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QUESTION 2: Is there a role for computed tomography (CT) scan with contrast in the diagnosis of spinal infections in patients who cannot undergo magnetic resonance imaging (MRI)?

RECOMMENDATION: Although evidence is limited for the routine use of CT scan with contrast, there is a role for it to be used in the presence of spine infection where MRI is contraindicated or when other advanced imaging is not available

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

Although there is growing evidence of the safety of MRI in the presence of implanted metallic devices [1], obtaining such a study may not always be possible. CT with either extradural or intravenous contrast can be used to identify spine infections.

Prior to the wide adoption of MRI, CT myelography was commonly used to diagnose extradural compressive pathology such as epidural abscesses [2]. The use of this invasive investigation in the setting of postoperative spine epidural abscess has not been studied. However, it can be assumed that the accuracy will be lower due to metal artefact [3].

The role of CT with intravenous contrast in the postoperative setting is unclear and has not been directly studied. CT is most useful in identifying implant and bony related complications such as implant loosening, endplate erosion and destruction. The addition of contrast provides information on paraspinal soft tissue involvement, phlegmon or abscesses albeit with lower sensitivity and specificity when compared to MRI [4].

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QUESTION 3: Is there a role for nuclear imaging (e.g., positron emission tomography scan (PET)) in the diagnosis of spinal infections?

RECOMMENDATION: PET scan, preferably PET-computed tomography (PET-CT), can be used as an adjunct to magnetic resonance imaging (MRI) to diagnose spinal infections when an MRI cannot be performed or is inconclusive.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

At the present time, MRI is the imaging test of choice for diagnosing spondylodiscitis (SD). This study should be performed when SD is suspected to avoid the morbidity and mortality associated with a delay in diagnosis. MRI is a favored choice as part of an infectious work up due to its lack of ionizing radiation, multi-planar capability, superior soft tissue contrast and ability to evaluate the neural structures. It has a sensitivity and specificity of 97% and 93% respectively. Ultimately, its accuracy in diagnosing SD is 94% [1–3]. A typical protocol should include T1- and T2-weighted sequences with gadolinium. T2 and post-gadolinium T1-weighted sequences should also be performed with fat suppression to increase the sensitivity of identifying pathology [4,5]. Furthermore, MRI allows for the evaluation of bone marrow edema and disc space inflammation, as well as paraspinal and epidural soft tissue involvement. Gadolinium is helpful in differentiating phlegmonous changes versus abscess formation.

Fluorine-18-fluorodeoxyglucose (18F-FDG) is the radionuclide-imaging test that can be a useful compliment to MRI. The role of 18F-FDG in the diagnosis of SD has been extensively investigated [6–13]. It has shown acceptable levels of sensitivity and specificity and is useful when MRI cannot be performed or is inconclusive. In addition to its value for diagnosing spondylodiscitis, 18F-FDG can be utilized to monitor response to treatment. Gallium-67-SPECT/CT is an acceptable alternative when 18F-FDG is not available [14].

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QUESTION 4: How can postoperative infections be distinguished from normal postoperative changes on magnetic resonance imaging (MRI)?

RECOMMENDATION: The presence of an abscess in the back muscles or posterior site, confirmed by gadolinium enhancement, is the most frequently-reported change on MRI of patients with surgical site infection (SSI). The presence of a collection of fluid outside the head of the pedicle screws is another sign of SSI.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 71%, Disagree: 8%, Abstain: 21% (Super Majority, Strong Consensus)

RATIONALE

A search was conducted using the MeSH terms "spine AND MRI AND surgical site infection." The initial search yielded 149 references, and after screening, 13 abstracts remained. However, only three studies assessed the use of MRI for postoperative spine infections and were found eligible.

Kanayama et al. retrospectively used MRI in 20 patients with surgical site infections after instrumented spinal surgery [1]. In their series they considered two markers for diagnosing SSI: (1) the presence or absence of osteomyelitis at the instrumented vertebra and (2) the presence or absence of intervertebral abscess. All 20 patients had a confirmed SSI, but in 7 MRIs it was considered negative. The study mainly aimed to assess the utility of MRI to confirm the severity of the infection. Using the above-mentioned criteria, they tried to predict the need for implant removal. However, MRI was not evaluated as a diagnostic tool for assessing the presence or absence of infection.

Kim et al. reviewed 43 patients with MRI after SSI [2]. First, they divided their infections on an anatomical basis, assessing if it affected only the posterior region (31 cases), only the anterior area or both posterior and anterior regions [2]. In addition, they looked for abscess in different spinal locations (posterior epidural space, laminectomy site, back muscles, subcutaneous fat layer, paravertebral space, psoas muscle and anterior epidural space). They also evaluated the presence of osteomyelitis of the vertebral body and discitis. The most frequent findings were abscesses in the back muscles in 40 patients (93%), abscesses in the laminectomy site in 29 (67.4%) and in the subcutaneous fat layer in 27 (62.8%). All abscesses were identified by the presence of peripheral rim or diffused enhancement of adjacent soft tissue after administration of intravenous gadolinium.

They did not compare their findings with those of patients without confirmed SSI. The authors concluded that for diagnosing infection, the posterior surgical field was more important than the vertebral body or the disc area. This conclusion supports the findings of the previous study by Kanayama, in which seven patients with SSIs did not show involvement of the vertebral body or the disc area.

Finally, Kimura et al. published a comparative study on postoperative MRI including 17 patients with a deep SSI and 64 non-SSI controls who had an MRI examination within 4 weeks after surgery [3]. Their investigation focused on the "pedicle screw fluid sign" (PS fluid sign) and did not search for other signs of infection. The PS fluid sign refers to the collection of fluid outside the head of a pedicle screw, suggesting the presence of an abscess on axial MRI scans. The authors observed that fluid collections medial to the pedicle screw head are not infrequent. They considered that when the collection expands outside the head of the screw into the paravertebral