Radiation oncology towards Intensity-Modulated Radiation Therapy (IMRT)

Radiotherapy is the most successful and frequently used treatment modality for cancer patients after surgery; it is applied to about 60% of all cancer patients as definitive, adjuvant or palliative to surgery or chemo-therapy.

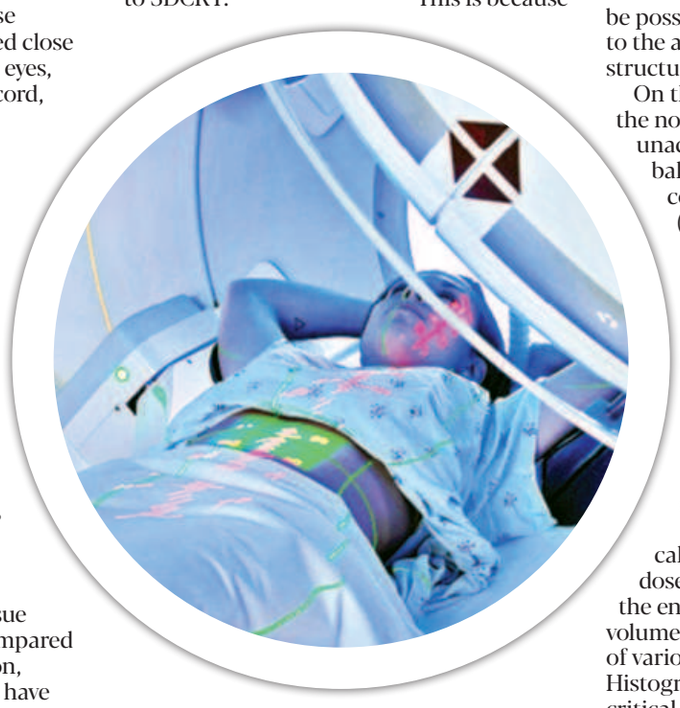
PROF DR KAZI MANZUR KADER

Radiotherapy aims to deliver a high radiation dose to a tumour, killing all tumour cells. However, from the physical and technical point of view, a difficult task because malignant tumours are often located close to radiosensitive organs such as the eyes, optic nerves and brainstem, spinal cord, bowels or lung tissues.

During radiotherapy, these so-called organs at risk (OAR) must not be damaged. The situation is even more complicated when the tumour itself is radio-resistant and very high is needed to reach a therapeutic effect.

This is where new technologies in radiation oncology, especially Three-Dimensional Conformal Radiotherapy (3DCRT), come into play. Any 3DCRT plan conforms the spatial distribution to the prescribed dose to the target, concomitantly excluding critical normal tissue from the volume receiving high radiation doses.

Reducing the dose to normal tissue permits tumour dose escalation compared to conventional methods. In addition, advances in computer technologies have significantly changed radiotherapy practice toward Intensity Modulated Radiation Therapy (IMRT). IMRT is considered an extension of an advanced form of 3DCRT. Instead of using uniform fields as in 3DCRT, IMRT uses intensity-modulated fields to generate dose distributions that are more conformal to the target. IMRT requires a higher level of precision compared to 3DCRT. This is because the generation of modulated fields by the inverse treatment planning algorithm is directly based on the Computerised Tomography (CT).



In radiotherapy practice, over the years of experience and research have confirmed that escalation of radiation dose to tumours results in better tumour control; with the routine radiotherapy technique, it would not be possible to increase the tumour dose due to the associated increase in dose to typical structures around the tumour.

On the other hand, higher doses to the normal structure have exhibited unacceptable complications. Thus, a balance was sought between tumour control (cure) and morbidity (difficulties); with improved imaging modalities, better delineation of the target volume is possible alone with critical structures around.

Development of computerised treatment planning systems and facility to transfer computerised tomography (CT) images to planning systems improved escalation of dose to various structures and the uniformity of dose to the entire target volume.

The development of various dose calculation algorithms could define dose precisely and point to point in the entire patient's body. This enables volumetric studies and critical dose analysis of various structures by Dose Volume Histograms (DVH) for target and other critical structures. All facilities are available in Bangladesh.

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Is a fourth dose of COVID-19 mRNA vaccine needed?

A fourth dose of the Pfizer-BioNTech (BNT162b2) vaccine for over 60 has been approved in Israel. Two retrospective cohort studies now assess its COVID-19 prevention efficacy. A fourth dose (8–14 days prior) was compared to three doses (629,00 recipients) and internal control (days 3–7). From week four to week six, the four-dose group had 3.5–4.3-fold lower rates of severe disease than the three-dose group and 2.3–2.8-fold lower than the internal control group. On average, the four-dose group had 2.0–1.1 times lower rates of SARS-CoV-2 infection than the three-dose group and 1.8–1.0 times lower than the internal control.

In a second study, there was a comparison between 182,000 sixty-year-old members of an Israeli healthcare organisation who received a fourth dose to those who received three doses. Between days 7 and 30 postvaccination, the relative effectiveness of a fourth versus the third dose was 45% against SARS-CoV-2 infection, 55% against symptomatic COVID-19, 68% against COVID-19–related hospitalisation, 62% against severe COVID-19, and 74% against COVID-19–related death.

The studies showed that a fourth dose of mRNA vaccine had a transient effect on infection but a larger effect on severe disease.

Heavy bleeding after giving birth is globally a leading cause of death in new mothers

The European Medicine Agency (EMA) Committee for Medicinal Products for Human Use (CHMP) recently adopted a positive opinion recommending an extension of the NovoSeven® label to treat women suffering from severe post-birth bleeding when uterine contractions anti-bleeding medications (uterotonics) are insufficient to stop the bleeding.

Postpartum haemorrhage (PPH) is the most common major childbirth-related haemorrhage. PPH is defined as blood loss of 1500 mL or more within 24 hours of delivery, regardless of the delivery route (vaginal or caesarean). Dizziness, shaking, increased heartbeat, and confusion is all symptoms of severe PPH. The global incidences of PPH and severe PPH are estimated to be 6-11% and 1-3% of all births, respectively, with substantial variations across regions.

Uterotonics failed to control the bleeding in a prospective randomised clinical trial of women with severe PPH. In the primary analysis, fewer women in the NovoSeven® arm (21 vs 35) needed additional medical procedures to stop bleeding, resulting in a 40% relative risk reduction.

Poor diet associated with increased diabetes risk across all gradients of genetic risk

STAR HEALTH DESK

A poor diet, irrespective of genetic risk factors, is associated with a 30% increased risk of diabetes. Genetic risk factors and diet quality are independently associated with type 2 diabetes; a healthy diet is linked to lower diabetes risk across all levels of genetic risk. That concludes a study of more than 35,000 United States (U.S.) adults publishing recently in PLOS Medicine by Jordi Merino of Massachusetts General Hospital, U.S., and colleagues.

Both genetic and lifestyle factors are known to contribute to individual susceptibility to type 2 diabetes. Previous studies have shown that adherence to a healthy lifestyle is associated with reduced risk of type 2 diabetes across genetic profiles, but whether genetic profiles, in part, interact with lifestyle factors was unclear.

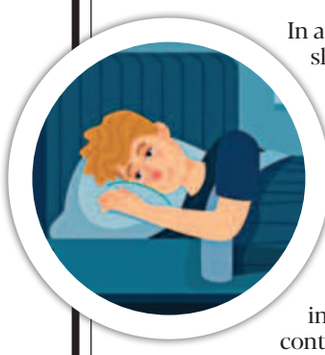
In the new study, researchers analysed data from three extensive cohort studies, including 35,759 U.S. health professionals followed for 902,386 person-years of follow-up.

The team found that irrespective of genetic risk, a low diet quality, as compared to high diet quality, was associated with a 30% increased risk of type 2 diabetes. The relative risk of type 2 diabetes was 1.29 per standard deviation increase in the global polygenic score.

In addition, the joint association of low diet quality and increased genetic risk was similar to the sum of the risk for each factor alone, further supporting independent associations. That said, one limitation of the study was that the cohort sampling might not necessarily generalise to other populations.

The researcher adds, "This study provided evidence that the risk of type 2 diabetes attributed to increased genetic risk and low diet quality is similar to the sum of the risks associated with each factor alone. Such knowledge could serve to inform and design future strategies to advance the prevention of diabetes."

Poor sleep and metabolic risk should be addressed



In a small, randomised study, sleep restriction increased daily calorie intake, weight gain, and abdominal fat deposition.

Researchers enrolled 12 healthy, non-obese people (aged 19 to 39 years; 75% men) in the study conducted in an inpatient setting.

Half were assigned to sleep restriction comprising 4 hours in bed nightly and a half to a control condition of 9 hours in bed.

All participants had unrestricted access to food. Sleep restriction increased calorie intake (308 kcal/day), protein intake, and fat intake but did not affect energy expenditure.

The study entailed four days of acclimation, in which participants were in bed for 9 hours, then 14 days of sleep restriction or control sleep, and then three days of recovery (9 hours in bed). After a 3-month washout period, patients crossed over to the alternate sleep condition.

All participants had unrestricted access to food. Sleep restriction increased calorie intake (308 kcal/day), protein intake, and fat intake but did not affect energy expenditure. Sleep deprivation increased weight gain (net weight gain, 0.5 kg).

Although total fat changed little between conditions, total abdominal fat increased with sleep deprivation (net increase, 15.2 cm2). Insufficient sleep can lead to weight gain and abdominal fat deposition.

Sleep deprivation may be a major contributor to cardiometabolic risk and should be addressed.