

## Overview

### Useful For

Precise measurement of glomerular filtration rate and renal plasma flow

### Profile Information

Test Id	Reporting Name	Available Separately	Always Performed
IOTC	Iothalamate Clearance	No	Yes
PAHCC	PAH Clearance	No	Yes

### Method Name

Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS)

### NY State Available

Yes

## Specimen

### Specimen Type

Plasma Na Heparin  
Urine

### Specimen Required

Contact MLI for approval prior to ordering this test.

**Both plasma and urine are required.**

**Specimen Type:** Plasma

**Container/Tube:** 6-mL Green top (sodium heparin)

**Specimen Volume:** 3-4 mL

**Collection Instructions:** Label specimen as plasma.

**Specimen Type:** Urine

**Container/Tube:** Sarstedt 5 mL Aliquot Tube (T914)

**Specimen Volume:** 5 mL

**Collection Instructions:**

1. Collect a random urine collection.
2. No preservative.
3. Label specimen as urine.

**Specimen Minimum Volume**

2 mL plasma/5 mL urine

**Reject Due To**

All specimens will be evaluated at Mayo Clinic Laboratories for test suitability.

**Specimen Stability Information**

Specimen Type	Temperature	Time	Special Container
Plasma Na Heparin	Refrigerated (preferred)	7 days	
	Frozen	7 days	
Urine	Refrigerated (preferred)	7 days	
	Frozen	7 days	

**Clinical & Interpretive****Clinical Information**

The assessment of glomerular filtration rate (GFR) is an important parameter of renal function utilized by clinicians in the care of patients with varying renal diseases, and for clinical research when precise assessment of renal function is necessary. The GFR is the sum of all the filtration rates of the individual nephrons within the kidney and, as such, reflects the number of functioning nephrons.

GFR can fall due to a chronic renal disease that causes a permanent loss of nephrons, or due to an acute renal injury that is potentially reversible. In addition, a decline in renal blood flow, ie, secondary to volume depletion, can result in a fall in GFR that is functional and (potentially) quickly reversible. GFR increases when factors that decreased renal blood flow are corrected, or the kidney heals after an acute injury. GFR also increases transiently during pregnancy, as well as in response to other physiologic stimuli that include hyperglycemia or a dietary protein load.

Measurement of GFR can be performed by several methodologies including creatinine clearance, iothalamate clearance, and inulin clearance. Of these methods, the latter 2 are significantly more accurate and reproducible than the former.

Renal clearance of inulin, a fructose polymer, has traditionally been considered the gold standard for determination of GFR. Disadvantages to the use of inulin are its high cost, limited availability, and analytical expense. Previous studies have shown close correlation between iothalamate and inulin GFR determinations. The short renal clearance test, which utilizes a subcutaneous injection of nonradiolabeled iothalamate and a single (1 hour) urine specimen, is the preferred method for measurement of GFR in most situations since it is less time consuming and less costly.

The Standard Renal Clearance test, which utilizes continuous intravenous infusion of iothalamate (or inulin) and additional urine and plasma collections, is an alternative means of measuring GFR and may be preferable in patients with low urine flows (eg, patients with severe liver failure).

---

The Standard Renal Clearance test also measures renal plasma flow (RPF). Intravenously administered para-aminohippurate (PAH) is used to determine RPF because PAH is nearly completely removed from the renal circulation in a single pass, by a combination of glomerular filtration and tubular secretion.

**Reference Values**

## GLOMERULAR FILTRATION RATE

20 years: 87-141 mL/min/SA

(Iothalate) Decreases by 4.95 mL/min/decade

&lt; or = 19 years: Not established

20 years: 87-141

21 years: 86-140

22 years: 86-140

23 years: 85-139

24 years: 85-139

25 years: 84-138

26 years: 84-138

27 years: 83-137

28 years: 83-137

29 years: 82-136

30 years: 81-136

31 years: 81-136

32 years: 81-135

33 years: 80-135

34 years: 80-134

35 years: 79-134

36 years: 79-133

37 years: 78-133

38 years: 78-132

39 years: 77-132

40 years: 77-131

41 years: 76-131

42 years: 76-130

43 years: 75-130

44 years: 75-129

45 years: 74-129

46 years: 74-128

47 years: 73-128

48 years: 73-127

49 years: 72-127

50 years: 72-126

51 years: 72-126

52 years: 71-125

53 years: 71-125

54 years: 70-124  
55 years: 70-124  
56 years: 69-123  
57 years: 69-123  
58 years: 68-122  
59 years: 68-122  
60 years: 67-121  
61 years: 67-121  
62 years: 66-120  
63 years: 66-120  
64 years: 65-119  
65 years: 65-119  
66 years: 65-119  
67 years: 64-118  
68 years: 64-118  
69 years: 63-117  
70-150 years: 62-116

**PARA-AMINOHIPPURATE (PAH) CLEARANCE**

## PAH Clearance

0-19 years: not established  
20-29 years: >448 mL/min/SA  
30-39 years: >413 mL/min/SA  
40-49 years: >378 mL/min/SA  
50-59 years: >343 mL/min/SA  
60-69 years: >308 mL/min/SA  
70-79 years: >273 mL/min/SA  
80-89 years: >238 mL/min/SA  
90-99 years: >203 mL/min/SA

**Note:** Reference range decreases by 35mL/decade.

**FILTRATION FRACTION**

>or=16 years: 18-22%

**Interpretation**

Iothalamate Clearance:

Low glomerular filtration rate (GFR) values indicate abnormal renal function, which may be either reversible/transient or irreversible/permanent. GFR tends to decline with age.

Para-Aminohippurate (PAH) Clearance:

The renal clearance of PAH, calculated from measurements of PAH in serum and timed urine specimens, equals renal plasma flow (RPF). However, it is important to note that only 85% to 90% of PAH is cleared from the circulation in a single pass, so the PAH clearance may underestimate RPF by 10% to 15%.

**Filtration Fraction (FF):**

The FF is the fraction of plasma perfusing the kidneys that is filtered ( $FF = GFR/RPF$ ). Under normal conditions, FF is approximately 20%. Values significantly different from this provide an index to changes in GFR relative to RPF. For example, in states of decreased renal perfusion due to congestive heart failure, both RPF and GFR are decreased, whereas the FF is  $>20\%$ .

**Cautions**

A theoretical complication (one that has not been observed clinically to date) is transient suppression of thyroid function in premature and newborn infants. Therefore, a sensitive thyrotropin test is suggested approximately 23 weeks after a standard renal clearance test in that age group.

Because complete clearance of para aminohippurate (PAH) is dependent on tubular secretion, diseases or conditions that disproportionately affect renal tubular cells may decrease PAH clearance without necessarily causing a proportional decrease renal plasma flow. Therefore, PAH clearance may underestimate renal perfusion flow in patients with selected diseases that affect renal tubulointerstitium.

**Clinical Reference**

1. Seegmiller JC, Burns BE, Fauq AH, et al: Iothalamate quantification by tandem mass spectrometry to measure glomerular filtration rate. *Clin Chem* 2010;56:568-574
2. Slack TK, Wilson DM: Normal renal function CIN and CPAH in healthy donors before and after nephrectomy. *Mayo Clin Proc* 1976;51:296-300
3. Liedtke RR, Durate CG: Laboratory protocols and methods for the measurement of glomerular filtration rate and renal plasma flow. *In* *Renal Function Tests*. Edited by CG Duarte. Boston, Little Brown and Co., 1980, pp 49-63
4. Kasiske BL, Keane WF: Laboratory assessment of renal disease: clearance, urinalysis, and renal biopsy. *In* *Brenner and Rector's The Kidney*. Sixth edition. Edited by BM Brenner. Philadelphia, PA, WB Saunders Co, 2000, pp 1129-1142
5. Wilson DM, Bergert JH, Larson TS, Liedtke RR: GFR determined by nonradiolabeled iothalamate using capillary electrophoresis. *Am J Kid Dis* 1997;30:646-652

**Performance****Method Description**

Blood and timed urine samples are obtained after continuous intravenous infusion of iothalamate and para-aminohippurate (PAH), the patient is allowed to equilibrate. Both iothalamate and PAH are measured by liquid chromatography-tandem mass spectrometry (LC/MS/MS). Renal clearance is calculated using the standard clearance formula.

**PDF Report**

No

**Day(s) Performed**

Monday through Friday

**Report Available**

Same day/1 to 4 days

**Specimen Retention Time**

7 days

**Performing Laboratory Location**

Mayo Clinic Laboratories - Rochester Main Campus

**Fees & Codes****Fees**

- Authorized users can sign in to [Test Prices](#) for detailed fee information.
- Clients without access to Test Prices can contact [Customer Service](#) 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact [Customer Service](#).

**Test Classification**

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

**CPT Code Information**

82542 x 7

**LOINC® Information**

Test ID	Test Order Name	Order LOINC® Value
STRC	Standard Renal Clearance	96403-1

Result ID	Test Result Name	Result LOINC® Value
IOTC	Iothalamate Clearance	90995-2
PAHC	PAH Clearance	96404-9
FILT	Filtration Fraction	96405-6
CMT13	Comment	77202-0