

# University of Florida, Department of Radiology

## POLICY:

### Gadolinium administration in patients with renal failure

- 1) Outpatients without known renal disease – OK to scan w/ gadolinium
- 2) Outpatients with known renal disease and all inpatients, determine renal function (See attached )

For patients with severe chronic renal insufficiency (NKF Stage 4 – GFR < 30 ml/min/1.73m<sup>2</sup>) or end stage established renal failure (NKF Stage 5 – GFR < 15 ml/min/1.73m<sup>2</sup>), MRI with gadolinium should, in general, not be performed. However, if a risk-benefit analysis deems that the benefits of MR imaging with gadolinium outweigh the small but finite risk of development of NSF, this should be documented in the chart along with an appropriately executed informed consent. In this situation, linear nonionic gadolinium chelates such as gadodiamide (Omniscan®) and gadoversetamide (OptiMARK®) should be avoided as these have the lowest thermodynamic stability constant and are thus more prone to transmetallation and tissue deposition. A linear ionic agent such as gadobenate (MultiHance®) or cyclic agent such as gadoteridol (ProHance®) should be considered.

For patients with moderate chronic renal insufficiency (NKF Stage 3 - GFR = 30-59 ml/min/1.73 m<sup>2</sup>), consider alternative imaging.

Non-contrast MRI

CT w/o contrast

CT w/ contrast w/dialysis

(Note the risk of contrast-induced nephropathy is probably greater than the risk of NSF)

Nuclear medicine

Ultrasound

Conventional R/F

As for patients with severe and end-stage renal insufficiency, for patients with moderate chronic renal insufficiency, the decision to allow scanning with gadolinium should be predicated on an appropriate risk-benefit analysis and should be documented in the chart. The risk of developing NSF is probably less in this category of patients.

Determine “proinflammatory milieu”. Studies have suggested that some events that tend to “rev up” the immune system may be positive modulators for the development of NSF. Specifically, recent major surgery (especially vascular), DVT, and infection have been implicated. These are not considered absolute contraindications, but should influence the risk/benefit decision with respect to administration of gadolinium in patients with renal insufficiency.

In any case in which gadolinium is allowed in patients with renal insufficiency, we would advocate using as low a dose as possible to answer the clinical question (MRA dose can be decreased to “single-dose” 0.1 mmol/kg – bolus timing issues become critical here.)

As a matter of policy, we do not require dialysis as a post-condition for scanning patients with renal insufficiency with gadolinium. There is good reason to believe that dialysis is probably of limited or no efficacy with respect to the ultimate development of NSF and is, of course, not without its own inherent risks.

## Methods to estimate renal function

- 1) Serum creatinine
- 2) Estimated Glomerular Filtration Rate (GFR)
  - a) Cockcroft-Gault Calculator

$$Cr_{Cl} = \frac{(140 - \text{age})(\text{weight in kg}) (0.85 \text{ female})}{72(S.Cr.)}$$

[http://www.kidney.org/professionals/kdoqi/gfr\\_calculator.cfm](http://www.kidney.org/professionals/kdoqi/gfr_calculator.cfm)

GFR Estimation using the MDRD Equation (Modification of Diet in Renal Disease Study Group)

$GFR = 170 * \text{power}(\text{PlasmaCr}, -.999) * \text{power}(\text{Age}, -.176) * \text{Sex} * \text{Race} * \text{power}(\text{BUN}, -.170) * \text{power}(\text{Albumin}, .318)$

**Input:**

PlasmaCr  mg/dl

Age  yr

Sex ☒ Female (0.762)  
☐ Male (1)

Race ☒ Black (1.18)  
☐ Non-Black (1)

BUN  mg/dl

Albumin  gm/dl

**Result:**

GFR  ml/min

Decimal Precision:

- b) Modification of diet in renal disease (MDRD) calculator

$$Cr_{Cl} = 186(sCr)^{-1.154} (Age)^{-0.203} (0.742 \text{ female})(1.210 \text{ black})$$

<http://medcalc3000.com/GFREstimate.htm>

GFR Estimation using the MDRD Equation (Modification of Diet in Renal Disease Study Group)

$GFR = 170 * \text{power}(\text{PlasmaCr}, -.999) * \text{power}(\text{Age}, -.176) * \text{Sex} * \text{Race} * \text{power}(\text{BUN}, -.170) * \text{power}(\text{Albumin}, .318)$

**Input:**

PlasmaCr  mg/dl

Age  yr

Sex ☒ Female (0.762)  
☐ Male (1)

Race ☒ Black (1.18)  
☐ Non-Black (1)

BUN  mg/dl

Albumin  gm/dl

**Result:**

GFR  ml/min

Decimal Precision:

### Stages of Chronic Kidney Disease

These guidelines are adapted from the National Kidney Foundation's  
Kidney Disease Outcomes Quality Initiative (KDOQI)

Stage	Description	GFR*
1	Signs of mild kidney disease but with normal or better GFR	greater than 90%
2	Mild kidney disease with reduced GFR	60-89%
3	Moderate chronic renal insufficiency	30-59%
4	Severe chronic renal insufficiency	15-29%
5	End-stage renal failure	less than 15%

\*GFR is given in ml/min/1.73 m<sup>2</sup>

[More information about GFR](#)

# Nephrogenic System Fibrosis (Nephrogenic Fibrosing Dermopathy)

## (1) History:

- (a) First identified in 1997

## (2) Clinical Features:

- (a) Systemic disorder with prominent cutaneous involvement
- (b) Severe inflammatory and systemic fibrotic process associated with chronic hemodialysis or peritoneal dialysis in the setting of end-stage renal disease
- (c) Renal failure in all cases and hemodialysis or CAPD in nearly all cases.
- (d) Possible association with recent surgery (particularly vascular) or other proinflammatory/healing event (infection/vascular event(ischemia/thrombosis)).
- (e) Association with recent exposure to extracellular gadolinium chelates (0.1-0.31 mmol/kg) (Gadodiamide/Omniscan most frequently associated in reported cases)*
- (f) Multiple logistic regression reveals sCr, proinflammatory events, and number CE-MR exams are independent risk factors
- (g) M=F
- (h) Mean age = 49.8 yrs
- (i) Pediatric cases have been reported
- (j) Progressive over days to weeks
- (k) Severity/rapidity of cutaneous progression correlated with poor prognosis/death.
- (l) 5% fulminant course.
- (m) 28% mortality in published cases
- (n) 28% no improvement, 20% modest improvement
- (o) May have severe pruritis

## (3) Cutaneous:

- (a) large areas of hardened skin with slightly raised plaques or confluent papules with or without pigment alteration
- (b) Skin histopathology similar to scleromyxedema
- (c) Fibrosis of skin and connective tissues
- (d) Erythematous papules progressing to diffuse brownish induration
- (e) Peau d' Orange appearance described in eosinophilic fasciitis
- (f) Sclerodactyly, induration of dorsum hands and lower legs

## (4) Systemic involvement:

- (a) May develop widespread organ fibrosis

- (b) Skeletal muscles, lung, and myocardium
- (c) Cardiomyopathy, pulmonary involvement
- (d) Tendon involvement with loss of motion and flexion contractures.
- (e) No clinical evidence of synovitis/arthritis
- (f) Thickening of digital flexor tendons and thickening of the palmar fascia
- (g) Woody induration of muscles in legs/thighs and forearms
- (h) Sensory/motor peripheral neuropathy

(5) Laboratory:

- (a) No specific laboratory findings
- (b) Elevated ESR +/- CRP
- (c) Normal to low CK
- (d) Mean serum Cr < 3 mg/dL*
- (e) No paraproteinemia (differentiating feature from scleromyxedema)

(6) Treatment:

- (a) No proven effective therapy with the possible exception of correcting the underlying renal insufficiency.
- (b) Results of plasmapheresis are inconsistent
- (c) Photopheresis not effective
- (d) Corticosteroids and other immunosuppressive therapies not effective