.49%, which is even better than for photons (about 0.7%). This value includes also the reproducibility of the beam dosimetry. It can therefore be stated that the reproducibility of the electron TLD dosimetry is certainly smaller than 0.5%.

<u>Irradiations at METAS</u>

The irradiations at METAS have been evaluated by applying the TLD calibration presented above. They are presented in figure 6.

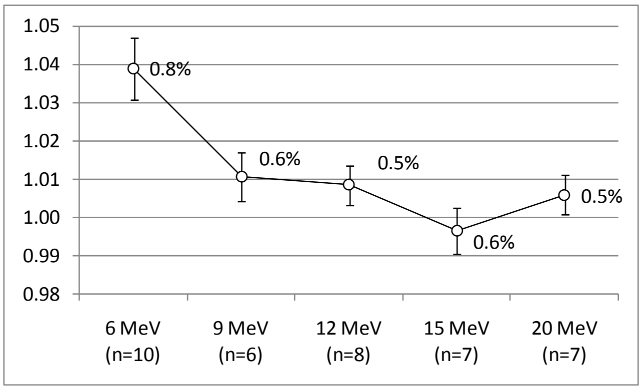

Figure 6: Ratios of the TLD measured dose to the stated dose by METAS, D_m/D_s. The standard deviations are indicated on the right of the data points. The number of TLD measurements per energy is quoted in brackets in the x-axis.

For 6 MeV, the TLD measured dose is 3.9% ± 0.8% higher than the stated dose by METAS. The mean D_m/D_s value for beam energies higher than 6 MeV accounts to 1.005 ± 0.005. The standard deviation includes both the TLD measurement and the irradiation process. The dosimetric reproducibility of the investigated electron beams at METAS has therefore to be clearly better than 0.5%. When the 6 MeV value is neglected, a clear energy dependent trend of the D_m/D_s values cannot be observed. Further investigations are needed to explain the strong deviation for 6 MeV.

<u>Results of the dosimetry intercomparison</u>

Altogether 26 institutions have participated in the dosimetry intercomparison. The absolute dosimetry of 71 photon (2 x 5 TLD's used per beam) and 144 electron beams (2 x 3 TLD's) has been checked.

Photon beams

The mean D_m/D_s value for all photon beams is 0.999 ± 0.011. This is in the same order as the mean D_m/D_s value in 2009, which was 1.000 ± 0.012. Figure 7 shows the D_m/D_s values for all checked energies.

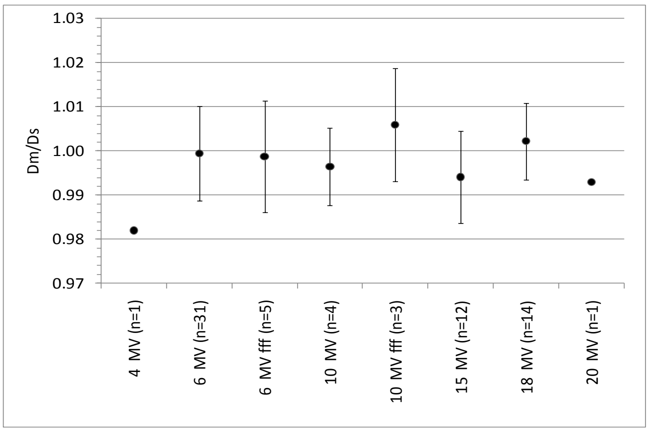

Figure 7: D_m/D_s values for photon beams

The frequency of the D_m/D_s values for photon beams is shown in figure 8.

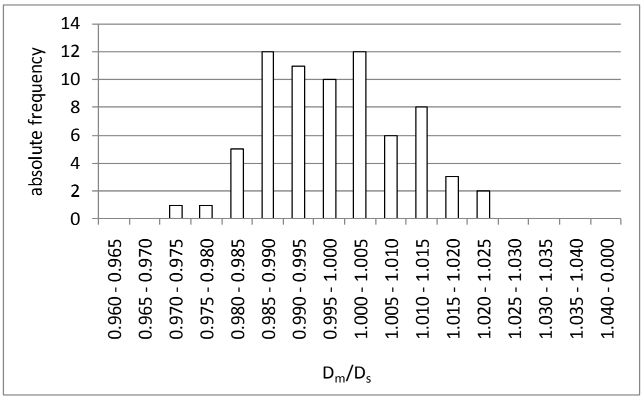

Figure 8: Frequency of the D_m/D_s values for photon beams. The mean standard deviation is 0.011.

Electron beams

The mean D_m/D_s value for all electron beams is 0.996 ± 0.020. Figure 9 shows the D_m/D_s values for all checked energies.

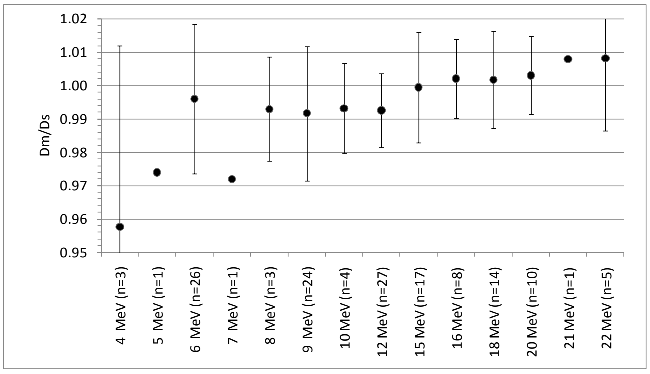

Figure 9: D_m/D_s values for electron beams

The mean standard deviation is about twice the value observed for the photon measurements (0.011). The energy specific standard deviations are remarkably larger for electron energies smaller than 9 MeV. For 4 MeV beams, it amounts to 0.054. This extraordinary large value is caused by one single measurement with a D_m/D_s value smaller than 0.9.

The frequency of the D_m/D_s values is shown in figure 10.

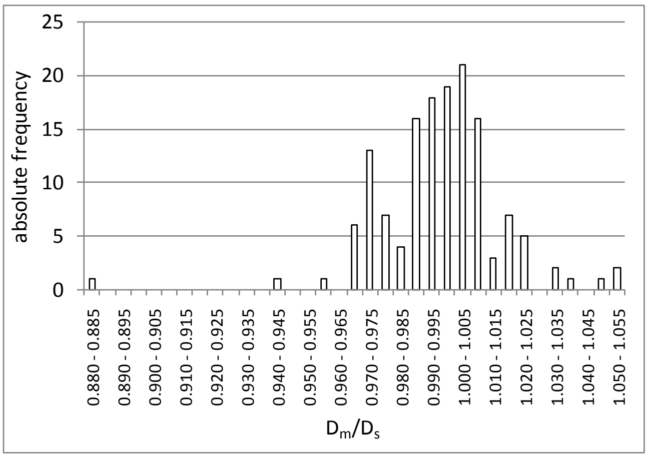

Figure 10: Frequency of the D_m/D_s values for electron beams. The mean standard deviation is 0.020.

Discussion and Conclusion

Photon beams

The TLD measurements of all checked beams coincide with the stated doses within 3% and fulfil therefore the dosimetric requirement. 94% of all D_m/D_s values are within the [0.98, 1.02] interval, which can be stated as an excellent result.

Electron beams

The calibration factor for all electron beams has been set to 1.056 relative to the 60-Co calibration factor. This figure results in energy independent D_m/D_s values close to unity for both the METAS as well the measurements of the institutions. This observation is a strong hint that the used energy calibration factor is plausible. Within the TLD measurement accuracy it is also apparent, that the measurement setup with the solid phantom leads to similar TLD readings as an irradiation in water.

The deviation for the 6 MeV beam of METAS cannot be interpreted for the moment and requires further investigations. The D_m/D_s values of the 6 MeV beams of the institutions show however no divergent behaviour compared to the other electron beam energies.

The TLD measurements of 138 out of 144 checked beams (95.8%) coincide with the stated doses within 4% and fulfil therefore the dosimetric requirement. 90.3% of all D_m/D_s values are within the [0.97, 1.03] interval, and 72.2% are within the [0.98, 1.02] interval. Dose measurements with low energy electron beams show few large deviations from the expected value. It can be assumed that the largest source of error is represented by the uncertainty of the stated percentage depth dose, when the TLD lie in the high dose gradient area. In the next dosimetry intercomparison involving electron beams, 2 mm thick platelets will be additionally provided to bring the TLD's closer to the dose maximum and to minimize in this way the influence of an error in the stated percentage depth dose.

For the future it is planned to use the solid phantom also for photon beams checks: The phantom frames are provided with knobs which allow piling multiple phantom frames on another. This allows performing photon beam measurements in larger depths than needed for electron beams, for instance 5 cm. Details on the measurement setup will have to be tested. When an identical measurement setup can be used for both beam modes, the effort for the institutions can be considerably reduced.

The cooperation with METAS as the Swiss Primary Dosimetry Laboratory represents an important contribution to the validity of the SSRMP intercomparison. We thank our colleagues at METAS, Dr. Sándor Vörös, Dr. Bénédicte Boillat and Dr. Damian Twerenbold, for the great support.

Thanks to Sándor for his extraordinary time and effort to design the irradiation setup, to perform the irradiations and for the assistance to interpret the measurement results!

At the end, we thank all institutions for their pleasing co-operation.

W.W. Seelentag H. Schiefer

1. *Set up for electron beams*

The phantom frame and the phantom for electron measurements are shown schematically in figure 1. The setup follows in principle the RPC setup. The TLD-section of the phantom consists of two slabs: three single TLDs are placed in drillings placed in the lower slab. This slab is marked with a serial number (i.e. “14”) on the front side. DO NOT OPEN THIS SECTION!

The height of each section slab is 5 mm, and the height of a TLD is about 1 mm. Therefore, the effective measurement point of each TLD is 5.5 mm from the section entrance surface of the beam, as shown in the sketch on the lower left of figure 1. Please, mount the phantom oriented as shown in the sketches on the right side of figure 1.

Setup parameters:

- At minimum 5 cm backscatter material has to be placed under the Phantom, e.g. Perspex slabs.
- Measurement depths: The arrangement of phantom and squared slabs is described below.
- The field center coincides with the phantom center.
- Field size: 10 cm x 10 cm (This can differ from the size used for machine calibration !!)
  (Reason: The conversion factors “measurement in phantom” → “measurement in water” are determined for a 10 cm x 10 cm field)
- Dose: As close as possible to 1.00 Gy at d_{max} (depth of maximum dose, D_{max})
- Focus to surface distance: 100 cm

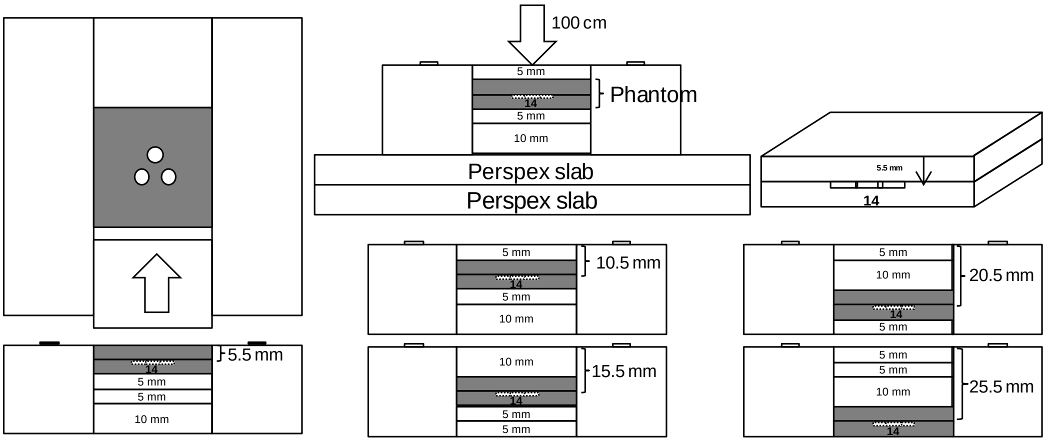

Figure 1: Assembly of the measurement equipment; phantom and (closed) phantom frame.

Depending on the energy, electron beam measurements are performed at discrete depths: 5.5 mm, 10.5 mm, 15.5 mm, 20.5 mm, and 25.5 mm, which is the maximum available measurement depth. The measurement depth can be adjusted by the order of three small 5 and 10 mm slabs and the TLD-section; see sketches in figure 1.

Rules to select the energy specific irradiation parameters and values to be reported, depending on the depth of maximum dose:

1. Look up the depth of maximum dose, d_{max}.
2. Calculate the number of MU (n), which is needed for a dose in water under standard conditions as close as possible to 1.00 Gy at d_{max}.
3. Calculate the exact dose in d_{max}, when n MU are applied, D_{max}. State D_{max} in table 1.
4. Select the discrete measurement depth, d_{meas}, , higher than and as close to the depth of maximum dose as possible. Take into account that the maximum available measurement depth is 25.5 mm.
5. Look up the percentage depth dose for the selected measurement depth, DD(d_{meas}). State DD(d_{meas}) in table 1. DD(d_{max}) = 100%.

Please, compare the data stated in the document „institutions machines energies.pdf“. Changes have to be stated in table 1 or table 2.

Electron calibration measurements have been performed in cooperation with METAS. At the moment of the intercomparison, some calibration factors are not known. Therefore, the reported doses will be based on the calibration performed in St.Gallen at first. They have to be interpreted as preliminary. The definite results are communicated as soon as possible.

The electron beam equipment has to be sent, together with the cylinders used for photon beam measurements, **registered and by express** back to St.Gallen!!

The ORAMED project

The use of ionizing radiation in modern health systems is increasing. Interventional radiology and cardiology together with nuclear medicine have been identified as radiation medical applications where staff is potentially exposed to high doses. Within this framework, in February 2008, a collaborative project funded by the European Atomic Energy Community's Seventh Framework Program was launched to enhance the safety and efficacy of the uses of radiation in diagnostics and therapy, by developing methodologies for better assessing and reducing exposures to medical staff in these fields. Five main topics related to radiation protection of medical staff have been addressed:

- Optimization of radiation protection in interventional radiology (WP1)
- Development of practical eye lens dosimetry in interventional radiology (WP2)
- Optimization of the use of active personal dosemeters in interventional radiology (WP3)
- Optimization of radiation protection in nuclear medicine (WP4)
- Training on radiation protection (WP5)

One of the main objectives of the ORAMED project has been to prepare an accurate teaching and knowledge dissemination program to make sure that the conclusions and recommendations of the project are transmitted to the stake-holders, mainly medical staff, both, physicians and technicians, radiation protection officers, dosimetry services and authorities in the field. The ORAMED 2011 workshop, held in Barcelona from the 20th till 22nd of January 2011, was focused mainly on the dissemination of ORAMED project results, together with the participation of invited speakers from professional societies and international bodies involved in the field of radiation protection. All the ORAMED results can be found at the ORAMED website (http://www.oramed-fp7.eu/).
The work has been performed by a consortium of 10 institutions and 2 small companies from 9 different European countries. The Centre Hospitalier Universitaire Vaudois (CHUV) has been involved as active member in all WPs except WP2. Moreover, measurements have been performed in several hospitals in Switzerland mainly CHUV and University Hospital of Geneva but also in University Hospital of Bern, Basel and the Hôpital de la Tour in Geneva.

WP1. Extremity dosimetry and eye lens dosimetry in interventional radiology /cardiology

WP1 aims at the development of methodologies for better assessing and reducing exposures of medical staff for procedures resulting in potentially high extremity and eye lens doses, such as interventional radiology/cardiology (IR/IC). A common protocol was used for performing measurements for the evaluation of eye lens and extremity doses. 1140 measurements were performed in 40 European hospitals. The procedures monitored were: CA, PTCA, pacemaker implantations (PM), radiofrequency ablations, embolizations and angiographies (DSA) and angioplasties (PTA) of lower limbs (LL), renal arteries (Re), carotids (Ca) and brain (B). Several parameters related to the procedure (tube position, projections, point of access of the catheter, staff position…) the protective equipment, and the respective KAP values were recorded. The highest median doses for hands and legs were found for cardiac peacemaker procedures (0.160 mSv and 0.066 mSv, respectively) while for the eyes the highest value was found for embolizations (ca 0.080 mSv). The maximal doses recorded on hands, legs and eye lens were 9.51 mSv, 7.82 mSv and 4.07 mSv, respectively. The large variability of practices employed in different hospitals was observed. In a number of cases the practice of IC and IR procedures could be improved by applying certain rules. This study showed that some parameters like position of the tube, presence of protective device etc. could influence the doses significantly; thus they can be used in the process of radiation protection optimization. As far as the effect of protective equipment is concerned, it was found that the ceiling suspended shield can reduce the eye doses up to 7 times, while the table shield can reduce the leg doses up to 5 times. The use of automatic contrast injector can reduce the doses up to 7 times. A series of recommendations were drawn from the ORAMED measurement campaign, the most important of which, is the proper use of the protective equipment that can be achieved by proper training of the medical staff in radiation protection issues.

WP2. Development of practical eye lens dosimetry in interventional radiology/cardiology

In recent years an increased occurrence of radiation related lens opacities for interventional radiologists have been reported. However, the eye lens doses are often not measured in routine applications or even if measured, the dosemeters are not used appropriately for this purpose. In particular, the dosemeters are not placed in the vicinity of eye-lens and are usually not taking into account the protective glasses used by the medical staff. Furthermore, there is a lack of procedures to measure eye lens doses. Hp(3) is mentioned as the operational quantity to control the dose limits, but the available calibration procedure (e.g. what phantom and conversion coefficients should be used) is not sufficient since no specific ‘eye lens’ phantom is available.

WP2 critically revised the theoretical fundamentals on which the eye lens operational quantity Hp(3) is based and thereafter the way to calculate it. This investigation has provided a set of new conversion coefficients from Ka to Hp(3), defined on a new model of phantom (a cylinder of square section 20x20cm2). The proposed formalism has been essential for the development of the eye lens dosemeter well suited to respond in terms of this operational quantity at interventional cardiology and radiology (IC/IR) workplaces and to specify the calibration and type test procedures for optimizing the radiation performance requirements of this kind of dosemeter. This is the first dosemeter available commercially specially designed to provide precise measurements of radiation dose to eye lens. It can be worn close to the eye and presents a good angular and energy response in terms of Hp(3). The dosemeter, consisting of a small capsule containing a TLD pellet and a holder worn on a head strap, is now under the process of being patented by Radcard s.c. under the commercial name EYE-D.

WP3. Optimization of the use of active personal dosemeters in interventional radiology/cardiology

WP3 deals with the optimization of the use of active personal dosemeters (APDs) in interventional radiology (IR). Indeed, a lack of appropriate APD devices is identified for typical IR fields. Very few devices can detect low energy X-rays (20-100 keV), and none of them are specifically designed for working in pulsed radiation fields. The aim of WP3 was to study the behaviour of some selected APDs deemed suitable for application in IR. For this purpose, measurements under laboratory conditions, both with continuous and pulsed X-rays beams, and tests in real conditions on site in different hospitals were performed. The selection of commercial APD models was based on the results from international intercomparisons and on the available usage data from different European countries. A pre-requisite for consideration was that each unit should respond to photon energies down to 20 keV. Seven APDs were selected: DMC 2000XB (MGPi), EPD Mk2.3 (Siemens), EDMIII (Dosilab), PM1621A (Polimaster), DIS-100 (Rados), EDD30 (Unfors) and AT3509C (Atomtex). Tests under laboratory conditions with continuous X-ray fields were performed to determine the dose, the energy, the dose rate and the angular responses of the selected APDs. The influence of the frequency and duration of pulses on the APD responses was studied with pulsed X-rays beams, still under laboratory conditions. In addition, tests in different hospitals were done to evaluate the behaviour of APDs in real conditions. All APDs present a linear dose response and most of them a satisfactory response at low energies (down to 24 keV), which is sufficient for IR. However, some of them do not fulfill the ISO 61526 standard requirements concerning dose rate and angular response. Tests in pulsed mode show that limitations of several APDs are mostly due to high dose rates rather than to pulse frequency. This point was confirmed by tests in hospitals. Five APDs were tested in routine practice and have a slight under response compared to passive TL dosimeters.

WP4. Extremity dosimetry in nuclear medicine

Work package 4 of the European ORAMED project aimed at enlarging the general knowledge of hand doses delivered to nuclear medicine (NM) staff when handling most frequently used radiopharmaceuticals, i.e. those labelled with ^{99m}Tc and ^{18}F for diagnostics procedures, and those labelled with ^{90}Y for therapy procedures. An extensive measurement program including 124 workers from 32 NM departments in Europe was performed. This represents the largest number of collected data on extremity dosimetry in NM. Dose distribution across the hand was obtained by measuring skin dose at 11 points of each hand using appropriate thermoluminescence dosemeters attached on gloves or taped to the operator's hands. All relevant information for radiation exposure was gathered in a unified protocol. Furthermore, more than 200 Monte Carlo simulations were performed to better understand the parameters influencing the hand dose. For this purpose, realistic scenarios involving voxelized hand phantoms were used. The final guidelines were elaborated by merging the statistically analyzed results of measurements with those from the simulations. The most exposed positions are the tip of the index finger and the thumb of the non dominant hand. For a given procedure, the maximum dose was determined considering for each worker the maximum doses normalized per activity among all measuring positions. The average of maximum doses per procedure was 0.33, 1.07 and 7.90 mSv/GBq for ^{99m}Tc, ^{18}F and ^{90}Y, respectively. For routine monitoring, the recommended dosemeter position is the index finger base of the non-dominant hand with the detector in palmar direction. Nevertheless, the maximum skin dose is underestimated on average by a factor of 6 at this position for all procedures. Compared to administration, preparation of radiopharmaceuticals led to higher exposure. Shielding of vials and syringes is essential for dose reduction but not a guarantee for low exposures. All tools increasing the distance (e.g. forceps, automatic injector) between the hands/fingers and the source are very effective for dose reduction. Working fast is not sufficient, shielding or increasing distance are more effective. Subjective parameters not directly measurable, such as risk awareness and training, also impact staff exposure. This study highlights the necessity to monitor extremity exposure in NM. The annual skin dose limit of 500 mSv was exceeded by 15 workers. Despite the wide range of measured doses, general trends were observed resulting into nine guidelines.

WP5. Training and dissemination of results

Education and training is an essential element in establishing effective radiation protection programmes. The ORAMED training proposal aimed at developing specific material to provide guidelines and recommendations for medical staff involved in interventional radiology, interventional cardiology and nuclear medicine. The particularity of the ORAMED training strategy is the use,of real images of good and bad practices as well as the experimental and computational results obtained during the of ORAMED's campaign. For this purpose, information packages have been developed for distribution among the stakeholders such as presentation modules and videos with examples of good practices. Three main stakeholders have been considered in the preparation of the training material: the occupationally-exposed medical staff, the medical staff trainers and dosimetry services together with calibration laboratories. A different approach is proposed depending on the targeted user. Furthermore, a workshop to ensure comprehensive dissemination of the main results and conclusions of the project was organized at the end of the 3 years contract period, so that the main results were presented. All results presented during the workshop will be published in a dedicated issue of Radiation Measurements foreseen for January 2012.

Marta Sans Merce, IRA, Lausanne

Radiation Oncology Informatics

Physics and Biology are the foundations of Radiation Oncology and without professional medical physicists or radio-biologists progress in Radiation Oncology would be unthinkable. With the development of newer techniques, informatics has become a further critical element matching the importance of the biology or physics. Radiation Oncology without informatics has too become unthinkable. As in Physics and Biology there are many specific aspects to informatics in the radiation oncology setting that go beyond classical medical informatics, surely medical physicists and radiobiologists agree. Examples include radiotherapy planning software or DICOM-RT issues.

In some departments radiation oncology informatics is something that is dealt with *en passant* by interested personnel from all areas; some are fortunate to rely on a dedicated informatician for support.

The trend is moving towards a clearer understanding of the importance of radiation oncology informatics and its special domain. As a witness to this two ongoing projects may be mentioned.

Annually since 2009 a workshop is taking place in Freiburg, Germany dealing with clinical and administrative Informatics in radiation oncology (KAI Workshop) bringing together several interested activists in the field of Radiation Oncology Informatics.

http://kai-workshop.strahlenheilkunde.org

Another Project, which is slowly but steadily growing is the Journal of Radiation Oncology Informatics, this international effort is to provide a publication platform for the crystalizing field.

http://jroi.org

The exchange of knowledge in this field is of central importance and participation and input in the above mentioned projects is very welcome.

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SSRMP Continuous Professional Education Event 2011 - How to improve my Presentation Technique – a Course for Medical Physicists

This year’s continuous professional education event, kindly organized by Hans W. Roser from Basel, was this time not dedicated to a specific medical physics subject as in earlier years but addressing how to improve our own presentation techniques. I guess most of you give presentations at various opportunities and different levels like scientific meetings and lectures. Maybe more importantly, most of us are spending quite some time attending such presentations and are not always satisfied how the subject was prepared and presented. To me, this annual continuous professional education event was quite an opportunity, even if I recognize myself not as a “green horn” anymore; however there is always something which can be improved.

Unfortunately the course was given in German over two days (March 29, 9 - 12 am at the University Hospital in Zurich and April 20, 8.30 – 12.30 am at the ETHZ) in Zurich, which was not optimal for our colleagues working in the western and southern parts. Maybe this was the reason, why only 9 attendees registered, whereas one dropped out for the second day. Prior to the course attendees were invited to report their experiences (positive and negative) regarding presentations and vocal behavior and to express their expectations for the course.
During the first day we had an interesting introduction from Jörg Bohlender, Physician at the department for phoniatrics and clinical logopaedia at USZ about the anatomy and pathology of the vocal apparatus. Then Britta Balandat, speech therapist from the same department, explained how to breathe correctly and how to train and to prepare properly our voice for a presentation or speech. To me this was the first time I heard about these subjects in a greater detail and the guided practical exercises in the whole group and in a one to one setting where quite helpful to me. Finally Eva Buff-Keller, a professional presentation trainer with a background as lecturer at various levels gave a presentation how to present successfully. With this package we walked away from the first part of the course to not only train actively what we have learned that day, but also to prepare a short (5-10 Minutes) presentation for the second part of the course.

Coming back three weeks later, we first had an introduction from Eva Buff-Keller repeating some take away messages from the first course day and reminding us to our vocal training exercises. Before all of us went on for the (Power Point) presentations, which were video recorded, Eva Buff-Keller outlined how to give and receive feedback on the presentations to be held. Provided with this information and a checklist to fill in, all attendees presented to the group. In order to facilitate the feedback and to speed up, the group was split into two sub-groups. After two presentations were given, the sub-groups gathered together for their feedback session. First we could watch the video, which is quite unusual but very helpful before the presenters could express their observations. Finally the sub-group went through the checklist and provided feedback to the presenter. This part of the course was also very helpful to me and I would like to have spent more time for this part.

From my point of view it was worth to spend the time and effort, since I had the chance to learn how to use and train my voice and how to improve my presentations. I also had the impression that all attendees walked away with some helpful information and/or feedback besides the video of their own presentation. I would like to thank Hans W. Roser and our board members for organizing and sponsoring this annual education event. Last but not least I met new colleagues and learned about their expertise. In case you have a chance to attend such a course, please do so, your audience will be gratefully.

Stefan Scheib, VMS Imaging Laboratory, Baden-Dättwil, Stefan.Scheib@varian.com

This article will be reprinted in European Medical Physics (EMP) News www.efomp.org

bern 2011
cyclotron symposium

First Bern Cyclotron Symposium

Bern, June 6-7, 2011

The First Bern Cyclotron Symposium was organized by the Laboratory for High Energy Physics (LHEP) of the University of Bern to foster research activities at the new multi-function and multi-disciplinary cyclotron laboratory, equipped with an external beam line dedicated to research. This event has been organized to stimulate ideas, synergies and collaborations by means of review talks given by distinguished international scientists.

The symposium, structured in two half days, was completely free of charge and scored more than 90 participants, among whom 13 colleagues from SSRMP.

After the welcome address given by the Rector of the University of Bern, Prof. Urs Würgler, the Dean of the Faculty of Sciences, Prof. Silvio Decurtinis, and by the Director of the LHEP, Prof. Antonio Ereditato, the first day was focused on main general scientific topics. Ugo Amaldi from CERN gave a very fascinating overview on the role of particle accelerators for science and society, highlighting the numerous interlinks between fundamental research in particle physics and medical applications. The lecture by Marco Silari, from CERN, on the different mechanisms of radioisotope production was followed by a comprehensive review on radiation protection for medical cyclotrons given by Riccardo Calandrino from the IRCCS San Raffaele in Milano. The scientific session was ended by Manjit Dosanjh, from CERN, who underlined the importance of international scientific collaborations around projects funded by EU on medical applications of particle physics.

Since industry plays a key role in bringing technology issued by fundamental physics research to the medical field, a special session on technological developments in industry was organized featuring talks by representatives from the following companies: AAA (France), D-Pace (Canada), ZAG (Germany) and TEMA Sinergie (Italy).

The first day ended at the Inselspital with the visit to the construction site of the laboratory, that will host the new IBA Cyclone 18 cyclotron, arriving in Bern for the middle of June.
The second day was characterized by more specific scientific topics related to a cyclotron facility. All the fields that can profit from a cyclotron laboratory could not be covered, but the speakers gave an overview on specific research subjects in physics (medical physics in particular), neurology, radiochemistry, highlighting the importance of an interdisciplinary scientific work. Three talks were in the field of medical physics: Mario Marengo (Policlinico S. Orsola-Malpighi, Bologna) presented the experience of the running cyclotron facility in Bologna, where, in parallel to the *routine* radioisotope production, new targets are developed in collaboration with industry and new "non standard" radioisotopes are produced; Neil Gibson (European Commission Joint Research Center, Ispra) illustrated the development of nanoparticles as radiotracers and their *in vitro* and *in vivo* applications; Michael Lassman

(Würzburg University Hospital) focused on the use of PET for treatment planning radiation oncology and non targeted radiotherapy underlying the dosimetric concerns. Moving to the field of neurology Dieter Heiss, from the Max Plank Institute in Köln, gave a very stimulating overview on the importance of PET radiotracers in the neurologic studies, from the imaging and cure of brain cancers to the diagnosis of some common brain diseases. The last speaker, Roger Schibli (ETH, Zürich and PSI, Villigen) with his talk on the radiopharmacy in the era of personalized medicine, stressed how nuclear imaging, with its high sensitivity, is an indispensable tool in the drug development.

A round table titled “Bern cyclotron: infrastructure, investments, multiple partners” concluded the symposium. The discussion was centered on a key point that indeed can be considered as the *leitmotiv* of the entire symposium, as underlined by all the speakers: the cyclotron is a special opportunity to create a “common language” between different scientific disciplines with the final goal of the benefit of society. The Bern experience represents also an evidence of a virtuous synergy between private investment and academic world with the same aim. A cyclotron for a *routine* radioisotope production can then have an added value, giving the occasion of developing interdisciplinary research, and being an appropriate place for specific student education, and specialized professional training. Moreover, the importance of scientific networking at European level clearly emerged.

The fruitful and stimulating discussions and the number of participants were really encouraging and triggered the idea of a Second Bern Cyclotron Symposium, to be probably held in two years.

The slides of the presentations can be downloaded from:

http://www.lhep.unibe.ch/cyclotron/

Saverio Braccini, LHEP, University of Bern

Paola Scampoli, University Federico II, Napoli (Italy)

The round table ending the symposium (left); participants visiting the construction site of the new Bern cyclotron laboratory (right).

P E R S O N A L I A

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After a PhD and 3 years of work as medical physicist at CHUV, **Olivier Pisaturo** will join the group of Pierre Bourgeois and Pierre-Alain Tercier on the 5th of September, in the service de radio-oncologie, hôpital cantonal, Fribourg. His new contact details will be Olivier Pisaturo, Service de radio-oncologie, HFR Fribourg - Hôpital cantonal, CH-1708 Fribourg.

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Après plus de 7 ans passés dans le département de médecine nucléaire de l'Inselspital, je vais rejoindre la Romandie ;-) et plus particulièrement le Centre de radio-oncologie de la Clinique de la Source à Lausanne où je collaborerai avec Michela Chianello.

Mes nouvelles coordonnées sont **Frédéric Corminboeuf**, Centre de Radio-Oncologie, Clinique la Source, Av. Vinet 30, 1004 Lausanne, f.corminboeuf@lasource.ch.

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Chers collègues, depuis mai 2011 je travaille au sein du groupe de physique de la radiothérapie de l'IRA au CHUV de Lausanne. Suite à l'obtention du diplôme français de physique médicale (DQPRM), j'ai réalisé une thèse dans le service de radiothérapie de l'institut Sainte Catherine d'Avignon (France). Au cours de ce doctorat, j'ai travaillé dans le domaine de la radiothérapie guidée par l'image (IGRT) sur le sujet de l'analyse des conséquences dosimétriques dues aux variations anatomiques au cours du traitement.

Mes nouvelles coordonnées sont : **Maud Marguet**, Institut de Radiophysique (IRA) - Rue du Grand-Pré 1 - CH 1007 Lausanne / 021 314 8650 / Maud.Marguet@chuv.ch

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– Pressespiegel –

Anmerkung der Redaktion: Hier finden sich interessante Artikel, die an anderer Stelle bereits erschienen sind.

Computertomografie: Unnötige Strahlenrisiken

NZZ Online

Ärzte setzen den Computertomografen viel zu häufig ein. Und setzen die Patienten oft einer unnötig hohen Strahlendosis aus.

In der Röhre: *Strahlenbelastung von Computertomografen lässt sich massiv senken*

Für Röntgenbilder setzen Ärzte immer häufiger auf Computertomografen (CT). Die Zahl der Scans stieg nach Angaben des Krankenkassenverbands Santésuisse zwischen 2006 und 2009 3,5 Mal stärker an als die Zahl der Arztbesuche. Rund 780 000 CT-Untersuchungen machten Spitäler und Ärzte laut dem Bundesamt für Gesundheit (BAG) allein 2008.

Der Einsatz des Computertomografen bietet Ärzten Vorteile: Das um den Körper des Patienten rotierende Gerät liefert dem Arzt scharfe dreidimensionale Bilder, anhand derer er schnell und sicher eine Diagnose stellen kann. In jüngster Zeit benützen Ärzte daher CT-Aufnahmen verstärkt, um auch Darmkrebs, Lungenembolien oder Gefässverschlüsse zu erkennen.

Belastung viel stärker als beim Röntgen

Jede Aufnahme setzt den Patienten aber einer Strahlenbelastung aus. Laut einer neuen BAG-Studie ist die effektive Strahlendosis von CT-Untersuchungen der Brust bis zu 100 Mal höher als bei Röntgenaufnahmen.

Etwa zwei Drittel der Strahlenbelastung der Bevölkerung geht laut dem Bundesamt auf das Konto von CT-Scans. Eine US-Studie von 2007 warnte davor, dass die heute durchgeführten Computertomografien künftig für bis zu 2 Prozent aller neuen Krebserkrankungen verantwortlich sein könnten. Für die USA bedeutet dies laut einer 2009 veröffentlichten Studie jährlich rund 29 000 zusätzliche Tumore. Für die Schweiz gibt es keine Zahlen.

Spitäler und Radiologie-Institute behandeln Patienten zudem oft mit mehr Strahlung, als nötig wäre. Manche Radiologen arbeiten laut der BAG-Studie bei CT-Scans des Herzens oder Schädels mit bis zu zehn Mal höheren Strahlendosen als andere.

Ein Teil der Strahlung wäre vermeidbar. So untersuchten Experten des Instituts für diagnostische Radiologie des Berner Inselspitals die CT-Praxis von zehn Spitälern und unterwiesen diese in der strahlenarmen Handhabung der Geräte. Ergebnis: Viele Spitäler setzen laut dem Radiologen Sebastian Schindera «ihre Computertomografen nicht optimal ein». Nach seinen Erfahrungen «lässt sich die Strahlenbelastung der Patienten um bis zu 40 Prozent reduzieren, ohne dass die Aussagekraft der Bilder leidet». Das Bundesamt bietet Radiologie-Abteilungen nun Schulungen an.

Tomografeneinsatz je nach Kanton anders

Viele Computertomografien sind ohnehin überflüssig. In Schweden sind laut Studien rund 20 Prozent aller Untersuchungen nicht gerechtfertigt. Das BAG verfügt über keine Zahlen. Ob ein Patient eine Computertomografie erhält, hängt auch davon ab, wo er wohnt. In Basel-Stadt kamen Patienten 2009 laut einer Santésuisse-Statistik 60 Prozent häufiger in die Röhre als der Schweizer Durchschnitts-Patient, Patienten in den Kantonen Schwyz, Appenzell Ausserrhoden oder Baselland 40 Prozent seltener. Santésuisse-Sprecherin Silvia Schütz geht davon aus, dass gewisse CT-Untersuchungen unnötig sind oder durch andere Verfahren wie Ultraschall oder Röntgen ersetzbar wären. Sie kritisiert, dass es «bisher keine Anreize gibt, CTs zu vermeiden».

Im Gegenteil: Ein Zürcher Spital kann pro CT-Scan des Brustkorbs knapp 600 Franken verrechnen, fünf Mal mehr als bei einer Röntgenaufnahme. *Eric Breitinger*

TIPPS

So schützen Sie sich vor zu viel Strahlung

Vor allem Kinder und jüngere Erwachsene sollten sich vor zu vielen und hoch dosierten Untersuchungen im Computertomograf (CT) hüten. Je jünger ein Patient ist, desto sensibler reagieren die Organe auf Strahlen. Mit der Lebenserwartung wächst zudem das Risiko, an Krebs zu erkranken.

■ Fragen Sie für sich oder Ihr Kind vor einer CT nach, ob ein Alternativverfahren ohne Strahlenbelastung in Frage kommt, etwa eine Untersuchung per Ultraschall oder eine Kernspintomografie (MRT).

■ Ist eine CT-Untersuchung nötig, sollte man sich bei den Radiologen erkundigen, ob sie eine strahlenarme Einstellung gewählt haben oder diese möglich ist.

SALDO Nr. 9 | 11. Mai 2011

Quelle: SALDO, Nr. 9, 11. Mai 2011

Verzerrte Risikoangaben schaden den Patienten

Warum eine korrekte Nutzen-Risiko-Beurteilung von medizinischen Interventionen oft schwierig ist

Medizinische Interventionen sind mit Chancen und Risiken behaftet. Diese müssen so kommuniziert werden, dass Patienten sachgerechte Entscheide fällen können. Es gibt viele Gründe, warum das in der Praxis oft nicht möglich ist. Erschreckende Unwissenheit.

Wie sehr Vorstellung und Realität voneinander abweichen können, zeigen die in langjähriger Forschungstätigkeit gewonnenen Erkenntnisse des renommierten Risikoforschers Gerd Gigerenzer vom Max-Planck-Institut für Bildungsforschung in Berlin. Über besonders relevante Einsichten berichtete der Psychologe unlängst auf der Jahrestagung der Schweizerischen Gesellschaft für Innere Medizin in Lausanne. Erschreckend ist demnach, wie wenig die Allgemeinbevölkerung über den Nutzen so gängiger Krebsvorsorgeuntersuchungen wie der Mammografie und der Bestimmung des Prostata-spezifischen Antigens (PSA) weiss.

Beide Verfahren dienen einer frühzeitigen Krebsdiagnose mit dem Ziel, die Sterblichkeit der Betroffenen – von Frauen mit Brustkrebs einerseits und Männern mit Prostatakarzinom andererseits – zu senken. Der lebensrettende Effekt der Reihenuntersuchungen ist aber weitaus geringer als offenbar angenommen. Laut Gigerenzer verliert er noch weiter an Bedeutung, wenn man die grosse Zahl falsch positiver – irrtümlicherweise für Krebs gehaltener – Ergebnisse in der Nutzen-Risiko-Gleichung berücksichtige. Solche Versehen schürten nämlich nicht nur unnötige Ängste. Sie verursachten darüber hinaus überflüssige Zusatzuntersuchungen und teilweise unnötige Behandlungen, die dem Patienten mehr Schaden zufügten als nützten. ….

Der ganze Artikel ist erscheinen:

Quelle:http://www.nzz.ch/nachrichten/hintergrund/wissenschaft/verzerrte_risikoangaben_schaden_patienten_1.10930020.html

Elekta to acquire Nucletron, complementing its product offering with world-leading brachytherapy technology

Elekta today announced the signing of a definitive agreement to acquire Nucletron, the world leader in brachytherapy treatment planning and delivery. Nucletron is the global market leader in brachytherapy with 2010 reported revenues of EUR 128 million and EBITDA of EUR 26 million.

Nucletron will add 1,000 new customers to Elekta's customer base of more than 5,000. The two companies have highly synergistic product and technology portfolios. The combination will lead to enhanced solutions for customers and patients, and will allow the enlarged group to take mutual advantage of Nucletron's expertise in brachytherapy combined with Elekta's global presence, particularly in emerging markets.

Under the terms of the agreement, Elekta will pay cash consideration of EUR 365 million to acquire Nucletron on a cash and debt-free basis. The transaction, which has been approved by the Board of Directors of both companies, is subject to regulatory approval and is expected to close in early autumn 2011.

Source: www.finanzen.net, 21. June 2011