

Guideline

In The Clinical Application Of Medical Imaging

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مقدمة

إن هذا العمل هو نتاج طيب لمجهود بعض خيرة الأخصائيين في مختلف التخصصات عبر لجنتين منفصلتين، حيث قام المشاركون في هذه اللجان بوضع تصوراتهم للاستخدام الأمثل لفحوصات الأشعة التشخيصية .

إن هدف الترشيح في استخدام إمكانيات التصوير الطبي ليس الحظر علي ذلك الاستخدام ولكن التوظيف المناسب لهذه الإمكانيات مما يؤدي بشكل تلقائي إلي تقنين استخدامات الأشعة حيث أنها تعرض للإشعاع وكذلك لتوظيف هذه الإمكانيات في مكانها الصحيح للاستفادة منها بأكبر قدر ممكن في مصلحة تشخيص الأمراض.

إن التعرض غير المبرر و المكثف للأشعة يؤدي إلي نتائج كارثية على حياة الأشخاص حيث أنه يؤدي إلي ضرر مباشر علي خلايا الجسم التي تتلقي حزمة الأشعة المباشرة، و حيث أنه توجد بعض الأعضاء الحساسة للأشعة مثل الغدة الدرقية، عدسة العين والأعضاء التناسلية، وكذلك فإن ضرر الأشعة قد يؤدي إلي تغيرات في صبغيات الإنسان (كروموزومات)، مما ينتج عنه تغير في الصبغة الجينية وحدوث تشوهات خلقية قد تمتد إلي الأحفاد، وكذلك فإن التعرض للأشعة المكثفة قد يؤدي إلي تشجيع ظهور أمراض سرطانية في الجسم.

إن التصوير الطبقي بالكمبيوتر (CT) يعرض إلي الإشعاع بشكل كبير حيث أن المقطع الواحد يعرض المريض إلى جرعة أشعة تتراوح بين 1-5cGy حسب نظام (CTDI) تكون أكثر في المقاطع الضيقة و الأجهزة القديمة، في حين ان صورة أشعة عادية تعرض الى جرعة إشعاعية تعادل 0.1-0.2cGy للصورة الواحدة ومجموع المقاطع اللازمة لتصوير منطقة كاملة يؤدي إلي ما يوازي بضع مئات المرات الجرعة الخاصة بصورة أشعة عادية.

إن أولى خطوات الترشيح تتمثل في تعبئة نموذج طلب الفحص (Request) بشكل جيد، مما يؤدي إلي إيصال المعلومات المناسبة عن تاريخ المرضي والتشخيص السريري الأولي للمريض، بحيث تفيد أخصائي الأشعة في كتابة التقرير وحصول المريض علي نتيجة صحيحة وتشخيص مناسب.

Obligations

- 1) The request of radiological investigations (clinical history, notes of previous investigations and probabilities of diagnostic) and patient data should be filled completed.**
- 2) The X-Ray request which is demanded by the treating doctor must respecting the protocols, if existing.**
- 3) The fluoroscopic exam must be demanded by a specialist and signed by the head of department.**
- 4) The Doppler ultrasound exam must be demanded by a specialist and signed by the head of department.**
- 5) The C.T request must be demanded by a specialist and must be signed by the head of department and respecting the protocols .**
- 6) The MRI request must be demanded by the most Senior of the department and signed by the head of department and medical director.**
- 7) The requests are not completed or signed will be rejected ,as mentioned previously.**

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Neurosurgery & Neurology

1)Vascular

- a) Extra cranial (carotid) vascular disease: colour Doppler U/S should be used.
- b) For extra and intracranial vascular disorders, MRI & MRA are recommended. However, the angio-C.T is used for demonstrating the intracranial vessels. Selective angiography still the gold standard exam.
- c) Cases of C.V.A: should be imaging by CT .If CT is normal with clinical manifestation of vertebra-basilar disorder, MRI is used.
- d) In cases of non traumatic sub arachnoid and intra cerebral hemorrhage , CT should be used . For further investigation to diagnose the cause . MRI is used.
- e) Concerning all cases of suspected intracranial venous thrombosis, MRI is the imaging of choice.
- f) Selective cerebral angiography is still the gold standing imaging of vascular disorders.

2)Trauma

- a) CT should be used as first line of cross sectional imaging.
- b) Cases of suspected spinal cord injuries (sub dural ,extra dural hematoma, contusions of cord and other injuries of the cord), MRI is recommended .
- c) Traumatic cervical disc injuries, MRI is recommended.

3)Congenital .

- a) In early infancy (before closure of anterior fontanel) cranial Ultrasound should be initially recommended .
- b) For further imaging MRI should be used expect in craniostenosis and follow up of obstructive hydrocephalus, where skull CT is recommended .

4) Infection.

- a) In cases of C.N.S infection (cerebritis and abscess) , MRI should be used as first line of imaging .
- b) For follow up of cases of brain abscess . CT is used.

5) Neoplasm .

- a) In cases of C.N.S tumors (primary and secondary), MRI is recommended after neurological consultation.
- b) In cases of sudden emergencies of brain Tumors, CT Scan be used.

6) Degenerative disc lesion:

- a) In cervical and dorsal disc lesion. MRI is the imaging of choice.
- b) In lumbar disc lesions. CT should be used first mainly for elderly patient. If CT is not diagnostic, MRI is used. MRI is preferable for young patient.

7) Others surgical :

- a) For cranial nerve lesions, MRI is the imaging of choice .
- b) For syringomyelia. MRI should be used .
- c) For case of discitis. MRI should be used.
- d) For diagnosis of acquired obstructive hydrocephalus, MRI is used to determine the cause and site of obstruction.

8) White matter disease (Demyelinated disease and multiple sclerosis)

All cases of suspected this disorder , MRI should be used.

9) All cases of suspected brain development abnormalities. MRI is the imaging of choice.

10) Dementia and other brain atrophy ,

CT should be the first imaging but in equivocal cases , MRI can be used

11) Epilepsy cases should be investigation by CT first. In negative CT , MRI is used .

12) Cases of phacomatosis, MRI is the imaging of choice.

13) Cases of chronic headache, imaging should be done after positive fundoscopy . CT should be used first .For further investigation, MRI is used .

14) In motor neuron disease "MND", MRI should be the imaging of choice .

15) In case of investigation of vascularity in brain pathology, MRA, perfusion MRI & Angio-CT are used .

16) Imaging of sella turcica and supra sellar region , MRI should be used.

Orthopedics

I) Cervical & Thoracic Spine.

1) Emergency:

- * The routine X-Ray : AP + Lateral are demanded
- * If fracture exists : C.T .Scan is demanded
- * If neurological injury is present : MRI is advised.

2) Out clinic:

- * If cervical pain + brachialgia exist:.

The routine exams demanded X-Ray AP+ lateral

- * If any sign of discopathy exists : EMG is demanded
- * If nerve root irritation is mild, so no need for MRI
- * If nerve root irritation is moderate to severe, the patient should be sent to the surgeons who work on cervical surgery to order him an MRI for surgical planning .

II) Lumber spine.

1) Emergency:

- * Routine X-Ray AP+ lateral are demanded
- * If fracture is present C.T.Scan is advised.

2) Out clinic:

- * In case of Lumber pain : AP + lateral X-Ray are demanded.
- * If pars fracture is suspected : Right and left oblique are demanded.
- * If any sign of discopathy C.T.Scan is advised
- * If spondylolisthesis exists :
 - Routine X-Ray AP + lateral are demanded
 - Lateral flexion & extension views are demanded.
- * When surgical planning is required : CT Scan is advised.
- * If suspicion of infection or tumor : MRI is advised.
- * If failed back syndrome : MRI is advised .
- * If kyphoscoliosis is suspected : AP + lateral X-Rays are demanded
- * If surgery is planning : MRI is advised.

III) Sacrum & Coccyx

- If fracture : routine X-Ray and C.T.Scan are demanded
- In suspected coccygodynia : MRI is advised
- If tumoral lesion is suspected CT and/or MRI are advised

IV) Shoulder .

1) Emergency:

- * If tumor is suspected : Routine X-Ray are demanded.
- * If comminuted fracture & scapular fracture exist C.T.Scan is advised.

2) Out clinic:

- * In case of shoulder pain : routine X-Ray AP is demanded
- * In case of impingement syndrome, the X-Ray demanded are
 - true shoulder AP view.
 - Styker notch view
 - Transthoracic view
- * If complex shoulder ST injury is suspected, shoulder team be referred to those who managed shoulder to evaluate wither the requirement of MRI for surgical planning.

V) Knee joint.

1) Emergency;

- * For Trauma the routine X-Ray AP+ lateral are demanded.
- * If articular fracture is suspected C.T.Scan is advised.

2) Out clinic:

- * Physical examination and Routine X-Ray in case of suspected
 - meniscus injury
 - ACL injury.
 - Cartilage injury
- * If atypical presentation of knee pain MRI is advised,
- * If just surgical planning is required (Arthroscopy), MRI is required by the team who work on arthroscopy.

VI) Hip Joint

1) Emergency:

- * Routine X-Ray of hip joint is demanded .
- * Pelvis CT.Scan is demanded.

2) Out clinic:

- * MRI is advised for : AVN
- * MRI is advised for : Perthe's disease
OCD

VII) All Tumors

Need of C.T.Scan and/or MRI

General surgery & Surgical Specialties – Medicine & Oncology

I) Abdomen & Pelvic Regions (Surgical Word)

1) Acute abdomen

- a) The routine investigation demanded are:
 - * Chest X-Ray
 - * Plain film abdomen.
 - * Left decubitus X-ray.
- b) Then other imaging modalities demanded:
 - * U/S is obligatory for female patients.
 - * Selective for male patient.
- c) According to the X-Ray results, if there are fluid levels, CT is preferred

2) Pancreatitis

- 1) X-Ray
 - a. Plain film supine.
 - b. Chest X-Ray.
 - c. Abdomen erect.
- 2) Abdomen U/S.
- 3) C.T in moderate and sever.
After 48hrs after appearance of symptoms.

3) Intestinal obstruction

- 1) Basic radiological studies
 - a. Abdomen Standing.
 - b. Chest X-Ray
 - c. Left lateral decubitus.
- 2) U/S : is useless in - the obese patient
- bowel distension of gas seen on the X-Ray
otherwise , U/S is advised mainly in female patient.
- 3) CT is advised as next step if needed and judged by the most signor specialist.
- 4) Barium study is contra indicated in acute phase of intestinal obstruction.

4) Hepato biliary (RHC or epigastric pain)

- 1) U/S is exam of choice.
- 2) C.T is advised to rule out pancreatic lesion and malignancy..

5) Acute pelvic condition

1. U/S is the exam of choice Doppler case coupled to the investigation.
2. Transvaginal U/S is complementary to localized some gynecological disorders.
3. If tumoral lesion is seen on U/S, exam – C.T are advised for tumoral staging.
4. For male patient if suspected prostatic cause by ultrasound CT is advised to determine the staging of cancer.

6) Ano-rectal region.

1. plain film X-ray.
2. Trans anal U/S is advised.
3. Endoscope is the first line of specific investigation then the further investigations are the following:
 - a) Barium enema is advised.
 - b) Trans rectal U/S is advised then MRI is mandatory for determination of lesion extension mainly demanded for fistula and ano-rectal cancers..
4. If tumor is proved , C.T is advised for staging of the tumor.
5. In case of physiological disorder, defecography is advised.

7) Mesenteric thrombosis.

1. In plus of routine investigation for acute abdomen.
2. Angio C.T is advised.
3. Other investigation according to the condition and disponibility of investigation material (selective angiography)

II) Gastro-intestinal Tract (Medical Word):

1) Esophageal Diseases

- 1- Barium Swallow is advised for patient who complaining of dysphagia to rule out esophageal stricture . achalasia, tumor, etc.
- 2- Upper endoscopy is advised for patients who have reflux , dysphagia, and chest discomfort.
- 3- Chest X-Ray and to rule out other pathologies and foreign body.
- 4- CT Chest & abdomen is advised for esophageal tumor seen on the barium study and endoscopy for confirmation and staging.

2) Stomach and small bowel Diseases

- 1- Endoscopy is the investigation of choice for PUD, Tumor, bleeding, gastritis, investigation of anemia , weight loss, obstruction, and gastroparesis .
- 2- Barium meal & Follow through are advised in case of suspected small intestine disease like Crohn's disease and mal absorption.
- 3- C.T abdomen & pelvis is advised in case of:
 - * Suspected tumors, to confirm the presence of masses and for tumor staging.
 - * Ascitis.
 - * Intestinal obstruction.
- 4- CT guided biopsies of masses as well as CT guided aspiration and drainage of collection and abscesses.

3) Large bowel Diseases

- 1- Colonoscopy is the investigation of choice.
- 2- Double contrast and/or simple Barium enema is advised in case of suspected tumor, diverticulosis & diverticulitis, and irritable bowel disease (IBD), and when colonoscopy is not available.
- 3- C.T abdomen & pelvis for staging of tumor.

4) CT/ Barium study/ endoscopy.

- 1- Should be demanded by specialist & signed by head of department.
- 2- If the treating doctor find it is necessary to do these investigations, he can consulte the gastroenterology team.

5) Liver diseases.

- * U/S is the investigation of choice
- * CT is advised ,
- * MRI is advised for:
 - a) For hemangioma.
 - b) MRCP.
 - c) Budd-Chiarri disease, however U/S Doppler still the exam of choice..

6) Splenic and pancreatic diseases , U/S and CT are advised.

7) Salivary gland pathology,

Ultrasound is the first line imaging. In inconclusive diagnostic, MRI is advised.

III) Endocrinological diseases.

- 1) Pituitary gland,** MRI is the exam of choice.
- 2) Thyroid gland:** dedicated U/S is the imaging of choice.
- 3) Parathyroid gland:** dedicated U/S is the primary Imaging , however isotope scan is the gold standard technique .
- 4) Thymus gland:** in case of suspected thymic tumor. C.T is the first line of imaging. MRI is advised as next step imaging.
- 5) Adrenal gland,** the first line imaging are U/S and CT which is preferable for obese patients. MRI is advised as second line imaging..
- 6) Testes:** U/S is the imaging modality of choice , except in undescended testis, MRI is advised. Laparoscopic exploration is preferable.

IV) Breast:

- 1) For dense breast (young& lactating),Ultrasound is the exam of choice. Otherwise mammography is the exam of choice.
- 2) MRI is the exam of choice of post operative status for differentiated recurrent lesion from fibrotic scar, and unknown origin of tumor.

V) Pleuro-pulmonary and mediastinal diseases :

- 1) Infection and / or inflammatory disease: CT is advanced.
- 2) Neoplasm of lung and pleura: CT is exam of choice except for apical lung or para-vertebral lung neoplasm, where MRI is exam of choice.
- 3) Suspected mediastinal tumors: C.T is advised as first line line imaging. MRI is second line imaging.

VI) Cardio vascular disease :

- 1) Echography combined with Doppler–duplex study is exam of first line.
- 2) Angio CT is exam of advised.
- 3) MRI is helpful in few disease of heart and major vessels.

ENT & Ophthalmology

I) Ear

1) Congenital anomaly.

- a) CT (spiral) is the imaging of choice.
- b) In cochlear anomaly, MRI is advised to visualize the auditory nerves.

2) Infection (chronic O.M & mastoiditis) .

CT is the imaging of choice.

If intracranial extension is suspected , MRI is more sensitive in early stage .

3) Tumors (Acoustic neuroma): MRI is the imaging of choice.

4) Trauma: High resolution CT is the imaging of choice .

II) Nose & Nasal sinuses:

1) Congenital anomaly (choanal atresia)

High resolution CT is the imaging of choice.

2) Other pathology of nose & nasal sinuses

- a) X-Ray is first line imaging (Walter's view, lateral view and high frontal view), lateral view for post-nasal space (soft tissue density).
- b) CT is advised except in tumours of nose or nasal sinuses, where MRI is advised to stage the tumour.

III) Larynx & neck.

1) Tumours of naso-pharynx and oral cavity.

C.T is the first line imaging then MRI can be advised.

2) Tumors of larynx.

CT is advised.

3) Carotid body tumour .

MRI is advised .

IV) EYES

1) Trauma & foreign bodies (F.B) injuries.

U/S is the first line imaging and CT is the imaging of choice.

2) Deep infection.

MRI is the imaging of choice.

3) Extra-orbital muscles pathology.

CT is advised , except in suspicious cases of tumours of muscles, MRI is advised .

4) Tumours:

a) For global tumors,

U/S and CT are advised, except in inconclusive cases MRI is advised .

b) Retro-global tumours, MRI is advised

c) For tumours of lachrymal glands, MRI is advised .

Urology & Gynecology

D)Urology

1) Trauma:

- a) kidney trauma, and impacted renal trauma U/S and IVP are exam of choice .
If insufficient or not conclusive diagnostic : CT is advised .
- b) Pelvic trauma : direct urethrogram is exam of choice.

2) Stones disease :

- a) Combination U/S and KUB are exams of choice.
 - In case of classic renal colic presentation, U/S should be done later on and not needed in the emergency department.
 - In case of atypical renal colic, with right iliac fossa pain of male patient, U/S is advised.
 - In case of young female patient with atypical renal colic, U/S is advised.
- b) IVU is indicated in cases of:
 - recurrent attack of urinary system stones
 - Big and/or obstructive stone after the acute phase
- c) In case of inconclusive result and in cases of impaired renal function , spiral CT without IV contrast is advised.

3) Infection:

- a) In case of recurrent renal colic, U/S and MCUG are exam of choice.
- b) In case of marked reflux seen on MCUG, IVU is advised to visualized the renal cavities anatomy and to determine the renal functioning.
- c) MCUG is advised in the follow up for recurrent urinary system infection.
- d) MRU is advised in case of renal impairment.
- e) In cases of insufficient result of U/S and some major renal infection with justification : CT is advised.

3) Neoplasm:

- a) In cases of upper urinary tract neoplasm, U/S and CT are exam of choice.
- b) In cases of suspicious tumoral invasion of veins as well as lower urinary system neoplasm, MRI is used.
- c) In cases of suspicious urinary bladder tumor, U/S is the first line imaging, MRI is specific for demonstrating local extension of tumor and C.T is used for staging of tumor.
- d) For follow up of upper urinary neoplasm . Ultrasound and CT are advised , MRI can be used .
- e) For prostatic tumor, Tran rectal U/S and/or guided biopsy is the exam of choice.

For suspicious cases of invasive prostatic tumors, MRI is used.

4) Congenital :

- a) In congenital genitourinary abnormalities Ultrasound, MCU , and , IVU are the imaging of choice .
 - b) For absent non palpable testis , U/S and MRI are advised .
- 5) For suspicious tethered cord** as a cause of urinary incontinence , MRI of spine is advised .

II) Gynecology & obstetric

1) Infection and inflammatory disease:

- a) U/S (abdominal and/or trans-vaginal), is exam of choice
- b) In case of suspected endometriosis, MRI is the exam of choice.

2) Neoplasm:

- a) U/S is first line of imaging.
- b) Tumoral lesion of uterus are predictive for MRI, MRI is helpful in new cases.
- c) Neoplasm follow up, MRI is advised.

3) Obstetric:

- a) Fetus congenital anomalies, especially cerebral lesion, U/S is exam of choice
- b) In case of inconclusive results, MRI is advised.

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