Kojinkai Social Medical Corporation

Hokkaido Ohno Memorial Hospital

Sapporo High Functioning Radiotherapy Center
-SAFRA-

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●It may take time for us to reply.

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『Non-surgical cancer treatment』

Kojinkai Social Medical Corporation

【Aiming for body-friendly non-surgical treatment ~Sapporo High Functioning Radiotherapy Center SAFRA~】

Hokkaido Ohno Memorial Hospital, which has the latest diagnostic devices and treatment equipment, is located in Sapporo, Hokkaido. This advanced acute-care hospital has 276 beds and treats mainly cancer, cerebrovascular diseases, heart diseases and motor system diseases. Using the latest equipment and treatments, we provide cutting-edge medical care.

Our hospital promotes multidisciplinary cancer treatment that effectively combines multiple therapeutic procedures (surgery, chemotherapy, immunotherapy, radiotherapy). Multidisciplinary cancer treatment requires cooperation among multiple clinical departments and centers. Among them, the Sapporo High Functioning Radiotherapy Center (SAFRA) plays a central role in “body-friendly non-surgical treatment,” which is our hospital' s mission. Taking advantage of the latest radiotherapy instruments, SAFRA provides cutting-edge radiotherapy. We hope to enable patients to live their day-to-day lives while undergoing cancer treatment.

SAFRA provides treatment using the latest model of the CyberKnife (CyberKnife M6) and TomoTherapy (TomoHD System). In the summer of 2018, proton therapy will begin. SAFRA will become the only facility in the world to be equipped with a proton therapy system, CyberKnife and TomoTherapy.

Director of the center

Kazushi Kishi

Vice-director,
Hokkaido Ohno Memorial Hospital Director,
Sapporo High Functioning Radiotherapy Center

〈Profile〉

After graduating from the Department of Medicine, School of Medicine, Wakayama Medical University in 1983, Dr. Kishi worked as an assistant (Department of Radiology), a lecturer, an assistant professor and an associate professor at the university. He assumed the post of director of the Department of Radiotherapy, Hokuto Social Medical Corporation Hokuto Hospital in 2013, and the post of vice-director of the hospital in 2014. Since October 2016, he has served as the vice-director of the Kojinkai Social Medical Corporation Hokkaido Ohno Memorial Hospital and the director of the Sapporo High Functioning Radiotherapy Center.
He studied in the radiation oncology program of the University of Texas MD Anderson Cancer Center in the United States in 1997 as a postdoctoral fellow.

【Qualifications】
Doctor of Medical Science
Radiologist
Japanese Society for Radiation Oncology: Certified physician
Japanese Society of Interventional Radiology: Certified specialist
Radiotherapy specialist

【Academic societies】
Secretary, Wakayama Society of Medical Imaging
Councilor, Japanese Society of Interventional Radiology
Secretary, Biology Committee, Japan Radiological Society
Secretary, Wakayama Malignant Tumor Society
Manager, Japanese Society for the Study of Angiomas and Vascular Anomalies
Delegate, Japanese Society for Radiation Oncology
Member, American Society of Therapeutic Radiation Oncology
Member, International Society for the Study of Vascular Anomalies
Member, American Brachytherapy Society

【Magazine editorial board memberships】
World Journal of Radiology
Japanese Journal of Radiology
Conference Papers in Medicine
American Journal of Cancer Therapy and Pharmacology
World Journal of Clinical Cases
Journal of Radiation Research
World Journal of Methodology
Journal of Cancer Research and Treatment

【Radiotherapy equipment at SAFRA①】

Cyberknife

CyberKnife is a radiotherapy system that consists of a high-precision robot arm of the kind used in precision industries and a small linear accelerator (Linac). Our hospital uses the CyberKnife M6 System, the latest model from Accuray Incorporated. It is the third of its kind in Japan and the first in Hokkaido.

Stereotactic radiotherapy and intensity-modulated radiotherapy

Using a freely moving robot arm, CyberKnife irradiates the target lesion from different directions. Its pinpoint irradiation of the target lesion minimizes radiation exposure to the surrounding normal tissue, affording fewer side effects and allowing elderly people and those who are frail to receive treatment. The system enables the pinpoint irradiation to be applied for risky cases in which surgery is difficult, and it enables lesions with an irradiation history to be re-irradiated. The choice between stereotactic radiotherapy and intensity-modulated radiotherapy depends on the treatment region and lesion.

Image-guided radiotherapy (IGRT) by CyberKnife

For positioning, CyberKnife uses X-ray images taken by two X-ray photography devices installed on the ceiling. Position gaps are corrected by using a bed with six joints, called RoboCouch, and a robot arm. Even during irradiation, X-ray images are taken at regular intervals for localization. During treatment, position gaps are calculated for correction, and adjustments are made by the robot arm. These procedures enable accurate positioning and position correction, as well as advanced pinpoint irradiation.

CyberKnife

Positioning for each region

①6D Skull Tracking
(positioning using the skull)

This method is used for the head region, a region for which CyberKnife excels. The system recognizes the boundaries between the skull bones and the air and positions the entire head. Each patient wears a custom-made mask called a "shell."

②Xsight Spine Tracking
(positioning using the vertebral body)

When the trunk is treated, the vertebral body (backbone) is used for positioning. This method is especially effective when the lesion to be irradiated is in or near the vertebral body.

③Fiducial Tracking
(positioning using a metal marker)

A metal marker embedded in the body is used for positioning. This method is used for regions away from the vertebral body as well as for the lungs and liver, where positioning based on X-ray images is difficult. A metal marker is placed in the body before treatment.

④Synchrony
(moving body tracking)

At our hospital, CyberKnife can track and irradiate a lesion in the lung, liver or pancreas that moves with respiration.* This can reduce the radiation exposure of normal tissue. Patients are not required to hold their breath. They can receive treatment while breathing normally.

*For some lesions, a metal marker must be placed before treatment is administered.

⑤Xsight Lung Tracking
(moving body tracking in the lung)

In cases where X-ray images can be used to visualize a lesion in the lung for positioning, a moving body can be tracked without using a metal marker. In addition to positioning using the vertebral body, the lesion is used as a marker to maintain positional accuracy. High-precision treatment can be provided without a metal marker if a pre-treatment simulation shows favorable results.*

*However, this method is limited to the irradiation of lesions in the lung.

Treatment session duration and number of sessions, and hospital visits

CyberKnife can deliver a high dose of radiation in each treatment. The duration of each treatment session is 30 to 60 minutes, including positioning, and the treatment is completed in one to several sessions. Outpatient treatment is usually possible. However, hospitalization may be recommended for certain medical conditions.

After the treatment, periodic imaging tests are conducted for follow-up. Follow-up observation may be made at another facility.

Major diseases amenable to this treatment

Head and neck	Spine and spinal cord	Breast and abdomen	Pelvis
Metastatic brain tumor	Metastatic bone tumor	Lung tumor	Prostate
Benign/malignant brain tumor	Benign/malignant spinal cord/spinal tumor	Hepatic tumor	Gynecologic tumor
Benign/malignant skull neoplasm	Arteriovenous malformation of spinal cord	Pancreatic tumor	Pelvic lymph node metastasis
Cerebral arteriovenous malformation		Mediastinal lymph node metastasis	
Acoustic tumor		Abdominal lymph node metastasis	
Cervical lymph node metastasis		Other breast or abdominal tumor	
Stomatol/otolaryngological disease			

*In addition to those mentioned above, there are other diseases that are amenable to treatment.
Based only on the disease name, it is not possible to determine whether CyberKnife is the right treatment.
It is necessary to check and study the clinical history and the results of various tests. Please contact us.

【Radiotherapy equipment at SAFRA②】

TomoTherapy

TomoTherapy is a versatile radiotherapy system that uses a small linear accelerator (Linac) embedded in a CT scanner. Our hospital has installed the TomoHDA System, the top-of-the line model from Accuray's TomoTherapy series. The system is the 13th of its kind in Japan and the first in Sapporo.

High-end intensity-modulated radiotherapy (IMRT)

TomoTherapy is characterized by intensity-modulated radiotherapy, which is an effective treatment that has fewer side effects. In this irradiation method, the beam shape and irradiation time are varied according to the position and angle of irradiation. Various radiation beams overlap, causing the intensity of radiation to differ at those overlapping points. This makes it possible to deliver a high dose of radiation to the target site while limiting the radiation exposure of surrounding normal tissue. The number of fine beams per treatment site can exceed 10,000. Considering that there are also IMRT machines with beam numbers of 100 or so, TomoTherapy can be described as a high-end IMRT model. Radiotherapy plans involving TomoTherapy that save normal tissue and deliver high doses of radiation to the target provide accurate, beautiful distribution charts of radiation that cannot be achieved with other treatment systems.

CT image-guided radiotherapy (CT-IGRT)

Another characteristic of TomoTherapy is CT image-guided radiotherapy (CT-IGRT), which enables accurate positioning. Even when high-precision irradiation is possible, position gaps affect the therapeutic efficacy and side effects. TomoTherapy efficiently combines a CT scanner and a radiotherapy unit to provide high-precision positioning. A CT image is taken just before each irradiation to accurately determine the position of the target. If the gap is large, the position is corrected automatically or manually for high-precision irradiation. Unlike X-ray images, in which bones and markers are used for positioning, the target in the body and the situation of the surrounding tissue (e.g., the movements of breathing and of the intestinal tract, the size of the bladder and the stomach) are clarified by CT for positioning. This is the most direct and accurate IGRT system.

Unique irradiation technologies (spiral irradiation and fixed direct irradiation)

Moreover, TomoTherapy enables spiral irradiation, which is not possible with other IMRT systems. Spiral irradiation is achieved by slowly moving the bed of the patient through beams that rotate at an extremely high speed while changing their shape (photo). When high-precision IMRT is used in a spiral manner, successive multiple targets can be irradiated consecutively and targets in a wide area can be irradiated uniformly. Like radiotherapy after breast-conserving surgery, fixed-angled irradiation is also possible (fixed direct irradiation). With TomoTherapy, even fixed-angle irradiation can limit the side effects on the lung and the heart because fine beams overlap.

TomoTherapy

Treatment session duration and number of sessions, and hospital visits

The time required for a TomoTherapy session varies depending on the treatment range and site, but it is estimated to be approximately 20 minutes, including CT scanning and confirmation. The number of sessions also depends on the site, but it is comparable to that for conventional radiotherapy. Outpatient treatment is usually possible. However, hospitalization may be recommended for certain medical conditions. After the treatment, periodic imaging tests are conducted as follow-up. The follow-up observation may be made at another facility.

Major target diseases

Malignant tumors	Whether primary or metastatic, head and neck cancers, prostate cancers, breast cancers, brain tumors, lung cancers, liver cancers, bile duct cancers, rectal cancers, stomach cancers, pancreatic cancers, bladder cancers, malignant lymphomas, myelomas, metastatic bone tumors and other tumors
Benign tumors	Cerebrospinal arteriovenous malformation and other tumors

*In addition to those mentioned above, there are also other diseases that are amenable to this treatment.
Based only on the disease name, it is not possible to determine whether TomoTherapy is the appropriate treatment.
It is necessary to check and study the clinical history and the results of various tests. Please contact us.

【Radiotherapy equipment at SAFRA③】

Proton therapy

Proton therapy is attracting world attention as a cutting-edge particle beam treatment. ProteusOne, which our hospital has introduced, is the latest model from IBA, the leading manufacturer of proton therapy systems. Our hospital is the 15th facility in Japan to offer proton therapy and the only facility in Japan with CyberKnife, TomoTherapy and a proton therapy system*. ProteusOne is one of the smallest proton therapy systems, which has enabled us to install the system in an area with excellent traffic access.

*as of January 2018

What is a proton beam?

There are various forms of radiation, and several of which are used in medical care. Of these, particle beams have been attracting attention for their therapeutic efficacy and fewer side effects. Proton beams are particle beams, and they are based on the proton, which is what remains after the electron is removed from the hydrogen atom. Protons accelerated in a large accelerator have a high level of energy, and protons with such energy are called proton beams.

Characteristics of proton beams (differences from conventional radiotherapies)

Radiotherapies work by directing radiation energy against cancer cells. With conventional radiotherapies, the X-rays have the highest energy level immediately after they enter the human body and this energy gradually decreases during transit through the body. Regarding proton beams, the energy level is low immediately after the beam enters the human body, but it suddenly becomes high at a certain point before becoming zero (the Bragg peak effect). Proton therapies are possible by providing such peak energy to the lesion. Compared with conventional radiotherapies, pinpoint therapeutic efficacy can be expected from proton therapy. It is an efficient therapy that minimizes the impact of radiation on the surrounding normal tissue.

ProteusOne techniques (pencil beam and scanning)

If the beam cross section has a greater area than the lesion surface, it is necessary to shape the beam such that it conforms to the lesion, in order to accurately treat the periphery of the lesion. ProteusOne should be applied to fill the lesion with a fine proton beam of 5 mm. Such a beam is called a pencil beam, because it treats the lesion as if drawing with the tip of the fine proton beam. The lesion is separated into layers, and each layer is irradiated as if it were being colored by a pencil beam moving at high speed (scanning irradiation).

Flow from medical examination to treatment

Patients are provided with medical examinations based on referral letters and imaging data from their regular doctors. Doctors from multiple clinical departments examine the lesion and determine whether proton therapy can be applied. If the cancer committee grants its approval, preparations for treatment will begin. As with conventional X-ray therapy, a brace is made to reproduce the same posture every time, and CT images of the patient wearing the brace are taken for therapeutic planning. MRI may be necessary, depending on the lesion type and site. Based on these images, a therapeutic plan is developed to determine the angle, depth, dose and frequency of proton beam application. Medical physics specialists and radiotherapy technologists verify the accuracy of the therapeutic plan so that the planned irradiation does not cause any problems to the human body. After the plan is approved by doctors, the proton therapy begins.

Major diseases that are amenable to this treatment

Brain tumors, head and neck cancers, lung cancers, mediastinal tumors, esophageal cancers, hepatomas, bile duct cancers, pancreatic cancers, prostate cancers, bladder cancers, cervical cancers, endometrial cancers, bone and soft tissue tumors, metastatic lung tumors, metastatic liver tumors, metastatic lymph nodes and other diseases

Treatment period

The period of proton therapy varies depending on the type of cancer and the irradiated site. It can range from a week at the shortest to two months or so at the longest. Irradiation is basically performed five times a week from Monday to Friday except national holidays. Outpatient treatment is usually possible. However, hospitalization may be recommended for certain medical conditions. After the treatment, periodic imaging tests are conducted as follow-up. Follow-up observation may be made at another facility.

If you have any questions, please feel free to ask.

【Flow from appointment/consultation to treatment】

❶Appointment with a doctor

This department sees patients by appointment only. Please be sure to make an appointment with a doctor by telephone or e-mail. Before making an appointment for your first visit, please consult with your regular doctor, prepare a referral letter from that doctor, and prepare CT and other imaging data and test results. Those who have undergone radiotherapy at other hospitals are kindly requested to prepare irradiation records.

❷Tests before treatment

- Before treatment, a test plan tailored to your condition is proposed. If your kidney function is low, a contrast medium test may be avoided. You are required to sign a letter of consent before the contrast medium test and other tests.
- Planned initial tests (work-ups) may be as below. If there are sufficient data, we can go into more detail about these work-ups and tell you what tests are needed. Additional detailed tests may be needed, depending on the test results you bring.
- Imaging tests (X-ray CT scanning, MRI scanning, PET-CT)
- Blood and physiological function tests (immunological function test, allergy test, gas diffusion capacity and other respiratory function tests, biochemical tests of blood including liver function, kidney function and blood cell component tests)
- IVR tests and endoscopy

  Angiography and other IVR tests, endoscopy and histological diagnosis are conducted if necessary. Angiography is conducted to study the nature of tumor vessels and to work out an appropriate strategy for the intra-arterial infusion of anticancer drugs. VR therapy in which blood vessels that feed cancer are filled with obstructing materials including anticancer drugs (arterial chemoembolization) can be performed simultaneously with diagnosis.

❸CT for therapeutic planning

CT imaging is performed for radiotherapy planning. If necessary, a brace is created so that the patient can maintain a stable posture for accurate treatment. Before treatment, a radiotherapy technologist gives a clear explanation of the radiotherapy.

❹Therapeutic planning

To develop and confirm the best, most accurate therapeutic plan, it takes approximately seven days after CT imaging.

❺Start of radiotherapy

Radiotherapy starts approximately seven days after CT imaging for radiotherapy planning. The starting day is subject to change. We will contact you again about the schedule before the initial treatment.

【Surgery, chemotherapy, immunotherapy and radiotherapy at our hospital】

Surgery

This is a procedure for surgically removing a cancer lesion. The latest procedures are minimally invasive, require only short-term hospitalization and leave only a small wound, making it possible for even frail people to undergo surgery. Minimally invasive surgery using da Vinci Xi, the latest surgical robot, and single-port laparoscopic surgery are available.

Radiotherapy

Minimally invasive and maximally effective radiotherapies are performed using the latest models of top-ranking therapeutic systems (CyberKnife, TomoTherapy). The latest radiotherapies are provided in combination with various procedures, such as short-term treatments using high-dose radiation, interventional techniques, measures to conserve normal tissue and immunotherapies. For prostate cancer and breast cancer, measures to cure these diseases without removing the lesion are employed. Patients are satisfied with such high-quality measures and therapeutic results. Regarding irradiation after breast cancer surgery, the dose to the heart that leads to a risk of ischemic heart disease 20 years later has been a problem in conventional procedures. However, accurate treatment can mitigate this risk. Proton therapy using ProteusOne will also start in 2018. Effective therapies using proton beams will be provided to patients with poor lung function.

Chemotherapy

With the advent of the latest anticancer drugs and molecularly targeted drugs, which are expected to have greater beneficial effect, chemotherapy is evolving. In any case, the genetic screening of cancer tissue is performed to select optimal drugs. In some cases, the use of drugs that are unavailable in Japan is considered.

Immunotherapy

In addition to the three main conventional therapies (surgery, radiation, chemotherapy), cancer immunotherapies (e.g., immune checkpoint inhibitor administration) have produced significant results and have increasingly been covered by insurance.

The human body has a system whereby it blocks an excessive immune response that would otherwise cause the body to destroy its own cells (an immune checkpoint). Cancer cells that disrupt this checkpoint system cannot be attacked even by killer lymphocytes. In such cases, drugs that inhibit the checkpoint (anti-PD-1 agents such as Opdivo) prevent disruption by cancer cells. The advent of Opdivo signaled the dawn of new immunotherapies. Coupled with various immunotherapies, the latest cancer treatments are provided. Combinations with radiotherapy are also expected. Immunotherapy is also effective for patients with infiltration, progressive cancer and terminal cancer.

【Combination of radiotherapy and immunotherapy】

<Cancer cells and the immune checkpoint system>

Activated killer lymphocytes can attack and kill cancer cells, except when the cancer cells have acquired the ability to disrupt the immune checkpoint system and evade an immune attack. It has been clarified that such disruption of the checkpoint by tumor cells is the predominant cause of immune dysfunction in cancer.

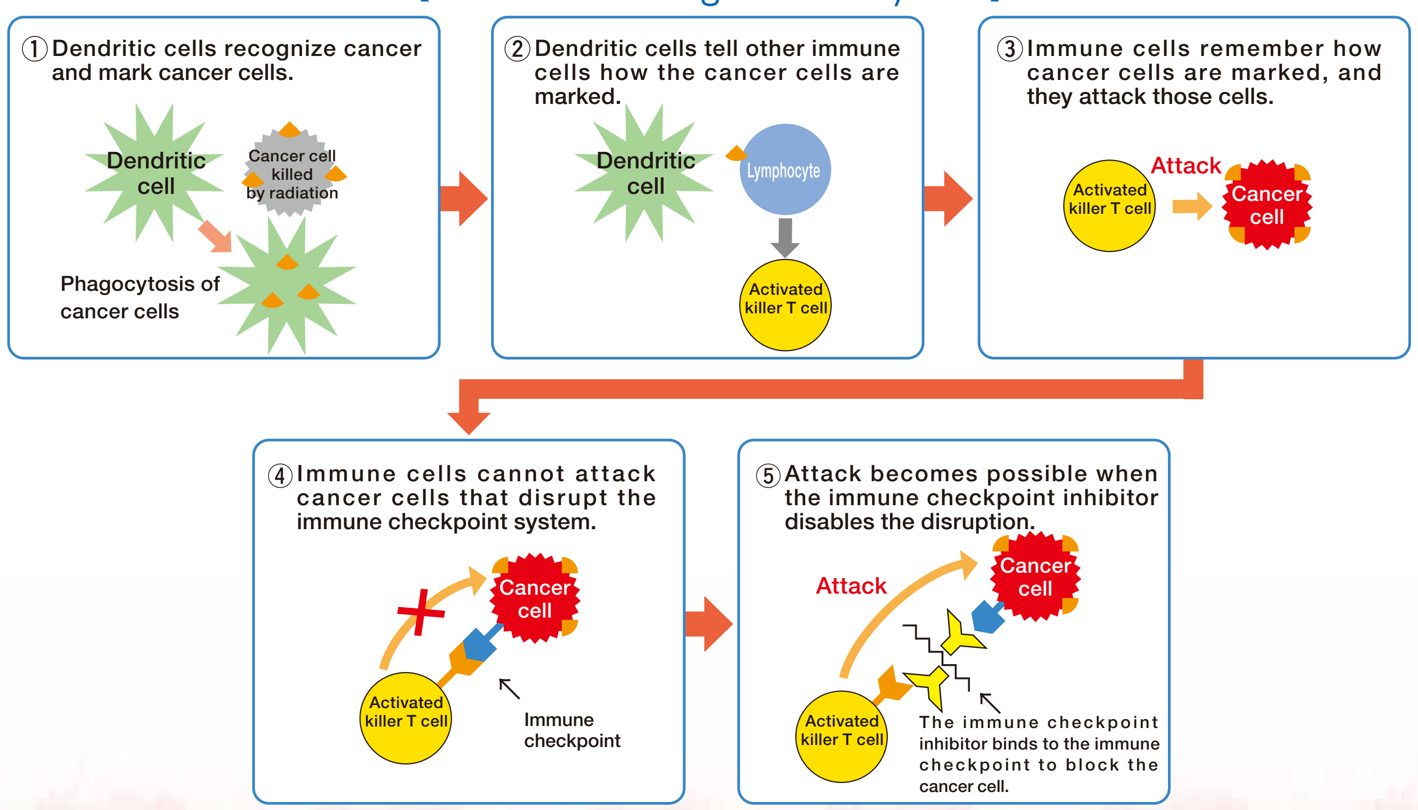
<Radiation and immunostimulation>

Various proteins (MARK kinases, including a MARK kinase that indicates cancer) are released by irradiated cancer cells. At that time, the immune system of the body recognizes many MARK kinases that are targets of the attack through dendritic cells. When dendritic cells pass that information to lymphocytes, lymphocytes are activated to become killer lymphocytes, which mount a powerful attack on cancer cells. However, killer lymphocytes cannot attack cancer cells that disrupt the immune checkpoint system, as mentioned before.

<Radiation and immune checkpoint inhibitors>

There have been many reports that when "disruption" is disabled, activated killer lymphocytes attack not only cancer cells that survive irradiation but also those that are not irradiated. In this way, radiotherapies and immune checkpoint inhibitor therapies are mutually suited. One current effective immune checkpoint inhibitor is Opdivo.

【The cancer-killing immune system】



【Access】

■By air
From Narita Airport or Haneda Airport to New Chitose Airport

From New Chitose Airport to Miyanosawa Station

■By bus
From New Chitose Airport International Terminal to Sapporo Station, then from Sapporo Station Bus Terminal to Nishimachi Kita 20-chome (approx. 100 min.)

■By JR train
From New Chitose Airport to Shin-Sapporo, then change to the Tozai Subway Line and get off at Miyanosawa (approx. 70 min.)