Chapter 12

RADIOTHERAPY PRACTICES IN SWEDEN COMPARED TO THE SCIENTIFIC EVIDENCE

Summary

Comparing the scientific literature to practices in Sweden reveals that radiotherapy is given to less than 34% of all patients with tumor diseases. This figure is lower than rates reported in other countries.

For most tumor types, curative radiotherapy in Sweden is generally similar to practices supported in the literature. Hyperfractionated radiotherapy and interstitial brachytherapy are used much too sparingly. Palliative radiotherapy is underutilized in Sweden. The need for radiotherapy can be expected to increase until the year 2010.

Literature review (Chapter 6)

A review of the scientific literature on radiotherapy for different tumor diseases was conducted by 17 experts under the leadership of a specially appointed project group. Chapter 6 presents the procedures and principles used to classify the literature. The aim of the literature survey was to report on the tumor diagnoses that are quantitatively most demanding on radiotherapy. Due to time limitations, the project group could not, as originally planned, review the literature on esophageal cancer, urinary bladder cancer, and skin cancer. However, the literature on total body irradiation in conjunction with bone marrow transplantation—a costly and very specialized radiotherapy method—was reviewed (although this method was not included in the survey). The literature review addresses tumor groups that utilize 89% of all radiotherapy in Sweden. Table 1 presents the total number of articles reviewed, the number of these articles judged as having high scientific value, and the number of patients included by these studies.

Survey of practice (Chapter 7)

A 12-week survey was conducted during the autumn of 1992 to identify radiotherapy practices in Sweden. All general and gynecologic oncology departments that offer radiotherapy participated in this inventory. The survey comprehensively registered several items of data concerning radiotherapy patients with diagnoses listed in Table 2.

For each patient, the survey recorded whether treatment was directed toward the primary tumor, locoregional recurrence, or distant metastases, and, if so, to what region. Further information collected included the number of fractions given, the number of fields irradiated, radiation dosage, and whether radiotherapy was given alone or in combination with other treatment. The palliative or curative intent of therapy was registered, although tumor stage and morphologic type were not.

The diagnostic groups included in the survey correspond to approximately 60% of all newly diagnosed cancer patients in Sweden. The diagnoses were chosen based on the need for radiotherapy, and include 82% of patients receiving radiotherapy in Sweden. The survey included nearly 3 000 patients, utilizing 48 839 radiotherapy fractions and 114 370 fields. Slightly more than two thirds of the patients were treated at regional hospitals, and about one third at county hospitals.

Half of all patients received potentially curative treatment. The percentage ranged from 39% at county hospitals to 52% at general oncology departments and 76% at gynecologic oncology departments at regional hospitals. Sixty-eight percent of the fractions and 72% of the fields were given with a curative intent. Palliative treatment was given to half of the patients, but utilized only one fourth of the radiotherapy resources as measured by the number of fields.

According to the prospective survey, approximately 34% of all tumor patients in Sweden would receive radiotherapy at some stage during their disease. However, the true number of patients must be lower since some of them began multiple treatments (different body areas) during the study period. The most probable range, 30% to 32%, is low in comparison to international data. Radiotherapy is included in treatment of 50% to 60% of cancer patients in the United States (1), half of the cases with a curative intent. Reports from the European Union (EU) (2) suggest that two of three tumor patients receive radiotherapy, with one third of the cases intended as curative treatment and the remaining two thirds as palliative treatment (Table 3). The indications for radiotherapy in Sweden are more stringent than in these countries, particularly for palliative treatment. At the time of the SBU survey, radiotherapy in

Table 1

Summary of the reviewed literature—studies judged to be of high scientific value, and the total number of studies meeting the criteria for review

Tumor Type	High scientific value		Total	
	Studies	Patients	Studies	Patients
Brain tumors	49	7 532	82	11 252
Head and neck cancer	101	36 881	424	79 174
Lung cancer	15	13 438	80	28 172
Breast cancer	57	346 717	97	387 634
Rectal cancer	50	12 140	73	15 042
Prostate cancer	10	44 038	53	52 005
Cervical cancer	31	28 639	59	34 024
Uterine cancer	25	10 269	55	13 597
Ovarian cancer	26	3 949	74	6 140
Hodgkin's disease	34	26 336	104	38 362
Non-Hodgkin's lymphoma	55	9 093	158	14 137
Soft tissue sarcomas	65	3 148	71	3 354
Bone sarcomas	20	1 075	28	1 394
Bone metastases	26	4 165	171	13 054
Transpl. bone marrow + stem cell	40	1 372	59	2 563
Quality of life	51	6 975	78	9 884
Total	665	551 900	1 666	709 788

Table 2

Diagnoses included in the prospective survey and the literature review regarding the use of radiotherapy.

ICD-9	Included in the survey of practice	Included in the literature review
	Diagnosis	
141, 143–149, 160–161	Head and neck cancer	Yes*
150	Esophageal cancer	No
154	Rectal cancer	Yes
162	Lung cancer	Yes
170	Bone sarcomas	Yes
171	Soft tissue sarcomas	Yes
173	Skin cancer, excl. melanoma	No
174	Breast cancer	Yes
180	Cervical cancer	Yes
182	Uterine cancer	Yes
183	Ovarian cancer	Yes
184	Other gynecologic cancers	No
185	Prostate cancer	Yes
186	Testicle cancer	No
187	Penile cancer	No
188	Urinary bladder cancer	No
191	Brain tumors	Yes
200–202	Malignant lymphomas	Yes

* except 143–145 and 160

Table 3

Utilization of radiotherapy for cancer treatment in different countries. The table shows the percentage of all cancer patients who received radiotherapy at some point during their disease (4).

Country	Year	Percent irradiated	Notes
Australia	1986	36	National survey
	1990	44	State survey
Canada	1975	48	Survey
	1987	54	Estimate
The Netherlands	1983	44	5 reports, some regional (33%–55%)
Great Britain	1979	45	Survey
		53	Estimate
USA	1983	46	Survey
	1985	50–60	Estimate of need
	1990	57	Estimate
Sweden	1992	<30–33	SBU Survey, see Chapter 7

Sweden, in comparison to many other countries, was a lesser utilized treatment modality.

The following sections discuss radiotherapy practices in Sweden compared to the practices supported by the literature. Estimates of future trends are based on the incidence projections reported in Chapter 5.

Head and neck tumors

In Sweden, tumors of the head and neck represent 2.5% of all newly diagnosed tumors. However, this tumor group represented 5.4% of the survey. Approximately 90% of all patients with head and neck tumors received radiotherapy, of whom four fifths received curative treatment, accounting for 13% of all fractions given for curative treatment, ie, 8% of the total number of fractions.

Of patients receiving primary treatment for head and neck tumors, 54% received radiotherapy alone, and 46% combination therapy (usually surgery). Regarding radiotherapy alone, an average of 4 fields per fraction in 31 fractions were given up to a total dose of 60 Gy. Regarding combination therapy, treatment consisted of 3 fields per fraction in 30 fractions for a total dose of 56 Gy. Locoregional recurrence was treated in only a few patients (10%) and then usually with 2 fields in 15 fractions up to a dose level of 35 Gy. Of the patients with laryngeal cancer, three fourths were treated by radiotherapy alone (64 Gy in 32 fractions).

The literature review confirms that radiotherapy is meaningful in treating tumors in the head and neck region. This finding coincides with the practice in Sweden, a practice thus supported by the international literature. However, no patients in Sweden received complementary brachytherapy, a practice supported by the literature for specific indications. Only a few patients have received hyperfractionated treatment. According to the literature

review, up to half of the patients in this tumor group would benefit from such treatment.

Expected trends. The number of patients with head and neck tumors is expected to increase by 25% by the year 2010. Radiotherapy will therefore continue to play a decisive role in treating these tumor diseases. Technical advancements are making radiotherapy more precise and easier for patients, which quite likely means that more patients can be treated with curative results. Advancements in surgery, (eg, laser surgery, removal of half the larynx, free transplantation) will probably lead to surgery alone in selected patients who are now treated by radiotherapy.

Brachytherapy is used extensively internationally, mainly for tumors in the tongue, floor of the mouth, and tonsils, and the literature review reports good treatment results. However, the value of this therapy depends on the experience and proficiency of the radiotherapist, and of the quality of the external radiotherapy which it complements, ie, the need for complementary brachytherapy increases as the quality of external radiotherapy decreases. If international brachytherapy rates applied to patients in Sweden, an estimated 10% would be candidates for treatment.

Several studies show that the curative figures are significantly better for hyperfractionated radiotherapy, mainly for mid-sized tumors. Immediate side effects from treatment may be accentuated, but late side eff ects do not appear to increase. Presumably, half of the patients receiving radiotherapy would benefit from hyperfractionation techniques. Hyperfractionated radiotherapy creates major demands on both personnel resources and on radiotherapy capacity.

Gastrointestinal cancer

Tumors in the gastrointestinal tract account for 22% of tumor diseases in Sweden. Radiotherapy plays a minor role, mainly palliative, for most of the tumors in the gastrointestinal tract—stomach cancer, small bowel cancer, colon cancer, liver cancer, and pancreatic cancer. A special study conducted at Radiumhemmet showed that only 1.6% of the radiotherapy patients had these diagnoses. On the other hand, radiotherapy plays an important role in esophageal and rectal cancers. These diagnoses account for 1.5% and 4.6%, respectively, of all radiotherapy patients. Of those who received local radiotherapy, approximately two thirds received it for curative purposes and one third for palliative purposes. Of those receiving curative therapy, the overwhelming majority received combination therapy including surgery. Potentially curative radiotherapy for gastrointestinal cancer accounts for approximately 3.4% of total fractions.

Esophageal cancer

Slightly less than half of the patients with esophageal cancer were treated with a curative intent, 20% received radiotherapy alone, 26% combination therapy, and the remaining 54% were treated with a palliative intent. In most cases of curative radiotherapy, 68 Gy was given in 34 fractions, while the most common dosage for combined primary treatment and locoregional recurrence was 40 Gy in 20 fractions. Esophageal cancer was not included in the literature review, and therefore the practice in Sweden cannot be related to the scientific literature.

Rectal cancer

An estimated one third of all patients in Sweden with this diagnosis received radiotherapy, whereof 3% received curative radiotherapy alone, 56% combination therapy with a curative intent, and 41% treatment for locoregional recurrence or metastases. Radiotherapy as a part of curative combination therapy was usually given preoperatively, and then usually with few fractions and high dosage. Curative radiotherapy alone was seldom given, but when it was, substantially more fractions were used. On average, 15 fractions were given for curative therapy, with 3.2 fields and a target dose of 37 Gy. Shortened preoperative therapy (5 Gy × 5) was given to two thirds of these patients (43% of all patients with rectal cancer in the survey). Palliative therapy was given with fewer fractions (13 fractions), a simplified method (2.3 fields), and at a somewhat lower dosage (35 Gy).

The literature review shows that preoperative radiotherapy reduces the risk for recurrence and extends the time before it appears. Research has been unable to show that it influences survival time, among elderly patients (over age 80 years) preoperative radiotherapy increases the risk for fatal cardiovascular complications postoperatively. Preoperative treatment may convert tumors that are primarily assessed as inextirpable, to extirpable. The results of the survey suggest this treatment method is underutilized in Sweden. The value of palliative radiotherapy in treating recurrence and advanced cancer is clearly demonstrated, particularly regarding effective pain relief. Given the evidence concerning this indication, the use of radiotherapy appears to be too limited.

Expected trends. Cases of rectal cancer are expected to increase approximately 17% by the year 2010. Comparing practice with the literature suggests an underutilization of radiotherapy, even with regard to palliation. A new, more aggressive surgical method (Heald) is being introduced widely in Sweden. This method is expected to reduce local recurrence rates to about 5%. If such a low recurrence rate can be achieved, general preoperative radiotherapy cannot be motivated, but should be reserved for patients with certain risk factors and locally more advanced tumors. Reducing the rate of local recurrence also reduces the need for later palliative radiotherapy.

The overall effects are difficult to judge. On one hand, radiotherapy is currently underutilized, and the disease is

expected to increase by 17%. However, on the other hand, the new surgical technique now being introduced should substantially reduce the need for radiotherapy. These effects may potentially offset each other, and the need for radiotherapy may remain essentially unchanged.

Lung cancer

In 1992, lung cancer comprised 6.4% of all malignant tumors. There are two main types: non-small cell lung cancer (NSCLC) comprising approximately 80% of the cases, and small cell lung cancer (SCLC) comprising the remaining 20%. The survey shows that 31% of the patients with lung cancer received radiotherapy for their primary tumor, with a curative intent in one fifth of the cases. Curative therapy is usually given in 21 fractions, using an average 2.5 fields, up to a target dose of 43 Gy. Standard radiotherapy for locoregional recurrence and metastases is 10 fractions, using 2 fields, up to 30 Gy.

The literature review shows that primary treatment for NSCLC stages I and II should be surgery, and the value of postoperative radiotherapy is not established. If primary surgery cannot be performed, radiotherapy may be an alternative. Patients at stage III are generally not primarily operable. Radiotherapy, possibly in combination with chemotherapy, marginally improves 2- and 3-year survival, but not 5-year survival. This improvement is, however, so slight that, for good reasons, the routine use of radiotherapy for stage III NSCLC must be questioned. Palliative radiotherapy may be indicated, however, only if tumor growth is symptomatic.

For limited SCLC, both radiotherapy and chemotherapy achieve rapid remission, but with rapid recurrence and poor survival. The literature review shows that radiotherapy added to chemotherapy can increase 3-year survival from 9% to 14%, and recent figures, although based on relatively short followup, suggest a further increase to nearly 30%. Since recurrence appears rapidly, 3-year survival can probably be considered permanent cure. The prognosis is worse for extensive disease, and published data does not show that radiotherapy improves survival.

The data from the survey does not distinguish the two main types of lung cancer. The data suggests, however, an underutilization of radiotherapy as palliative treatment for lung cancer.

Expected trends. Based on the prognosis, the number of patients will increase 26% by year 2010. This means an increased need mainly for palliative radiotherapy.

Tumors in bone, soft tissue, and skin

Primary tumors in bone and soft tissues are called sarcomas. These represent an uncommon group of tumor diseases that vary widely in localization and morphologic type.

Bone sarcomas

The literature review shows that radiotherapy is of limited value in treating bone sarcomas. According to the survey, no patients received primary radiotherapy and a few received palliative therapy for recurrence or metastatic disease.

Soft tissue sarcomas

This group of tumors is relatively unusual, with not quite 300 new cases diagnosed per year. The survey shows an estimated 90% receive radiotherapy, although only one fourth in conjunction with primary treatment, and then usually in combination therapy. Three fourths of the patients receive palliative treatment, many of whom receive a few fractions with high doses.

The literature survey shows that radiotherapy is of value, but the proportion of patients is, nevertheless, unexpectedly high. For soft tissue sarcomas of the arms and legs (comprising one third of sarcomas) radiotherapy is not indicated if the primary treatment strategy is adequate and surgery is radical.

Expected trends. This tumor group is expected to increase by approximately 19% until year 2010. Based on the literature, it is reasonable to assume that the number of patients receiving radiotherapy will, nevertheless, decline.

Skin cancer (excluding malignant melanoma)

The dominant types within this tumor group are squamous cell carcinoma, and basal cell carcinoma (basiloma). Since the latter are not reported to the cancer registry, the percentage of total skin cancers receiving radiotherapy cannot be given. In the survey data, patients with skin tumors comprised 4.5% of all radiotherapy patients. Nearly all patients received curative radiotherapy, 45% as the only treatment for primary tumors, 30% as part of combination therapy, and 10% for treatment of local recurrence. The most common fractionation for curative radiotherapy alone was 10 Gy $\times$ 4, but the number of fractions and dose levels were substantially higher for combination therapy, probably since it was the extensive nature of these tumors that motivated combination therapy.

Earlier, radiotherapy played a major role in treating skin cancer, and two decades ago, skin cancer patients were the most common diagnostic group at radiotherapy departments (3). Currently, surgery and freezing (cryosurgery) are routine treatments, and radiotherapy is used in only the few cases where these methods are inappropriate. This tumor group was not included in the literature survey.

Breast cancer

Each year, about 5 300 women develop breast cancer, comprising 13% of all, and 25% of female, cancer cases.

Survival is approximately 70% after 5 years, and 50% after 10 years.

In the survey, these patients accounted for approximately 30% of all radiotherapy cases. An estimated 37% of all newly diagnosed breast cancer patients receive curative radiotherapy, on average with 23 fractions to 2.7 fields up to a dose of 49 Gy. Most of these patients are treated according to accepted clinical guidelines or within the framework of ongoing studies. Palliative radiotherapy is usually given in 10 fractions to an average 1.8 fields up to a dose of 30 Gy. Breast cancer represents the largest diagnostic group (34%) among patients with bone metastases.

The literature is extensive, including many randomized studies. It shows that primary treatment usually involves surgery, with postoperative radiotherapy integrated into the treatment strategy. Radiotherapy in conjunction with breast removal in patients with cancer in the axillary lymph nodes significantly reduces the number of local recurrences. However, if radiotherapy is given only after recurrence has been diagnosed, lasting local cure is rare. Several studies of modern radiotherapy methods have observed improvements in long-term survival between 5% and 10%, but these figures are not significant, ie, not scientifically verified. Radiotherapy in conjunction with breast conserving surgery significantly lowers the risk for local recurrence. No differences in survival have been observed. For advanced inoperable tumors, radiotherapy, chemotherapy, and various types of hormonal therapy often have good results. Radiotherapy is also valuable in treating distant metastases, mainly in bone and the brain.

The survey shows that somewhat more than 60% of breast cancer patients receive radiotherapy sometime during the course of disease, half as combination therapy directed at the primary tumor. Curative treatment is generally given according to internationally accepted guidelines, within the framework of clinical protocols or controlled studies. Hence, Swedish practice is supported in the international literature.

Expected trends. The number of breast cancer cases is expected to increase slightly more than 20% during the next 15 years. The tendency toward earlier detection of smaller tumors and fewer patients with axillary lymph node metastases, will continue to reduce the need for radiotherapy following breast removal. The number of patients receiving breast conserving surgery will probably increase. Currently, these patients, almost without exception, are given postoperative radiotherapy. Recent studies show that some subgroups of patients are at relatively low risk for developing local recurrence even without radiotherapy. Hopefully, it will become possible to find markers that better indicate which patients are at high risk for local recurrence and thereby require postoperative radiotherapy. Hence, it may be possible to avoid irradiating a large group of patients.

The combined impact of these trends are difficult to estimate. Expected increases in the number of cases may be partially, or completely, offset by a lower percentage requiring radiotherapy. The need for radiotherapy as an integrated component in primary treatment of breast cancer will probably remain unchanged. The need for palliative treatment for metastases will probably increase.

Gynecologic tumors

Cervical cancer

The incidence of cervical cancer has declined during the past 30 years. Slightly more than 500 new cases were diagnosed in 1992. The survey shows that two thirds of newly diagnosed patients are candidates for curative radiotherapy. This is given as external radiotherapy in 44%, as intracavitary brachytherapy in 26%, or as combination therapy in 30% of the patients.

The literature shows that in early stages with small tumor volumes, the results are the same for surgery and radiotherapy alone as primary treatment methods. Postoperative radiotherapy may be motivated for lymph node metastases. For more advanced stages, radiotherapy alone or in combination with surgery is the dominant treatment method. The literature review supports curative radiotherapy in a high percentage of patients.

Expected trends. During the next 15 years, the number of newly diagnosed patients is expected to decline further, approximately 15%. The proportion of patients who receive external or intracavitary radiotherapy will remain unchanged. To improve radiation protection, developments will continue toward so-called high dose rate brachytherapy, ie, more treatments but shorter treatment times. This, in turn, will lead to a reduction in the need for inpatient beds, but will increase the number of treatment visits.

Uterine cancer

Cancer of the uterus mucosa (endometrial cancer) is diagnosed in about 1 200 patients annually. Endometrial cancer is a radiosensitive tumor type, and it did not take long to discover that 70% of the patients at early stages could be cured by radiotherapy alone. Later, it was shown that combination therapy, mainly preoperative brachytherapy and surgery, yielded even better results in high risk patients with lymph node metastases or other unfavorable prognostic factors. Patients at stage I comprise almost half of the cases, and the scientific literature provides no guidance on whether primary surgery or primary brachytherapy (insertion of radiation sources in the uterus) is preferable in these patients. The trend in Sweden, mainly during the past 2 years, has been more toward primary surgery in order to surgically stage the disease. Hence, the need for primary brachytherapy is declining.

The value of radiotherapy has been documented for early stages in high-risk patients with lymph node metastases or other unfavorable prognostic factors, and in technically inoperable patients at advanced stages (stages II–IV), and for recurrence.

At the time of the survey, radiotherapy continued to play a major role in Sweden, often as a complement to surgery. Approximately 84% of the patients received radiotherapy in some form, whereof 70% received brachytherapy alone or in combination with external radiotherapy, and the remainder received external radiotherapy alone. This practice has changed since the time of the survey.

Expected trends. During the next 15 years, the number of endometrial cancer cases is expected to decline by approximately 3%. The percentage of patients receiving external radiotherapy will remain unchanged. The use of intracavitary brachytherapy will decline, and will be reserved for patients with advanced disease and for postoperative treatment in selected cases.

Ovarian cancer

Approximately 900 new cases of ovarian cancer are diagnosed annually, corresponding to 2.8% of all cancer cases. In the survey, 1.7% of the patients had this diagnosis, and approximately 20% of the patients with ovarian cancer are candidates for radiotherapy. Half are given radiotherapy in curative combination therapy, and the other half receive it for palliative treatment, mainly for locoregional recurrence. A common dosage for this indication is 40 Gy in 25 fractions.

Based on the literature, surgery and chemotherapy are the main treatment methods, but the literature review provides no clear guidance as to radiotherapy's role. Radiotherapy is valuable for consolidation following surgery and chemotherapy, or to treat minimal tumor residuals. The results of the survey suggest that radiotherapy is being utilized more than can be motivated scientifically.

Expected trends. Ovarian cancer is expected to increase by nearly 4% until the year 2010. Radiotherapy can be expected to continue its role as consolidation treatment and as palliative treatment. Total need should, however, decline despite an increase in the number of patients.

Other gynecologic cancers

This group mainly includes tumors in the vagina and labia, comprising 0.4% of all new cancer cases. In the survey, this group involved a small segment of radiotherapy patients (0.6%), but approximately 46% of all newly diagnosed patients received radiotherapy. In nearly all cases, the intent was curative, most frequently as part of combination therapy. A distinct fractionation schedule cannot be identified. Brachytherapy was given in isolated cases. Since this tumor group was not included in the literature survey, practice cannot be assessed from a scientific standpoint.

Tumors of male reproductive organs

Prostate cancer

Prostate cancer is the most common type of cancer in men, accounting for approximately 5 000 new cases annually, corresponding to 13% of all tumor cases. The survey shows that approximately 40% of the patients with prostate cancer were given radiotherapy, whereof 17% with a curative intent. Curative treatment averaged 29 fractions to 4 fields up to a final dose of 58 Gy. This suggests that curative radiotherapy for prostate cancer is a relatively complex, time-consuming procedure. Palliative radiotherapy was used mainly to treat bone metastases.

The literature contains no reliable information concerning the effects of radiotherapy at early tumor stages in relation to surgery or watchful waiting alone. Patients irradiated for more advanced tumors (T3) may have disease-free, 15-year survival of 18% to 27%, but the same may apply to untreated patients. Controlled studies based on randomized patient data are lacking. Radiotherapy has been shown to provide excellent palliation and reduce troublesome, subjective symptoms.

Considering the current state of knowledge, one must question whether any form of curative treatment is indicated for prostate cancer, except for less common, poorly differentiated tumors which are generally radiosensitive. Comparing practice and science suggests that not all curative therapies find support in the literature, but there are probably opportunities for valuable palliative treatment yet to be found. Overall, it is difficult to judge whether Sweden overutilizes or underutilizes radiotherapy for prostate cancer.

Expected trends. The number of prostate cancer cases are expected to increase by 25% until the year 2010.

Testicular cancer

There are two main types of testicular tumors, seminoma and embryonal carcinoma. Treatment mainly involves surgical resection of the tumorous testicle. Furthermore, for seminoma, radiotherapy is directed at the abdominal lymph nodes. Chemotherapy is used for carcinoma, and retroperitoneal lymph node dissection is performed in some cases. In Sweden, radiotherapy is seldom used for primary management of embryonal cancer. According to the survey, most of the limited number of patients who received radiotherapy were given 30 Gy in 15 to 17 fractions in combination therapy, most likely for seminoma.

Penile cancer

This diagnosis involved a few isolated patients who received radiotherapy for locoregional recurrence and lung metastases. Hence, further analysis of practices concerning this type of tumor is not purposeful.

Tumors of the urinary tract

Of tumors affecting the urinary tract, cancer in the urinary bladder places the greatest demand on radiotherapy resources, while cancer in the renal pelvis and ureter are less common. Earlier, postoperative radiotherapy was given for primary tumors in the kidneys, but now surgery alone is used, possibly complemented by adjuvant hormonal treatment in selected cases.

Urinary bladder cancer

Urinary bladder cancer accounts for 5% of all newly diagnosed cancer cases. According to the survey, 20% of all patients with urinary bladder cancer are given radiotherapy (curative radiotherapy in two thirds of the cases). Radiotherapy is used either as the only curative treatment (57%) or as combination therapy (43%). The dose levels in the former case are 60 Gy to 68 Gy in 30 to 34 fractions, in the latter case either 20 Gy in 5 fractions (preoperatively) or approximately 65 Gy in 33 fractions (postoperatively). For logistical reasons, the literature review could not be completed as planned, and therefore practice in Sweden cannot be related to the scientific literature.

Primary brain tumors

Primary brain tumors account for slightly over 3% of all newly diagnosed tumors, about 1200 new cases per year. Slightly over 30% of patients with primary brain tumors are given radiotherapy, two thirds for curative purposes. On average, treatment involved 24 fractions in 2.6 fields up to a dose of 49 Gy.

About half of the primary brain tumors are *high-grade malignant glioma (glioblastoma)*. Several studies show that postoperative radiotherapy can extend survival by weeks to months, and is more effective than chemotherapy. However, one can question the value of subjecting patients to prolonged and often arduous postoperative radiotherapy to extend life only a few weeks. As short-term palliative treatment, radiotherapy has some value in selected cases, eg, for relieving severe headache.

Low-grade malignant glioma (*astrocytoma*) accounts for slightly less than 20% of brain tumors. These tumors have an prolonged course, and more than half of the patients are alive 5 years after diagnosis. Primary treatment is surgery, and several studies show that postoperative radiotherapy extends survival. Hence, postoperative radiotherapy can be defended for these patients, although the benefits are limited.

Meningioma originates in the meninges and represents approximately 30% of brain tumors. Primary treatment is surgery, but two retrospective studies show that postoperative radiotherapy after non-radically resected tumors substantially reduces the recurrence risk. It must therefore be considered as indicated when the radicality of surgery is uncertain, but not following a macroscopically radical operation.

According to the survey, about 20% of the patients with primary brain tumors are candidates for curative radiotherapy. Since glioma is the dominant tumor type, this probably suggests a higher utilization of radiotherapy than what is supported by the literature. On the other hand, palliative treatment with few fractions was given to only a small proportion of patients, and therefore appears to be underutilized.

Expected trends. The number of patients with primary brain tumors is expected to increase by about 15% until 2010. The proportion of patients receiving postoperative radiotherapy should decline, due mainly to a reduction in high-grade malignant gliomas. However, in selected cases with pronounced symptoms, the use of palliative treatment with few fractions should increase.

Malignant lymphomas

Malignant lymphomas are classified into two basic types, Hodgkin's lymphoma and non-Hodgkin's lymphoma (NHL). The latter group dominates among the approximate 1 500 new cases annually. Both types of lymphoma are characterized by high radiosensitivity. Earlier, radiotherapy offered the only opportunity for cure. Later, these diseases were also found to be highly sensitive to chemotherapy. At more advanced stages, chemotherapy is the primary treatment modality, with radiotherapy as adjuvant treatment. At early stages in the disease, radiotherapy alone can be given as curative treatment.

The survey showed that malignant lymphomas represented 7% of all radiotherapy cases. Somewhat less than 60% of all newly diagnosed lymphoma patients should be candidates for radiotherapy, whereof 45% as curative treatment. Among patients given curative treatment, approximately half were given radiotherapy alone.

According to the literature, radiotherapy should be the dominant treatment for early stages of *Hodgkin's disease*. Chemotherapy dominates at more advanced stages, but radiotherapy is a beneficial addition in selected cases, both in conjunction with primary treatment and also later for recurrence. Treatment results are excellent.

Radiotherapy alone is superior for treating both low- and high-grade malignant forms of *non-Hodgkin's lymphoma* at stage I, while at other stages and for certain

forms of NHL it is of value only in selected cases. Radiotherapy also plays an important role in palliative treatment.

The survey shows that approximately 50% of the patients with malignant lymphomas receive radiotherapy at some point in the course of their disease, whereof half received it as the only treatment modality. Based on the literature review, this figure is reasonable.

Expected trends. Until the year 2010, non-Hodgkin's lymphoma is the tumor group expected to increase most, by 30%. Concurrently, Hodgkin's disease will continue to decline by approximately 5%. The percentage of patients receiving radiotherapy will apparently remain unchanged or possibly decline somewhat with continued improvements in chemotherapy. However, this possible reduction cannot outweigh the major expected increase in the number of patients.

Whole body irradiation for bone marrow transplantation

Whole body irradiation combined with high dose chemotherapy is used prior to transplantation of bone marrow or peripheral stem cells for a range of cancer diseases, mainly leukemia and malignant lymphomas. Increasing utilization can be observed worldwide for an increasing number of diagnoses. This method is both technically complicated and resource intensive (both in terms of equipment time and staff), placing major demands on dosimetry. Consequently, treatment should be limited to only a few centers. The literature review reveals that treatment strategies at the different centers are highly heterogeneous, but also shows that fractionated whole body irradiation has some advantages in view of side effects, and is less stressful for the patient. The survey did not include this particular type of treatment method.

Expected trends. A continued increase in utilization of this type of treatment can be expected.

Metastases

Bone metastases

Undoubtedly, bone metastases are the most common indication for palliative radiotherapy. The survey showed that radiotherapy was given for this indication to approximately one fourth of all radiotherapy patients, corresponding to approximately 10% of all patients with tumor diseases in Sweden.

The literature review fully supports radiotherapy as an effective treatment method to reduce pain, prevent fracture, and provide patients with pain-free mobility. However, the most appropriate fractionation is unclear: 1, 5, or 10 treatments. The answer probably depends on a range of factors, mainly where in the skeleton the metastases are located and the patient's expected survival time. In Sweden, an average of 8 fractions are used in each treatment series. This figure may appear to be somewhat high. A conservative estimate would be that 15% could be treated with 1 fraction, 60% with 5 fractions, and 25% with 10 fractions. Changes in accordance with these figures would reduce the average number of fractions from 8 to 5.65 per patient. Such a reduction would mean, for the whole of Sweden, a savings corresponding to half the price of one radiotherapy unit.

The survey shows that only one in ten cancer patients receives palliative radiotherapy for bone metastases. This proportion is lower than in other nations, and clearly represents an underutilization when compared to figures presented in the literature.

Expected trends. Total tumor cases are expected to increase approximately 18% by the year 2010, leading to more cases of bone metastases. Based on the literature review, it would be desirable to give most of these patients radiotherapy. Even using fewer fractions with larger doses per fraction will probably not fully compensate for the expected increase in the number of cases. A substantial increased in demand for palliative treatment of bone metastases can be expected.

Brain metastases

The brain is one of the three most common sites for metastases. The literature shows that metastases develop in 15% to 20% of all cancer patients, which in Sweden corresponds to between 6 000 and 8 000 patients annually. Many do not have symptoms, and therefore most patients do not require treatment. According to the survey, slightly over 400 patients per year are treated for this indication.

The literature review shows that effective symptom relief can be achieved in approximately 70% of the patients with symptomatic brain metastases. The effects are satisfactory and lasting, even following a few high-dose treatments. Postoperative radiotherapy often prolongs survival in cases of isolated, solitary brain metastases where surgical treatment may be indicated. For small, distinct metastases, stereotactic irradiation can lead to lasting regression and years of survival.

The survey shows that only one cancer patient in one hundred in Sweden receives radiotherapy for brain metastases. This figure suggests an underutilization of the treatment method.

Expected trends. Considering the expected 18% increase in tumor diseases over the next 15 years, one must assume that more patients will be candidates for this treatment indication. Even if only a few fractions are used to treat each patient, the need for radiotherapy for brain metastases will probably increase.

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