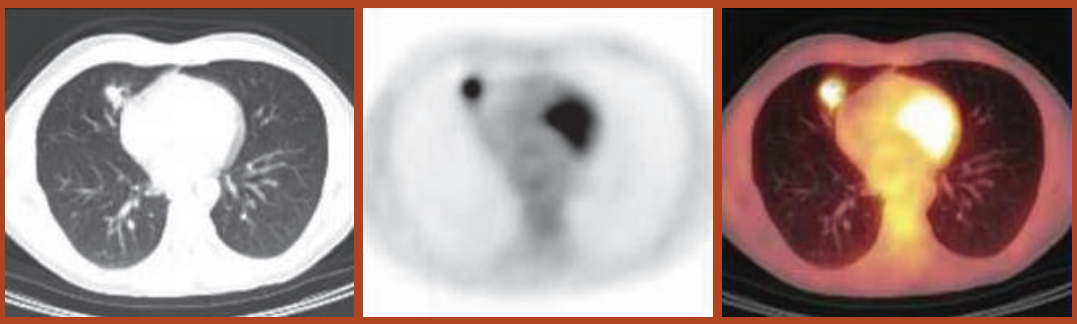

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No. 9

Appropriate Use of FDG-PET for the Management of Cancer Patients

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FOREWORD

The global incidence of cancer is increasing in both developed and developing countries and will become a heavy health burden in the coming decade. This increase in the cancer rate will bring with it challenges for health care systems, clinicians, and patients and their families. Technologies that improve the decision making process and optimize treatment have the potential to benefit society as a whole.

The purpose of this publication is to develop a consensus based on evidence from existing systematic reviews, to make health care providers aware of the value and the appropriateness of the introduction of positron emission tomography (PET), either alone or in combination with computed tomography (PET/CT) using 2-fluoro-2-deoxy-D-glucose (FDG) labelled with ^{18}F, in the management of patients affected by cancer.

Although the concept of appropriateness has been defined in terms of clinical utility, it may also be used to assist in the allocation of limited resources in an environment of shrinking health budgets. There is, however, the danger that new interventions will be underutilized, because they are viewed by health care administrators as inappropriate. This could be due to a narrow interpretation of appropriateness that is based solely on the cost of the intervention, isolated from the potential cost savings derived from its use. In reality, therefore, there might be a series of interventions, services and health services of proven effectiveness whose necessary implementation requires an increase in costs, at least in the short and medium terms.

Thus, if decision makers are to rely only on appropriateness criteria in decisions to fund health services, they must accept that the main aim of appropriateness is the optimization of resource allocation and not simply the reduction of costs. Therefore they must also focus on the inappropriateness of failing to introduce innovations of proven effectiveness.

While the use of PET is well established and integrated into oncological practice in many developed countries, it is limited or absent in many developing countries. Based on these considerations, the IAEA recognizes the need to make reliable information widely available to support Member States in the use of PET scanning. Within the Asia–Pacific region, the IAEA has initiated technical cooperation projects addressing the technical aspects and quality assurance of PET scanning, and aimed at identifying the indications for PET scanning most likely to provide the greatest benefit to both individual patients and the health system.

The regional project on Strengthening Clinical Applications of PET in RCA Member States (RAS/6/049), under the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology

(RCA) programme, was formulated to address this need in the Asia–Pacific region. As an integral component of this project, the IAEA convened an expert consultant group to consider the available systematic reviews and to draft a list of indications for PET scanning. The expert consultant group was also requested to consider specific issues that may affect the utility of PET scanning in the Asia–Pacific region.

The recommendations included here have been written and approved by the IAEA to promote the optimal use of FDG-PET imaging procedures. These broad recommendations cannot be rigidly applied to all patients in all clinical settings. This publication represents the state of knowledge at the time of writing regarding the utility of FDG-PET in the treatment of cancers that are common in the Asia–Pacific region. Since FDG-PET is a rapidly evolving technology, this report will require periodic updating, and readers are advised to seek the most recent reports pertinent to this particular area.

The IAEA officers responsible for this publication were M. Dondi of the Division of Human Health and M.P. Dias of the Division for Asia and the Pacific.

CONTENTS

1. INTRODUCTION

1.1. BACKGROUND

In the past decade, appropriateness has become a guiding principle to justify the introduction of new health care interventions, from the use of new drugs or new treatment modalities to the implementation of new diagnostic procedures. The concept of appropriateness, with a decision aid for its assessment, provides clinicians and funders with a tool to determine which diagnostic investigations and therapies should be implemented. In the context of diagnostic investigations, new investigations are deemed appropriate when the difference between the expected incremental information and the expected or possible adverse effects is sufficiently large that the investigation is warranted for the indication concerned. The decision tool for rating appropriateness includes a literature review and synthesis of the evidence according to designated indications.

Although the concept of appropriateness has been defined in terms of clinical utility, it may also be used to assist in the allocation of limited resources in an environment of shrinking health budgets. There is, however, the danger that new interventions will be underutilized, because they are viewed by health care administrators as inappropriate. This could be due to a narrow interpretation of appropriateness that is based solely on the cost of the intervention, isolated from the potential cost savings derived from its use. In reality, therefore, there might be a series of interventions, services and health services of proven effectiveness that are widely underutilized, whose necessary implementation requires, at least in the short and medium terms, an increase in costs.

Funding decision makers must accept that the main aim of appropriateness is not cost reduction, but rather optimization of health resource allocation, recognizing the consequences of failure to implement innovations of proven effectiveness. It is only through acceptance of this perspective that innovations of proven effectiveness will be introduced for the benefit of both individuals and society.

1.2. OBJECTIVE

The purpose of this publication is to develop a consensus based on evidence from existing systematic reviews, to make health care providers aware of the value and the appropriateness of the introduction of positron emission tomography (PET) or PET combined with computed tomography (PET/CT) using 2-fluoro-2-deoxy-D-glucose (FDG) labelled with ^{18}F in the management of patients affected by cancer.

1.3. SEARCH STRATEGY

The search of the available scientific publications was initially confined to systematic reviews of PET scanning in oncology using full ring PET and/or PET/CT that were published prior to 2009. However, owing to the rapid recent improvements in PET technology, for indications not deemed 'appropriate' (see definition below) in the systematic reviews, a literature review of publications more recent than the current systematic review was undertaken, to determine whether more recent information changed the classification of appropriateness, as defined below.

1.4. DEFINITIONS OF THE APPROPRIATENESS CRITERIA FOR THE USE OF PET

The use of PET for clinical indications can be considered appropriate, potentially appropriate, possibly appropriate or inappropriate. The appropriateness criteria for the usefulness of PET are defined as follows:

Appropriate (all the conditions below must be met)

- There is evidence of improved diagnostic performance (higher sensitivity and specificity) compared with other current techniques.
- The information derived from the PET scan influences clinical practice.
- The information derived from the PET scan has a plausible impact on the patient's outcome, either through adoption of more effective therapeutic strategies or through non-adoption of ineffective or harmful practices.

Potentially appropriate (potentially useful)

There is evidence of improved diagnostic performance (greater sensitivity and specificity) compared with other current techniques, but evidence of an impact on treatment and outcome is lacking.

Possibly appropriate (appropriateness not yet documented)

There is insufficient evidence for assessment, although there is a strong rationale for clinical benefit from PET.

Inappropriate

Improved accuracy of tumour staging will not alter management, or the performance of PET is poorer than that of other current techniques.

1.5. DEFINITIONS OF INDICATIONS FOR PET SCANNING

Seven different indications for PET scanning are considered here: diagnosis, staging, response evaluation, restaging, suspected recurrence, follow-up and radiotherapy (RT) planning. They are defined as follows:

Diagnosis

- Characterization of mass lesion: indication of whether a mass lesion is benign or malignant;
- PET guided biopsy: assistance in guiding biopsy to the region of a tumour with the highest metabolic activity, identified on the PET scan by the area(s) of highest FDG uptake;
- Detection of occult primary cancer (cancer of unknown primary site);
- Raised tumour markers: determination of the presence of cancer;
- Metastasis: determination of the primary site when metastases have been detected.

Staging

Assessment of the extent of disease prior to initiation of treatment.

Response evaluation

Assessment of treatment response during or after therapy.

Restaging

Assessment of the extent of disease following initial therapy or when recurrence has been confirmed.

Suspected recurrence

Assessment of the presence of cancer following clinical and/or biochemical suspicion of recurrence.

Follow-up

Surveillance in the absence of clinical evidence of recurrence.

RT planning

Aid in the placement of radiation fields (this assumes that there has been a decision to use RT).

1.6. STRUCTURE

Indications for the use of FDG-PET/CT in the management of 21 types of cancer are outlined in Section 2 and presented in more detail in Sections 3–23. Seven different possible indications are considered for each type of cancer, with recommendations given as to the appropriateness of FDG-PET/CT for each indication.

2. CLINICAL SCENARIOS FOR FDG-PET/CT INDICATIONS

Overall, 21 different types of cancer are considered here, with seven different possible indications for each. It should be noted that the recommendations refer to 'average individuals'. Specific clinical conditions may require the referring physician to take decisions that may differ from the evaluations included in this publication.

2.1. SUMMARY OF RESULTS

The following cancers have been considered:

(1) Non-small cell lung cancer (NSCLC)
(2) Small cell lung cancer (SCLC)
(3) Lymphoma
(4) Breast cancer
(5) Melanoma
(6) Ovarian cancer
(7) Cancer of the uterus and cervix
(8) Head and neck cancers
(9) Kidney cancer
(10) Germinal tumours
(11) Cancer of unknown primary (CUP)
(12) Colorectal cancer
(13) Gastric carcinoma
(14) Sarcomas (soft tissue and bone)
(15) Primary tumours of the central nervous system
(16) Nasopharyngeal carcinomas
(17) Gastrointestinal stromal tumours (GISTs)
(18) Pancreatic adenocarcinoma
(19) Cholangio- and gallbladder carcinomas
(20) Oesophageal cancer
(21) Thyroid cancer.

Cancers for which FDG-PET has no established role, such as prostate and hepatocellular carcinoma, are not discussed in this publication. Also, as most gastro-entero-pancreatic tumours (GEPTs) and mucinous adenocarcinomas are not FDG avid, FDG-PET is usually inappropriate for them.

Tables 1–4 summarize clinical indications for which the use of FDG-PET is recognized as appropriate, potentially appropriate, possibly appropriate and inappropriate, respectively.

Text continues on p. 15.

TABLE 1. INDICATIONS CONSIDERED APPROPRIATE

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Lung cancer	Characterization of SPN	NSCLC considered for curative treatment					
Lymphoma		HD, aggressive NHL Assess FDG avidity	HD and NHL with proven FDG avidity	HD and NHL with proven FDG avidity	Characterize masses after treatment of HD and NHL with proven FDG avidity		
Melanoma				Operable versus inoperable recurrence			
Ovarian cancer					Complementary to MRI		
Cancer of the uterus and cervix		N staging in tumours invading beyond uterus		Confirmed recurrence	Yes		
Head and neck cancers	CUP		After chemotherapy and/or radiotherapy	End of treatment	After surgery and/or radiotherapy		

TABLE 1. INDICATIONS CONSIDERED APPROPRIATE (cont.)

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Colorectal cancer				In apparently isolated local recurrence or metastases prior to surgery	In case of rising tumour markers and non-diagnostic conventional imaging		
Naso-pharyngeal carcinomas		N, M staging	Yes	End of treatment Confirmed recurrence			
Gastrointestinal stromal tumours (GISTs)		Yes	Yes	Viability assessment of confirmed recurrent tumour	Viability assessment of suspected recurrent tumour	Yes	
Oesophageal cancer		M staging					
Thyroid cancer				In patients with positive Tg and negative ^{131}I whole body scan	Rising tumour markers (Tg, calcitonine) to detect lesions accessible to surgery		

Note: CUP: cancer of unknown primary; FDG: 2-fluoro-2-deoxy-D-glucose; HD: Hodgkin's disease; MRI: magnetic resonance imaging; NHL: non-Hodgkin's lymphoma; NSCLC: non-small cell lung cancer; RT: radiotherapy; SPN: solitary pulmonary nodule; Tg: thyroglobulin.

TABLE 2. INDICATIONS CONSIDERED POTENTIALLY APPROPRIATE

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Lung cancer			NSCLC: Following neoadjuvant CXT to evaluate operability During definite RT/CXT to adapt dose according to response				NSCLC: Define RT treatment fields
Breast cancer		Locally advanced disease	Advanced/metastatic disease	Confirmed recurrence	In case of rising tumour markers		
Melanoma		Advanced (stage III–IV) disease					
Ovarian cancer		Yes		Confirmed recurrence			
Cancer of the uterus and cervix				End of treatment			RT planning (para-aortic nodal involvement in cervical carcinoma)
Head and neck cancers		Detect nodal involvement, distant metastases, synchronous tumours		Confirmed recurrence			Assist in defining target volume

TABLE 2. INDICATIONS CONSIDERED POTENTIALLY APPROPRIATE (cont.)

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Kidney cancer				Confirmed recurrence			
Cancer of unknown primary, non-ENT	Detect primary	Evaluate extent of disease					
Colorectal cancer		Yes					
Nasopharyngeal carcinomas					Identify site(s) of recurrence		
Pancreatic adenocarcinoma	Assess FDG avidity to characterize pancreatic mass				Distinguish recurrence from post-treatment changes		
Oesophageal cancer			Assess response after neoadjuvant therapy prior to surgery		Identify disease amenable to locoregional therapy		Assist in defining target volume

Note: CXT: chemotherapy; ENT: ear–nose–throat; FDG: 2-fluoro-2-deoxy-D-glucose; NSCLC: non-small cell lung cancer; RT: radiotherapy.

TABLE 3. INDICATIONS CONSIDERED POSSIBLY APPROPRIATE

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Lung cancer		SCLC		Guide selection of appropriate therapy in case of solitary metastases or local recurrence of NSCLC	NSCLC SCLC		SCLC NSCLC: Define total dose
Breast cancer							Assist in defining target volume
Melanoma					Assess FDG avidity in lesions not easily amenable to biopsy		
Ovarian cancer			Yes	End of treatment		Yes	
Cancer of the uterus and cervix			Yes				
Kidney cancer		In advanced disease					
Germinal tumours			Except for mature teratoma		Elevated tumour markers/equivocal CT		
Cancer of unknown primary, non-ENT	Raised tumour markers and normal/ inconclusive conventional workup	Evaluate extent of disease					

TABLE 3. INDICATIONS CONSIDERED POSSIBLY APPROPRIATE (cont.)

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Colorectal cancer			Yes			Yes	Yes
Gastric carcinoma		Yes	After neoadjuvant therapy			Yes	
Sarcomas (soft tissue/bone)	Guide biopsy	Yes (extra-pulmonary metastases)	Potentially change CXT in case of non-response	Yes (extra-pulmonary metastases)	Guide biopsy	Yes	Yes
Primary CNS tumours	Guide biopsy		Yes		Distinguish recurrence from radionecrosis	Low grade tumour	Guide RT dose escalation
Naso-pharyngeal carcinomas						Yes	Assist in defining target volume
Pancreatic adenocarcinoma		M staging	Yes				Assist in defining target volume; dose intensification
Cholangio-/ gallbladder carcinoma	Differentiate benign from malignant lesions	N, M staging	Yes				

Note: CNS: central nervous system; CT: computed tomography; CXT: chemotherapy; ENT: ear–nose–throat; FDG: 2-fluoro-2-deoxy-D-glucose; NSCLC: non-small cell lung cancer; RT: radiotherapy; SCLC: small cell lung cancer.

TABLE 4. INDICATIONS CONSIDERED INAPPROPRIATE

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Lung cancer	SCLC		NSCLC after definitive CXT/RT SCLC	NSCLC at end of treatment SCLC		NSCLC SCLC	
Lymphoma	HD and NHL	Non-follicular low grade NHL				Yes	Yes
Breast cancer	Yes	Axilla in the absence of palpable nodes		End of treatment		Yes	
Melanoma	Yes	Staging of stage I–II melanomas	Yes	End of treatment		Yes	Yes
Ovarian cancer	Yes						Yes
Cancer of the uterus and cervix	Yes					Yes	
Head and neck cancers	Characterize lesion Guide biopsy (except CUP)					Yes	
Kidney cancer	Yes	Yes (except advanced disease)	Yes	End of treatment	Yes	Yes	Yes
Germinal tumours	Yes	Yes		Yes		Yes	Yes
Cancer of unknown primary (CUP) with metastases outside neck			NA	NA	NA	NA	NA

TABLE 4. INDICATIONS CONSIDERED INAPPROPRIATE (cont.)

Type of cancer	Diagnosis	Staging	Response evaluation	Restaging	Suspected recurrence	Follow-up	RT planning
Colorectal cancer	Yes						
Gastric carcinoma	Characterize lesion Guide biopsy			End of treatment	Yes		Yes
Sarcomas (soft tissue/bone)	Characterize lesion						
Primary CNS tumours	Yes	Yes		End of treatment Confirmed recurrence			
Nasopharyngeal carcinomas	Yes						
Gastrointestinal stromal tumours (GISTs)	Yes			After curative surgery			Yes
Pancreatic adenocarcinoma				End of treatment Confirmed recurrence		Yes	
Cholangio-/ gallbladder carcinoma				End of treatment Confirmed recurrence	Yes	Yes	Yes
Oesophageal cancer	Characterize lesion Guide biopsy			End of treatment		Yes	
Thyroid cancer	Yes	Yes	Yes			Yes	Yes

Note: CNS: central nervous system; CUP: cancer of unknown primary; CXT/RT: chemotherapy/radiotherapy; HD: Hodgkin's disease; NA: not applicable; NHL: non-Hodgkin's lymphoma; NSCLC: non-small cell lung cancer; RT: radiotherapy; SCLC: small cell lung cancer.

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3. NON-SMALL CELL LUNG CANCER (NSCLC)

3.1. DIAGNOSIS

Characterization of mass lesion

Recommendation: Appropriate

Solitary pulmonary nodules (SPNs) are common and present a diagnostic challenge, particularly in persons with chronic pulmonary disease or any other condition where biopsy may be risky. FDG-PET is used to differentiate malignant from benign SPNs, with a sensitivity of 97% and specificity of 78% in lesions 1 cm or larger. SPNs with high FDG uptake should be considered malignant, whereas lesions with low uptake are likely to be benign or slowly growing malignancies such as broncho-alveolar carcinoma (BAC) and may be considered for surveillance using CT scanning. The use of PET for diagnostic characterization of SPNs is cost effective.

3.2. STAGING

Regional lymph nodes

Recommendation: Appropriate

The use of PET represents the standard of care for staging NSCLC in many countries, with meta-analysis indicating a higher sensitivity and specificity for PET than for CT scanning (85% and 90%, respectively, for PET versus 57% and 82%, respectively, for CT). This is especially important for mediastinal lymph nodes close to normal size, with a 20% false negative rate with CT compared with an 80% true positive rate with PET. Histological confirmation of PET positive lymph nodes is highly recommended if the patient's management may change, particularly from surgical to non-surgical treatment. PET is accurate even in those regions of the world where tuberculosis is endemic.

Distant metastases

Recommendation: Appropriate

Approximately one quarter of tumours initially staged as stage III prior to PET scanning are upstaged to stage IV following PET scanning. Brain metastases are not detected adequately using FDG-PET.

3.3. RESPONSE EVALUATION

Following neoadjuvant chemotherapy

Recommendation: Potentially appropriate

The PET response following neoadjuvant chemotherapy can be used to select patients with stage III tumours for subsequent surgical resection. If metastatic mediastinal lymph nodes show good response to chemotherapy, debulking or curative surgery may be considered. However, if there is poor response in mediastinal nodes, survival is very poor and patients probably should not undergo surgery.

Following definitive RT or chemoradiation

Recommendation: Inappropriate

Survival following definitive RT or chemoradiation is strongly predicted by PET, with improved survival in patients whose tumours show no uptake on post-treatment PET scans. This predictive value is much greater than that based on CT response. However, as this information does not change subsequent management, the use of PET for this purpose is not indicated.

During definitive RT or chemoradiation

Recommendation: Possibly appropriate

Some initial reports suggest that serial PET scans during a course of RT may be useful in determining the total RT dose. Tumours that fail to show a reduction in PET uptake during RT may be considered for a higher RT dose.

3.4. RESTAGING

End of therapy

Recommendation: Inappropriate

There is no rationale for the use of FDG-PET following completion of therapy.

Confirmed recurrence

Recommendation: Possibly appropriate

Although there are no data regarding the value of PET when recurrence has been confirmed, in a situation involving a solitary metastasis or local recurrence, restaging with PET may allow selection of appropriate therapy.

3.5. SUSPECTED RECURRENCE

Recommendation: Possibly appropriate

Data are lacking for this indication. However, there is a good rationale for the use of PET to confirm recurrence.

3.6. FOLLOW-UP

Recommendation: Inappropriate

While recurrence can probably be detected at an earlier point by PET than by clinical examination or another type of imaging, there is no evidence that patient management or survival would be affected.

3.7. RT PLANNING

Recommendation: Potentially appropriate

Many single centre reports, mostly on limited series of patients, indicate that the information available from PET scanning alters the size of RT treatment

fields in 27–100% of the cases. In most cases, the field size is increased to incorporate PET positive areas, while in some cases the field size is reduced in order to avoid unnecessary radiation to adjacent normal tissues, especially in the proximity of critical anatomic structures. To date there are no data showing an improvement in outcome.

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4. SMALL CELL LUNG CANCER (SCLC)

4.1. DIAGNOSIS

Characterization of mass lesion

Recommendation: Inappropriate

SCLC usually presents with a large central mass and concomitant hilo-mediastinal adenopathy; SCLC rarely presents with a peripheral mass. (In the rare event of SCLC presenting as an SPN, FDG-PET would be of value, as indicated for NSCLC.)

4.2. STAGING

Recommendation: Possibly appropriate

Management of SCLC is based on staging derived predominantly from CT findings. Although a number of reports indicate upstaging in approximately a quarter of the cases of limited stage SCLC, there are no data to indicate whether these patients should be managed as per limited stage or extensive stage disease.

4.3. RESPONSE EVALUATION

Recommendation: Inappropriate

As SCLC shrinks rapidly in response to effective treatment, it is unlikely that PET would contribute to the assessment of treatment response.

4.4. RESTAGING

Recommendation: Inappropriate

Although FDG-PET is likely to be more sensitive than CT in detecting sites of recurrent disease, recurrence is considered to be incurable and CT should be adequate for identifying recurrence.

4.5. SUSPECTED RECURRENCE

Recommendation: Possibly appropriate

The high FDG uptake of SCLC suggests that PET is a sensitive tool for identifying recurrence, although there are insufficient data indicating that PET alters clinical management.

4.6. FOLLOW-UP

Recommendation: Inappropriate

Recurrence of SCLC is considered to be incurable, with CT providing adequate detection of recurrence.

4.7. RT PLANNING

Recommendation: Possibly appropriate

It is likely that PET would have the same benefit for SCLC as has been demonstrated for NSCLC, resulting in a modification of the RT field definition for a high proportion of cases.

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5. LYMPHOMA

5.1. DIAGNOSIS

Recommendation: Inappropriate

There is no rationale to support the use of FDG-PET for the diagnosis of lymphoma, since histology is needed to establish such a diagnosis.

5.2. STAGING

Recommendation: Appropriate

Owing to its superior sensitivity and specificity for most types of lymphoma, FDG-PET is appropriate for staging of Hodgkin's disease (HD) and aggressive non-Hodgkin's lymphomas (NHLs), but not for non-follicular low grade lymphomas. Since diffuse bone marrow involvement and small disease foci may be missed, FDG-PET cannot be recommended to replace bone marrow biopsy at initial staging.

A baseline FDG-PET scan is also indicated to assess FDG avidity of the tumour when subsequent evaluation of response to treatment with FDG-PET is planned.

5.3. RESPONSE EVALUATION

Recommendation: Appropriate

FDG-PET is the method of choice for the assessment of response to therapy in Hodgkin's and non-Hodgkin's lymphomas with pretreatment FDG avidity, and is superior to the CT based International Workshop Criteria. It helps to characterize residual masses, and the absence or persistence of FDG uptake even after fewer than three chemotherapy courses permits the separation of patients into favourable and unfavourable prognosis categories.

5.4. RESTAGING

Recommendation: Appropriate

The role of FDG-PET in restaging is equivalent to that in staging.

5.5. SUSPECTED RECURRENCE

Recommendation: Appropriate

FDG-PET is useful in selected patients for determining the nature of new masses. Positive foci require pathological confirmation.

5.6. FOLLOW-UP

Recommendation: Inappropriate

FDG-PET currently has no recognized role in the routine surveillance of patients treated for HD and NHL.

5.7. RT PLANNING

Recommendation: Inappropriate

There are no data available to support the use of PET for RT planning.

Note: The above recommendations also apply to primary central nervous system (CNS) lymphomas.

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6. BREAST CANCER

6.1. DIAGNOSIS

Recommendation: Inappropriate

Multiple prospective studies have shown a low sensitivity (25%) for primary tumours 1 cm or smaller in diameter. The uptake of FDG in primary breast cancers is related to tumour size, histology and grade; more aggressive tumours usually have higher uptake than less aggressive ones. Other factors relevant to tumour biology also seem to influence the degree of FDG uptake and consequently the ability to detect the primary tumour by PET/CT.

6.2. STAGING

Axilla

Recommendation: Inappropriate

The sensitivity of FDG-PET is too low to correctly stage the axilla, as micrometastases may be missed. FDG-PET cannot replace sentinel node biopsy.

Distant metastases

Recommendation: Potentially appropriate

FDG-PET allows detection of extra-axillary nodes and distant metastases with higher sensitivity than other diagnostic imaging methods; an exception is brain metastases, where magnetic resonance imaging (MRI) is the method of choice. The relative role of bone scans using ^{99m}Tc compounds or FDG-PET in the detection of bone metastases remains undefined. Nevertheless, bone metastases from breast cancer tend to be osteolytic, and such lesions are known to be detected with higher sensitivity by FDG-PET than are sclerotic bone metastases.

6.3. RESPONSE EVALUATION

Recommendation: Potentially appropriate

There is growing evidence that FDG-PET permits reliable response assessment after 1–3 cycles of chemotherapy in locally advanced and/or metastatic disease. This is an evolving role for PET-FDG in the management of breast cancer.

6.4. RESTAGING

End of therapy

Recommendation: Inappropriate

No data are available to support the use of FDG-PET in the restaging of breast cancer.

Confirmed recurrence

Recommendation: Potentially appropriate

Due to its high sensitivity for distant metastases, particularly nodal and skeletal metastases, FDG-PET is helpful in establishing the extent of recurrent disease.

6.5. SUSPECTED RECURRENCE

Recommendation: Potentially appropriate

There is a role for FDG-PET in the detection of recurrence, especially in patients with rising tumour markers. So far, however, prospective trials that also address the issues of management changes, outcome and cost efficiency are lacking.

6.6. FOLLOW-UP

Recommendation: Inappropriate

No data are available, including from patients on long term therapy.

6.7. RT PLANNING

Recommendation: Possibly appropriate

Although only limited data are available, a rationale exists supporting the use of FDG-PET to define radiation fields for metastatic lesions.

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7. MELANOMA

7.1. DIAGNOSIS

Recommendation: Inappropriate

The diagnosis of melanoma requires biopsy and histopathological examination. FDG-PET does not reliably distinguish between benign and malignant naevi, particularly for the small cutaneous lesions that usually characterize pigmented skin lesions.

7.2. STAGING

Stages I and II, low pretest probability of metastases

Recommendation: Inappropriate

PET is less sensitive than sentinel node biopsy for staging regional lymph nodes. In patients with low pretest probability of distant metastases, the sensitivity of PET for distant metastases has been reported to be low. Very small metastases are common in melanoma and may be beyond the resolution of PET, despite the usually high avidity of these tumours for FDG.

Stages I and II, high pretest probability of metastases

Recommendation: Appropriate

In patients with intermediate or high risk of distant metastases (melanoma of the head, neck and trunk, Breslow index $\geq$4 mm, ulceration, high mitotic rate), FDG-PET is appropriate for detecting potentially operable metastases.

Stage III or potential stage IV

Recommendation: Potentially appropriate

There is a role for FDG-PET in assessing locoregional or distant disease to guide appropriate therapy.

7.3. RESPONSE EVALUATION

Recommendation: Inappropriate

There are few data supporting the role of FDG-PET in assessing response to systemic therapy.

7.4. RESTAGING

End of treatment

Recommendation: Inappropriate

There is no rationale for the use of FDG-PET following completion of therapy.

Confirmed recurrence

Recommendation: Appropriate

FDG-PET is of value in distinguishing operable from non-operable recurrent disease. It should be noted that PET is less sensitive than MRI and CT in the detection of brain and lung metastases, respectively. Management changes are reported to occur in 22–34% of patients after PET scanning.

7.5. SUSPECTED RECURRENCE

Recommendation: Possibly appropriate

In the case of a lesion that is not readily amenable to biopsy, high uptake of FDG-PET is strongly suggestive of recurrent melanoma. There is an overlap with the role of FDG-PET in confirmed recurrence (see discussion above).

7.6. FOLLOW-UP

Recommendation: Inappropriate

There is no evidence that early detection of unsuspected metastases will influence patient outcome.

7.7. RT PLANNING

Recommendation: Inappropriate

There is no evidence that FDG-PET contributes to treatment planning.

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8. OVARIAN CANCER

8.1. DIAGNOSIS

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in the initial diagnostic approach to ovarian cancer.

8.2. STAGING

Recommendation: Potentially appropriate

Although staging of ovarian cancers is usually performed surgically, the US National Oncologic PET Registry (NOPR) shows an impact of FDG-PET on intended management at initial staging of ovarian cancer in 16.1% of patients.

8.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

Relevant prospective studies are lacking.

8.4. RESTAGING

End of treatment

Recommendation: Possibly appropriate

Currently, there is no evidence of the value of FDG-PET in the restaging of ovarian cancer.

Confirmed recurrence

Recommendation: Potentially appropriate

According to the NOPR, the use of FDG-PET changed the intended management plan in 37.7% of the cases where it was used in restaging and in 44.5% of the cases where it was used in detection of recurrence.

8.5. SUSPECTED RECURRENCE

Recommendation: Appropriate

The number of patients in prospective controlled studies is small. Nevertheless, most studies show the diagnostic accuracy of FDG-PET, and particularly PET/CT, to be slightly superior to that of other imaging methods, in particular contrast-enhanced CT. In some studies, MRI was shown to be slightly more accurate; other studies found MRI and PET to be complementary for lesion characterization. In cases of peritoneal involvement, no currently used imaging method is sensitive enough to depict the full extent of the disease, as early proliferative peritoneal lesions are less than 1 mm thick.

8.6. FOLLOW-UP

Recommendation: Possibly appropriate

Currently, there is no evidence of the value of FDG-PET in follow-up of ovarian cancer, although a strong rationale exists for its use.

8.7. RT PLANNING

Recommendation: Inappropriate

RT has a very limited role in the management of ovarian carcinoma. When used palliatively, RT is directed at symptomatic masses identified by CT.

Note: Mucinous adenocarcinomas are usually non-FDG avid, and PET may therefore be inappropriate in this particular subgroup.

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9. CANCER OF THE UTERUS AND CERVIX

9.1. DIAGNOSIS

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in the diagnosis of cancer of the uterus and cervix.

9.2. STAGING

Recommendation: Appropriate

In stage Ib–IV cervical cancer, FDG-PET is a valuable adjunct to conventional imaging methods, namely CT. Although MRI is the preferred method for evaluation of local extension, PET is superior for the evaluation of nodal involvement. The sentinel lymph node technique combined with surgical staging is more sensitive for local node involvement. In a recent NOPR evaluation, the use of PET changed the intended management plan in 14.1% of the cases where it was used in staging cancer of the uterus and in 9.1% of the cases where it was used in staging cancer of the cervix.

9.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

There is insufficient evidence to validate the usefulness of FDG-PET in assessing response to chemoradiation therapy, although persistent FDG avidity seems to be related to unfavourable outcome.

9.4. RESTAGING

End of therapy

Recommendation: Potentially appropriate

Persistence of FDG uptake seems to be related to unfavourable outcome.

Confirmed recurrence

Recommendation: Appropriate

There is evidence of the improved diagnostic accuracy of FDG-PET in restaging of these tumours. The NOPR study confirmed that the addition of FDG-PET changed the intended management plan in 30.5% of patients with uterine cancer and in 26.9% of patients with cervical cancer.

9.5. SUSPECTED RECURRENCE

Recommendation: Appropriate

According to the NOPR study, the impact of FDG-PET on detection of suspected recurrence resulted in a change of the intended management plan in 38.8% of patients with uterine carcinomas and in 35.9% of patients with cervical carcinomas.

9.6. FOLLOW-UP

Recommendation: Inappropriate

There are no data to support the use of FDG-PET in this setting.

9.7. RT PLANNING

Recommendation: Potentially appropriate

For locally advanced tumours, the detection by FDG-PET of metastasis in para-aortic lymph nodes may lead to modification of treatment fields. This is of particular importance in cervical cancer.

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10. HEAD AND NECK CANCERS

The following discussion does not include nasopharyngeal and thyroid cancers; these are discussed in separate sections.

10.1. DIAGNOSIS

Characterization of mass lesion

Recommendation: Inappropriate

The diagnosis of primary head and neck cancers is made on the basis of clinical examination, endoscopy with biopsies, and imaging with CT/MRI and/or ultrasound.

PET guided biopsy

Recommendation: Inappropriate

No data are available to suggest that FDG-PET improves imaging guided biopsy.

Cervical adenopathy with occult primary

Recommendation: Appropriate

The true positive rate for PET is approximately 30% where PET is performed when all other diagnostic tests are negative or when some other tests may have been positive. Small tumours (<5 mm) may be missed by PET.

10.2. STAGING

Recommendation: Potentially appropriate

Use of CT or MRI remains the standard of care for T and N staging in this setting. FDG-PET is accurate in detecting regional nodal disease, distant metastases and synchronous tumours.

10.3. RESPONSE EVALUATION

Recommendation: Appropriate

If performed 8–10 weeks after treatment, FDG-PET is accurate in detecting residual disease after chemotherapy alone or combined with RT. If performed earlier, false positive results due to inflammatory changes are possible. Persistently enlarged FDG negative nodes need to be clinically monitored.

10.4. RESTAGING

End of therapy

Recommendation: Appropriate

The role of FDG-PET in the restaging of head and neck cancers is the same as in response evaluation (see Section 10.3).

Confirmed recurrence

Recommendation: Potentially appropriate

FDG-PET is accurate in detecting regional nodal recurrence, distant metastases and second tumours.

10.5. SUSPECTED RECURRENCE

Recommendation: Appropriate

Since distortion of tissue structures following surgery and RT may limit the diagnostic abilities of anatomic imaging techniques, the use of PET to identify recurrences is appropriate if conventional methods of diagnosing recurrence are inconclusive.

10.6. FOLLOW-UP

Recommendation: Inappropriate

There is no evidence that FDG-PET is useful in patients who have already been treated and are without any evidence of disease.

10.7. RT PLANNING

Recommendation: Potentially appropriate

Data demonstrate that target volumes and doses may be modified on the basis of FDG-PET findings. In particular, FDG-PET is helpful for the inclusion or exclusion of lymph nodes in the radiation field, although no data on patient outcome are available.

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11. KIDNEY CANCER

11.1. DIAGNOSIS

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in the diagnosis of kidney cancer.

11.2. STAGING

Recommendation: Possibly appropriate

Although some studies suggest a potential role for FDG-PET in advanced kidney cancer, there are still insufficient data to support its use for routine staging.

11.3. RESPONSE EVALUATION

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in the assessment of treatment response.

11.4. RESTAGING

End of treatment

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in the restaging of kidney cancer.

Confirmed recurrence

Recommendation: Potentially appropriate

Limited studies suggest that FDG-PET has good accuracy for the detection of unsuspected metastatic disease.

11.5. SUSPECTED RECURRENCE

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in detecting suspected recurrence of kidney cancer.

11.6. FOLLOW-UP

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in follow-up of kidney cancer.

11.7. RT PLANNING

Recommendation: Inappropriate

The placement of radiation fields is based on the presence of symptomatic gross disease, which is evident from results of conventional imaging.

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12. GERMINAL TUMOURS

12.1. DIAGNOSIS

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in the diagnosis of germinal tumours.

12.2. STAGING

Recommendation: Inappropriate

The negative predictive value is not high enough to avoid adjuvant therapies in the case of negative results.

12.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

FDG-PET is superior to CT, with a reported sensitivity of 59–89% and specificity of 92–100%. With the exception of mature teratoma, PET can distinguish residual tumour from necrosis and/or fibrosis.

12.4. RESTAGING

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in the restaging of germinal tumours.

12.5. SUSPECTED RECURRENCE

Recommendation: Possibly appropriate

In cases of equivocal CT findings and/or elevation of serum tumour markers, PET can be used to diagnose recurrence when other imaging techniques are not helpful.

12.6. FOLLOW-UP

Recommendation: Inappropriate

Currently, there is no evidence of the value of FDG-PET in follow-up of germinal tumours.

12.7. RT PLANNING

Recommendation: Inappropriate

RT has a minimal role in non-seminomatous germ cell tumours, and there are no data indicating that PET has an impact. For early stage seminomas, for which the patterns of failure are well described, there are no data to suggest that PET may influence radiation fields.

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13. CANCER OF UNKNOWN PRIMARY (CUP)

13.1. DIAGNOSIS

Raised tumour markers

Recommendation: Possibly appropriate

For tumour types that are potential origins of the raised markers and that are generally FDG avid, PET-CT should be used if the conventional workup has failed to identify the primary tumour.

Metastases outside the neck

Recommendation: Potentially appropriate

A single-trial analysis comparing PET and CT in locating primary tumour in patients with cancer of unknown origin indicated that the sensitivity of PET-CT was 36% versus 15% for CT.

Metastases in the head and neck area

See the discussion of head and neck cancers in Section 10 of this report.

13.2. STAGING

Recommendation: Possibly appropriate

FDG-PET may be appropriate for evaluation of the extent of disease.

13.3. RESPONSE EVALUATION

Not applicable

13.4. RESTAGING

Not applicable

13.5. SUSPECTED RECURRENCE

Not applicable

13.6. FOLLOW-UP

Not applicable

13.7. RT PLANNING

Not applicable

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14. COLORECTAL CANCER

14.1. DIAGNOSIS

Recommendation: Inappropriate

Any symptoms suggestive of colorectal cancer must be investigated by endoscopy, with biopsy of suspicious lesions. However, there are numerous cases where unsuspected and asymptomatic colorectal cancers have been detected on FDG-PET scans performed for other purposes.

14.2. STAGING

Recommendation: Potentially appropriate

FDG-PET is superior to other imaging modalities for detecting additional intrahepatic and extrahepatic metastases when a hepatic metastasis has been detected by CT or ultrasound, and may also be superior to those imaging techniques for detecting lymph node metastases. The use of FDG-PET in staging results in a change of treatment in approximately one quarter of the cases.

14.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

FDG-PET provides a sensitive assessment of the response to chemotherapy or chemoradiation that is superior to CT assessment. This may lead to a change from ineffective therapy.

14.4. RESTAGING

Recommendation: Appropriate

The common situations where restaging is required are (1) consideration of isolated local recurrence and (2) isolated hepatic metastases. The use of FDG-PET prior to hepatic resection changes management in approximately one third of the cases, mainly through identification of more extensive metastatic disease than

is shown with CT. The use of FDG-PET in this situation is cost effective. FDG-PET correctly identified resectable disease in 80% of the cases, and correctly identified unresectable, incurable disease in 90% of the cases. Therefore, surgical exploration should be undertaken when FDG-PET indicates resectable disease; conversely, surgery may be avoided when FDG-PET identifies extensive incurable disease. Care in interpretation of PET images is required following pre-operative chemotherapy, as hepatic metastases may be less evident.

14.5. SUSPECTED RECURRENCE

Recommendation: Appropriate

FDG-PET is valuable for determining the site or sites of recurrence when carcinoembryonic antigen (CEA) levels are rising and CT is non-diagnostic.

14.6. FOLLOW-UP

Recommendation: Possibly appropriate

FDG-PET provides evidence of pelvic recurrence earlier than CT scanning, with the potential for more effective local therapy.

14.7. RT PLANNING

Recommendation: Possibly appropriate

There are no data indicating a role for PET in assisting with the placement of radiation fields, although a strong rationale exists for its usefulness in this setting.

Note: GEPTs (gastro-entero-pancreatic tumours) and mucinous adenocarcinomas usually are not FDG avid, and FDG-PET may be inappropriate in this particular subgroup.

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15. GASTRIC CARCINOMA

The following discussion refers to distal gastric cancers. Tumours involving the gastroesophageal junction are generally considered as distal oesophageal carcinomas.

15.1. DIAGNOSIS

Characterization of mass lesion

Recommendation: Inappropriate

There is no evidence that the addition of PET to endoscopy and biopsy improves diagnostic ability.

PET guided biopsy

Recommendation: Inappropriate

There are very limited data available to date. Normal gastric mucosa shows some level of physiological FDG uptake.

15.2. STAGING

Recommendation: Possibly appropriate

There are limited data on the value of FDG-PET in detecting nodal and metastatic disease.

15.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

FDG-PET may identify response to neoadjuvant therapy. There are, however, no data to determine the impact of PET on clinical outcome.

15.4. RESTAGING

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET after the completion of definitive therapy.

15.5. SUSPECTED RECURRENCE

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET.

15.6. FOLLOW-UP

Recommendation: Possibly appropriate

There are limited data indicating a role for FDG-PET.

15.7. RT PLANNING

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET. Palliative RT is targeted at the CT defined mass; curative post-operative RT (usually with chemotherapy) is targeted at the surgical bed.

Note: Gastro-entero-pancreatic tumours (GEPTs) and mucinous adenocarcinomas usually are not FDG avid, and PET may be inappropriate in this particular subgroup.

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16. SARCOMAS (SOFT TISSUE AND BONE)

16.1. DIAGNOSIS

Characterization of mass lesion

Recommendation: Inappropriate

Although benign tumours generally exhibit less uptake than do sarcomas, there is considerable overlap, and some benign tumours have high avidity for FDG. Biopsy is required for diagnosis.

PET guided biopsy

Recommendation: Possibly appropriate

As sarcomas behave according to the highest grade of the tumour, and as treatment may change according to the tumour grade, the use of PET to identify the optimal biopsy site has a strong rationale, which has been confirmed by several reports.

16.2. STAGING

Recommendation: Possibly appropriate

Sarcomas have a particular propensity for initial metastatic spread to the lungs. High resolution CT is more effective than FDG-PET for detecting small lung metastases. However, PET may be more useful for extrapulmonary metastases. PET has also been shown to be more sensitive than bone scans using ^{99m}Tc labelled compounds for bone metastases from Ewing's sarcoma.

16.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

There is considerable interest in the use of PET to monitor the response of osteosarcomas to neoadjuvant chemotherapy. The goal is early evaluation of response; in the event of poor response, the drug combinations can be changed.

16.4. RESTAGING

Recommendation: Possibly appropriate

The role of FDG-PET in the restaging of sarcomas is the same as in the initial staging of sarcomas.

16.5. SUSPECTED RECURRENCE

Recommendation: Possibly appropriate

Suspected recurrence will usually require biopsy for confirmation. However, as indicated above (see Section 16.1), FDG-PET may guide biopsy to the site most likely to yield a high grade component.

16.6. FOLLOW-UP

Recommendation: Possibly appropriate

FDG-PET may be useful for detecting recurrence at an early stage, when salvage surgery may be possible or less mutilating. FDG-PET has some additional advantages over CT and MRI, as PET is not affected by abnormal, post-surgical anatomy or metal prostheses.

16.7. RT PLANNING

Recommendation: Possibly appropriate

There are no reports indicating the use of PET to assist RT planning. However, there is a rationale to support the concept.

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17. PRIMARY TUMOURS OF THE CENTRAL NERVOUS SYSTEM

17.1. DIAGNOSIS

Characterization of whether a mass lesion is low or high grade

Recommendation: Inappropriate

Although there is generally good correlation between FDG uptake and tumour grade, the high background in normal grey matter limits the ability to detect lesions with FDG-PET.

PET guided biopsy

Recommendation: Possibly appropriate

In selected cases, FDG-PET may be of value for identifying the most aggressive component within a lesion.

17.2. STAGING

Recommendation: Inappropriate

MRI provides excellent anatomic definition to determine the extent of the tumour.

17.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

There are few reports regarding the use of FDG-PET to assess the response to multimodality therapy, although a strong rationale exists for its use.

17.4. RESTAGING

End of therapy

Recommendation: Inappropriate

There is no indication of a role for PET scanning following the completion of therapy.

Confirmed recurrence

Recommendation: Inappropriate

There is generally no requirement to further define the tumour using PET when recurrence has been confirmed.

17.5. SUSPECTED RECURRENCE

Recommendation: Possibly appropriate

PET may provide information additional to that provided by MRI or CT for detection of recurrence following resection. FDG-PET has also been used to distinguish radiation necrosis from recurrent tumour; however, there are conflicting results and the accuracy seems to be low.

17.6. FOLLOW-UP

Recommendation: Possibly appropriate

PET has been used for routine surveillance of untreated low grade gliomas to assess transformation to high grade lesions.

17.7. RT PLANNING

Recommendation: Possibly appropriate

FDG-PET currently has no role in defining radiation fields or doses. However, there is a rationale for using PET for dose escalation to the metabolically intense region within the tumour.

Note: For CNS lymphomas, see the discussion on lymphomas in Section 5 of this report.

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18. NASOPHARYNGEAL CARCINOMAS

18.1. DIAGNOSIS

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET in the diagnosis of nasopharyngeal carcinomas.

18.2. STAGING

Recommendation: Appropriate

For both the N and M stages of the disease, FDG-PET provides incremental value over conventional imaging.

18.3. RESPONSE EVALUATION

Recommendation: Appropriate

If performed 8–10 weeks after treatment, FDG-PET is accurate in detecting residual disease. If performed earlier, there is a possibility of false positive results due to inflammatory changes. Persistently enlarged FDG negative nodes require watchful monitoring.

18.4. RESTAGING

End of therapy

Recommendation: Appropriate

See discussion on response evaluation.

Confirmed recurrence

Recommendation: Appropriate

Due to the high risk of distant disease, whole body imaging with FDG-PET is required to guide therapy.

18.5. SUSPECTED RECURRENCE

Recommendation: Potentially appropriate

When standard procedures are non-diagnostic, FDG-PET may identify the site(s) of recurrence.

18.6. FOLLOW-UP

Recommendation: Possibly appropriate

No data exist supporting the use of FDG-PET for follow-up, but a rationale exists, as early detection of local recurrence may permit curative treatment.

18.7. RT PLANNING

Recommendation: Possibly appropriate

PET may improve target volume delineation and identify involved lymph nodes of borderline size on structural imaging.

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19. GASTROINTESTINAL STROMAL TUMOURS (GISTs)

19.1. DIAGNOSIS

Recommendation: Inappropriate

Gastrointestinal stromal tumours (GISTs) are usually diagnosed by endoscopy and/or biopsy.

19.2. STAGING

Recommendation: Appropriate

A baseline FDG-PET scan is necessary to determine tumour avidity for subsequent treatment and response evaluation.

19.3. RESPONSE EVALUATION

Recommendation: Appropriate

For FDG avid tumours, PET is highly recommended for response evaluation because of the ability to identify the early response to tyrosine kinase inhibitor therapy.

19.4. RESTAGING

End of therapy

Recommendation: Inappropriate

After complete surgical resection, PET is not indicated. In patients with unresectable or residual disease, tyrosine kinase inhibitor therapy is continued unless intolerable toxicity occurs or resistance is documented.

Confirmed recurrence

Recommendation: Appropriate

An FDG-PET scan is necessary to determine FDG avidity of the recurrent tumour.

19.5. SUSPECTED RECURRENCE

Recommendation: Appropriate

FDG-PET is a sensitive procedure to determine possible recurrence(s), as the vast majority of GISTs are FDG avid.

19.6. FOLLOW-UP

Recommendation: Appropriate

In patients with persistent tumour, following incomplete resection of primary or recurrent tumour, FDG-PET is required to identify active disease.

19.7. RT PLANNING

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET in RT planning for treatment of GISTs.

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20. PANCREATIC ADENOCARCINOMA

20.1. DIAGNOSIS

Recommendation: Potentially appropriate

When a pancreatic mass is detected by conventional imaging, the degree of FDG avidity may help distinguish benign from malignant lesions.

20.2. STAGING

Recommendation: Possibly appropriate

FDG-PET sensitivity is low for N staging but may be improved by the use of contrast enhanced PET/CT. For M staging, FDG-PET may complement conventional imaging modalities.

20.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

There is a rationale for the use of FDG-PET for the assessment of response to systemic therapy, but only limited data are available.

20.4. RESTAGING

End of therapy

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET following completion of therapy for pancreatic adenocarcinoma.

Confirmed recurrence

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET in the restaging of pancreatic adenocarcinoma.

20.5. SUSPECTED RECURRENCE

Recommendation: Potentially appropriate

The degree of FDG avidity may help distinguish recurrence from post-treatment changes.

20.6. FOLLOW-UP

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET in follow-up of pancreatic adenocarcinoma.

20.7. RT PLANNING

Recommendation: Possibly appropriate

FDG-PET data may be useful for target volume delineation and dose intensification.

Note: Gastro-entero-pancreatic tumours (GEPTs) usually are not FDG avid and are excluded from these recommendations.

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21. CHOLANGIO- AND GALLBLADDER CARCINOMAS

21.1. DIAGNOSIS

Recommendation: Possibly appropriate

FDG uptake may discriminate benign from malignant strictures of the biliary tract.

21.2. STAGING

Recommendation: Possibly appropriate

In limited series, FDG-PET is more accurate than CT scanning for defining the N and M stages of the disease.

21.3. RESPONSE EVALUATION

Recommendation: Possibly appropriate

No data are available, although a rationale exists for the use of FDG-PET in this setting with the use of chemotherapy to downstage tumours.

21.4. RESTAGING

End of therapy

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET following completion of therapy for cholangio- and gallbladder carcinomas.

Confirmed recurrence

Recommendation: Inappropriate

Limited data are available; however, it is unlikely that PET detected recurrence would be amenable to curative treatment.

21.5. SUSPECTED RECURRENCE

Recommendation: Inappropriate

Limited data are available; however, it is unlikely that PET detected recurrence would be amenable to curative treatment.

21.6. FOLLOW-UP

Recommendation: Inappropriate

There are no data indicating a role in FDG-PET in follow-up of cholangio- and gallbladder carcinomas.

21.7. RT PLANNING

Recommendation: Inappropriate

There are no data indicating a role for FDG-PET in the planning of RT for cholangio- and gallbladder carcinomas.

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22. OESOPHAGEAL CANCER

22.1. DIAGNOSIS

Characterization of mass lesion

Recommendation: Inappropriate

There is no evidence that the addition of FDG-PET improves the diagnostic accuracy of endoscopic ultrasound (EUS) and biopsy.

PET guided biopsy

Recommendation: Inappropriate

Only very limited data are available on the use of FDG-PET in PET guided biopsy of oesophageal cancer.

22.2. STAGING

Recommendation: Appropriate

There are several reports on the value of FDG-PET in detecting metastatic disease. The reported sensitivity varies, but it is always superior to that of CT. This feature is important, as upstaging usually indicates that radical surgery is inappropriate; it is also important for multimodality therapy.

22.3. RESPONSE EVALUATION

Recommendation: Potentially appropriate

FDG-PET may identify locoregional disease unresponsive to neoadjuvant therapy and interval metastases prior to planned surgery (approximately 8–14% of cases). The endoscopic findings should be taken into consideration, as oesophagitis may mimic residual disease on a PET scan.

22.4. RESTAGING

Recommendation: Inappropriate

There are no data indicating a definite role for FDG-PET after completion of potentially curative therapy.

22.5. SUSPECTED RECURRENCE

Recommendation: Potentially appropriate

This recommendation is particularly relevant for lower stage tumours treated with local techniques that have recurred locally and remain amenable to potentially curative locoregional therapy.

22.6. FOLLOW-UP

Recommendation: Inappropriate

There are no data indicating a role for FDG–PET in follow-up of oesophageal cancer.

22.7. RT PLANNING

Recommendation: Potentially appropriate

FDG-PET findings have been used to modify target volumes. Insufficient data are available on clinical outcome.

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23. THYROID CANCER

23.1. DIAGNOSIS

Recommendation: Inappropriate

No data are available. FDG avid incidental nodules need to be evaluated with ultrasound guided fine needle aspiration cytology (USG-FNAC).

23.2. STAGING

Recommendation: Inappropriate

No data are available to support the use of FDG-PET for the staging of thyroid cancer. For undifferentiated (anaplastic) cancer and for medullary thyroid cancers, PET is not useful for modifying treatment. Well differentiated tumours are usually non-FDG avid.

23.3. RESPONSE EVALUATION

Recommendation: Inappropriate

No data are available to support the use of PET to evaluate the response to treatment of thyroid cancer.

23.4. RESTAGING AND SUSPECTED RECURRENCE

Differentiated thyroid cancers

Recommendation: Appropriate

In patients with rising thyroglobulin (TG) levels and a negative ^{131}I whole body scan, FDG-PET provides useful data. RhTSH stimulation may increase sensitivity.

Medullary thyroid cancers

Recommendation: Potentially appropriate

In patients with rising calcitonin or carcinoembryonic antigen (CEA) levels, FDG-PET may identify tumour foci amenable to surgical treatment.

23.5. FOLLOW-UP

Recommendation: Inappropriate

No data are available to support the use of PET for follow-up of thyroid cancer.

23.6. RT PLANNING

Recommendation: Inappropriate

No data are available to support the use of PET.

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