

XXXX Nuclear Cardiology Laboratory

Adenosine Stress Test Procedure

Rationale: Adenosine is a direct coronary arterial vasodilator and results in a 3.5 to 4 fold increase in myocardial blood flow. Myocardial regions supplied by diseased coronary arteries have an attenuated hyperemic response. Depending upon the severity of coronary stenosis and coronary flow reserve limitation, relative flow heterogeneity is induced. In patients with severe CAD, true ischemia may also be induced because of a coronary steal phenomenon. Since the myocardial tracer uptake is proportional to the regional myocardial blood flow, an unequal distribution of radiotracer occurs in the myocardium. Adenosine results in a modest increase in heart rate and a modest decrease in both systolic and diastolic blood pressures.

Indications: See exercise stress test procedure and:

1. Inability to perform adequate exercise due to any extracardiac factors (pulmonary, peripheral vascular, musculoskeletal conditions)
2. Left bundle branch block
3. Concomitant treatment with medications which blunt the heart rate response (beta blockers, calcium channel blockers)

Contraindications and Precautions:

1. Asthmatic patients with ongoing wheezing should not undergo adenosine stress testing. However, patients with adequately controlled asthma can undergo adenosine stress test.
2. Known or suspected bronchoconstrictive or bronchospastic lung disease (ARDS, emphysema)
3. Hypersensitivity to adenosine
4. Greater than first degree heart block without a pacemaker or sick sinus syndrome.
5. Systolic blood pressure less than 90 mm Hg.
6. Recent myocardial infarction
7. Congestive heart failure
8. Use of dipyridamole in the last 24 hours or use of xanthines (aminophylline or caffeine) in the last 12 hours.
9. Severe sinus bradycardia (heart rate <40 bpm)

Adenosine Dose: (See chart)

1. Adenosine is given as a continuous infusion at a rate of 140 ug/kg/min over a 4 minute period. Maximum dose 60 mg.
2. Radiotracer infusion between 2 ½ to 3 minutes after the start of the adenosine infusion
3. Adenosine dose is given under the direction of the stress test physician.

Adenosine Stress Test Procedure

Adenoscan Dosing Chart (4 minute infusion)															
Wt (lbs)	KG	CC	mg	Wt (lbs)	KG	CC	mg	Wt (lbs)	KG	CC	mg	Wt (lbs)	KG	CC	mg
75	34.1	6.4	19.1												
76	34.5	6.4	19.3	116	52.7	9.8	29.5	156	70.9	13.2	39.7	196	89.1	16.6	49.9
77	35.0	6.5	19.6	117	53.2	9.9	29.8	157	71.4	13.3	40.0	197	89.5	16.7	50.1
78	35.5	6.6	19.9	118	53.6	10.0	30.0	158	71.8	13.4	40.2	198	90.0	16.8	50.4
79	35.9	6.7	20.1	119	54.1	10.1	30.3	159	72.3	13.5	40.5	199	90.5	16.9	50.7
80	36.4	6.8	20.4	120	54.5	10.2	30.5	160	72.7	13.6	40.7	200	90.9	17.0	50.9
81	36.8	6.9	20.6	121	55.0	10.3	30.8	161	73.2	13.7	41.0	201	91.4	17.1	51.2
82	37.3	7.0	20.9	122	55.5	10.4	31.1	162	73.6	13.7	41.2	202	91.8	17.1	51.4
83	37.7	7.0	21.1	123	55.9	10.4	31.3	163	74.1	13.8	41.5	203	92.3	17.2	51.7
84	38.2	7.1	21.4	124	56.4	10.5	31.6	164	74.5	13.9	41.7	204	92.7	17.3	51.9
85	38.6	7.2	21.6	125	56.8	10.6	31.8	165	75.0	14.0	42.0	205	93.2	17.4	52.2
86	39.1	7.3	21.9	126	57.3	10.7	32.1	166	75.5	14.1	42.3	206	93.6	17.5	52.4
87	39.5	7.4	22.1	127	57.7	10.8	32.3	167	75.9	14.2	42.5	207	94.1	17.6	52.7
88	40.0	7.5	22.4	128	58.2	10.9	32.6	168	76.4	14.3	42.8	208	94.5	17.6	52.9
89	40.5	7.6	22.7	129	58.6	10.9	32.8	169	76.8	14.3	43.0	209	95.0	17.7	53.2
90	40.9	7.6	22.9	130	59.1	11.0	33.1	170	77.3	14.4	43.3	210	95.5	17.8	53.5
91	41.4	7.7	23.2	131	59.5	11.1	33.3	171	77.7	14.5	43.5	211	95.9	17.9	53.7
92	41.8	7.8	23.4	132	60.0	11.2	33.6	172	78.2	14.6	43.8	212	96.4	18.0	54.0
93	42.3	7.9	23.7	133	60.5	11.3	33.9	173	78.6	14.7	44.0	213	96.8	18.1	54.2
94	42.7	8.0	23.9	134	60.9	11.4	34.1	174	79.1	14.8	44.3	214	97.3	18.2	54.5
95	43.2	8.1	24.2	135	61.4	11.5	34.4	175	79.5	14.8	44.5	215	97.7	18.2	54.7
96	43.6	8.1	24.4	136	61.8	11.5	34.6	176	80.0	14.9	44.8	216	98.2	18.3	55.0
97	44.1	8.2	24.7	137	62.3	11.6	34.9	177	80.5	15.0	45.1	217	98.6	18.4	55.2
98	44.5	8.3	24.9	138	62.7	11.7	35.1	178	80.9	15.1	45.3	218	99.1	18.5	55.5
99	45.0	8.4	25.2	139	63.2	11.8	35.4	179	81.4	15.2	45.6	219	99.5	18.6	55.7
100	45.5	8.5	25.5	140	63.6	11.9	35.6	180	81.8	15.3	45.8	220	100.0	18.7	56.0
101	45.9	8.6	25.7	141	64.1	12.0	35.9	181	82.3	15.4	46.1	221	100.5	18.8	56.3
102	46.4	8.7	26.0	142	64.5	12.0	36.1	182	82.7	15.4	46.3	222	100.9	18.8	56.5
103	46.8	8.7	26.2	143	65.0	12.1	36.4	183	83.2	15.5	46.6	223	101.4	18.9	56.8
104	47.3	8.8	26.5	144	65.5	12.2	36.7	184	83.6	15.6	46.8	224	101.8	19.0	57.0
105	47.7	8.9	26.7	145	65.9	12.3	36.9	185	84.1	15.7	47.1	225	102.3	19.1	57.3
106	48.2	9.0	27.0	146	66.4	12.4	37.2	186	84.5	15.8	47.3	226	102.7	19.2	57.5
107	48.6	9.1	27.2	147	66.8	12.5	37.4	187	85.0	15.9	47.6	227	103.2	19.3	57.8
108	49.1	9.2	27.5	148	67.3	12.6	37.7	188	85.5	16.0	47.9	228	103.6	19.3	58.0
109	49.5	9.2	27.7	149	67.7	12.6	37.9	189	85.9	16.0	48.1	229	104.1	19.4	58.3
110	50.0	9.3	28.0	150	68.2	12.7	38.2	190	86.4	16.1	48.4	230	104.5	19.5	58.5
111	50.5	9.4	28.3	151	68.6	12.8	38.4	191	86.8	16.2	48.6	231	105.0	19.6	58.8
112	50.9	9.5	28.5	152	69.1	12.9	38.7	192	87.3	16.3	48.9	232	105.5	19.7	59.1
113	51.4	9.6	28.8	153	69.5	13.0	38.9	193	87.7	16.4	49.1	233	105.9	19.8	59.3
114	51.8	9.7	29.0	154	70.0	13.1	39.2	194	88.2	16.5	49.4	234	106.4	19.9	59.6
115	52.3	9.8	29.3	155	70.5	13.2	39.5	195	88.6	16.5	49.6	235	106.8	19.9	59.8
												236	107.3	20.0	60.0

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Patient Preparation:

1. NPO for 3 hours including food, tobacco, alcohol, and smoking.
2. Removal of metal and objects that might attenuate in the field of view.
3. No caffeine containing products for 18-24 hours. (See table below)
4. No theophylline products for 48 hours. (See table below)

Drinks containing caffeine	
Coffee	Pepsi
Instant coffee	Diet Pepsi
Decaffeinated coffee	Regular colas
Brewed tea	“Caffeine free” cola
Iced Tea	Dr. Pepper
Instant tea	Mr Pibb
Coca-Cola	Mellow Yellow
Diet Coke	Mountain Dew
Tab	Cocoa
Foods containing caffeine	
Chocolate Candy	Chocolate coated
Baking chocolates	Chocolate cake
Chocolate pudding	Chocolate milk
Brownies	
Prescription Drugs with Caffeine	
Cafergot	Esgic
Fioricet	Fiorinal
Norgesic	Synalgos
Wigraine	
Drugs containing Theophylline	
Aeorlate	Tedral
Constant – T	Theo-24
Elixophylline	Theoclear
Primatene	Theo-dur
Quibron	Theolair
Respbid	Theo-Organidin
Slo-bid	Theo-Sav
Slo-phylline	Theostat
T-PHYL	TheoX
OTC Drugs containing caffeine	
Anacin	Excedrin
No Doz	
Drugs containing dipyridamole	
Aggrenox	Persantine

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Clearance Data:

- Cardiovascular History including: indication for the examination, medications, symptoms, cardiac risk factors, and prior diagnostic or therapeutic procedures should be reviewed by the stress physician
- 12-lead ECG for evidence of acute ischemia, arrhythmia or conduction disturbances
- Cardio-respiratory auscultation for wheezing, rales, murmur etc.
- Vital signs: Heart Rate, Blood Pressure, Pulse Oximetry (as needed)
- Life support instruments and emergency drugs must be immediately available. In addition, an ACLS trained individual must be available to supervise procedure.

Procedure:

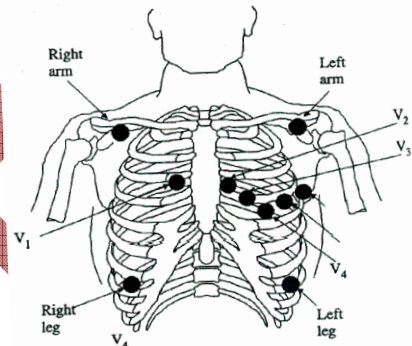
1. Obtain informed consent (see Informed Consent Procedure Adenosine)
2. An IV should have been started for injection of the rest radiopharmaceutical. If not obtain an IV using the right antecubital, connect 12" IV tubing with a "T" connector, tape IV securely, flush with 1.0 ml heparin flush.
3. ECG preparation:
 - a. The electrode sites should be rubbed with "Nu Prep" and alcohol until the skin is erythematous to remove skin oils and a superficial layer of skin.
 - b. If hair is present the sites should be shaved.
 - c. Electrodes are attached to the skin as per the figure below. It is best, if possible to avoid placing the electrode over large muscles masses.
 - d. Obtain a 12 lead ECG to insure there is no baseline artifact. If baseline artifact is present, repeat skin prep described above and repeat the 12 lead ECG.
4. Obtain baseline blood pressure recording
5. If patient history demonstrates COPD or moderate to severe dyspnea obtain baseline pulse oximetry measurement.
6. Explain procedure and possible side-effects to the patient.
7. Select adenosine protocol on the ECG monitor
8. Calculate the correct dose of adenosine based upon the patient's weight. See attached chart.
9. Draw up the dose in a 60 cc syringe then dilute to 34 ml using normal saline.
10. Place dose in the BAXA infusa pump. The plunger will be at the 4 minute mark on the pump. Flow rate of pump should be "1".
11. Press the green start button. The pump will ring and flow rate 1 will flash. You should be able to see the plunger moving, pushing the fluid.
12. Press the "Start Exercise Button" on the ECG monitor
13. To reduce the side affects of adenosine, ask the patient to march in place vigorously or perform low-level stress test using a Naughton protocol if the patient's condition permits (see Stress Test Procedure).
14. Inject the radionuclide 2 minutes into the adenosine infusion. The infusion should not be interrupted for the radionuclide injection,
15. The ECG and the presence of symptoms should be monitored continuously during the test.
16. An ECG tracing should be obtained every minute of the infusion. A blood pressure should be obtained every two minutes. The patient should be asked about symptoms every minute.
17. After the completion of the infusion, press "Stop Exercise" on the ECG console

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18. The patient should be monitored for 5 minutes upon completion of the infusion. An ECG and symptoms should be obtained every minute and the blood pressure should be obtained every 2 minutes.
19. Continue to monitor if patient continues to have symptoms or ECG changes.
20. Finalize the report to print table and trend reports.
21. If necessary obtain post-imaging ECG to verify return to baseline.

Adverse Reactions:

- Flushing
- Chest discomfort
- Shortness of breath
- Headache
- Nausea
- Throat, neck or jaw discomfort
- Heart block (first, second or third degree)



Electrode position for V leads:
V₁: 4th ICS, right sternal border
V₂: 4th ICS, left sternal border
V₃: halfway between V₂ and V₄
V₄: 5th ICS, anterior axillary line
V_{4R}: 4th ICS, right anterior axillary line

Indications for Stopping Adenosine Infusion and/or Administering Aminophylline

1. Severe hypotension: Systolic pressure < 80 mm Hg or 20 mm Hg fall, which persists
2. ST depression: > 3 mm beyond baseline EKG without angina or > 2mm with angina
3. Persistent 2nd or 3rd degree heart block
4. Severe chest discomfort, dizziness, dyspnea, headache, nausea, syncope or dysrhythmia
5. Wheezing

Reversal of Adenosine:

The half-life of Adenosine is less than 10 seconds. Thus the adverse effects are generally rapidly self limiting. Treatment of any prolonged adverse effect should be individualized and directed toward the specific effect.

1. Stop infusion – most effects resolve within 30-60 seconds post infusion
2. If symptoms persist, administer aminophylline, 125 mg, IV by slow infusion (1 minute) on physicians direction. Dosage may be repeated again in five minutes if there is no response to the first dose.
3. Note: Aminophylline administration should be delayed for at least one minute post-radionuclide administration.

Treatment of Adverse Reactions: (See above)

Any other severe adverse and symptomatic reactions including chest pain, bradycardia, tachycardia, hypotension, hypertension or in the rare instance cardiac arrest should be treated according to the Advanced Cardiac Life Support Algorithms. (See Stress Test Procedure – Attachments D-N)

Forms: See Attachments A-C

Adenosine Stress Test Procedure

References:

ACR Practice Guideline for the Performance of Cardiac Scintigraphy. In ACR Practice Guideline; 439-447.

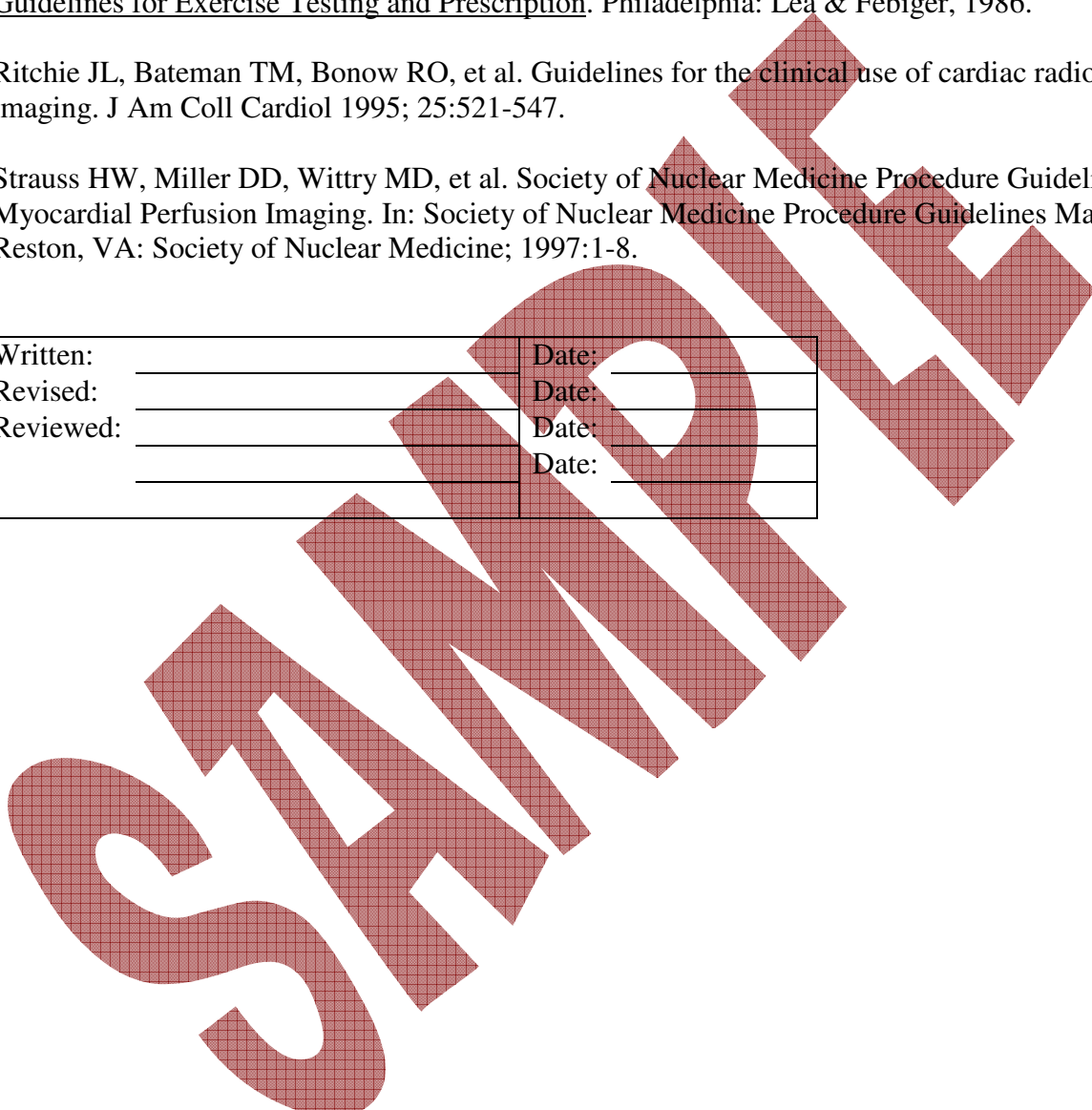
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Ritchie JL, Bateman TM, Bonow RO, et al. Guidelines for the clinical use of cardiac radionuclide imaging. J Am Coll Cardiol 1995; 25:521-547.

Strauss HW, Miller DD, Wittry MD, et al. Society of Nuclear Medicine Procedure Guideline for Myocardial Perfusion Imaging. In: Society of Nuclear Medicine Procedure Guidelines Manual 1997. Reston, VA: Society of Nuclear Medicine; 1997:1-8.

Written:	_____	Date:	_____
Revised:	_____	Date:	_____
Reviewed:	_____	Date:	_____
	_____	Date:	_____



Attachment A

CONSENT FOR ADENOSINE MYOCARDIAL PERFUSION SCAN

I, _____, authorize Dr. _____ and his assistants to administer and conduct an adenosine myocardial perfusion stress test. This test is designed to determine the presence or absence of clinically significant heart disease; to evaluate the effectiveness of my current therapy; and/or to measure my fitness for work or sport.

I understand that I will be given a dose of medicine, adenosine. I will walk in place for 2-4 minutes to minimize or reduce side-effects of the adenosine. After 2 minutes a radioisotope substance (Tc99M Myoview) will be injected intravenously.

Every effort will be made to conduct the test in such a way as to minimize discomfort and risk. However, I understand that just as with other types of diagnostic tests there are potential risks (approximately 2 to 3 per 10,000) associated with adenosine myocardial perfusion test. These include episodes of dizziness, headaches, flushing, nausea or vomiting. Rarely extra heartbeats may occur. There is a very slight possibility of heart attack or sudden death, although these have not been reported. There is no risk or side effect associated with the radioisotope injection. I further understand that the laboratory is properly equipped for such situations and that its professional personnel are trained to administer any emergency care necessary. I voluntarily accept the risks associated with the above procedures.

Signature of Patient

Signature of Witness

Date

Attachment B

Pre-Stress Test Cardiac History

Patient Name: _____ Date: _____
Age: _____ Gender: _____ Height: _____ Weight: _____
Referring MD: _____

Reason your doctor ordered the test: _____

What medications do you take? _____

Do you ever get chest pain or discomfort? Yes or No If yes, please describe: _____

Where is the discomfort located?
How long does it last?
What were you doing when you got the discomfort?
Does anything make the discomfort better (i.e. rest, burping, deep breaths etc.)?
Do you get nausea or shortness of breath when you get the discomfort?

Have you ever had a heart attack? Yes or No If yes, when? _____

Have you ever had heart surgery? Yes or No If yes, when? _____

Have you had an angioplasty or balloon? Yes or No If yes, when? _____

Do you get cramps in your legs when you walk? Yes or No If yes, describe? _____

Do you have high blood pressure? Yes or No If yes, how long? _____

Are you a diabetic? Yes or No If yes, how long? _____

Do you have high cholesterol? Yes or No If yes, how long? _____

Do you smoke? Yes or No If yes, how long? _____

Does anyone in your family have heart disease? Yes or No If yes, who? _____

If you are a female, do you take hormone replacement? Yes or No _____

Do you ever get heart palpitations? Yes or No If yes, describe _____

Do you ever get dizzy, light headed or pass out? Yes or No If yes, describe _____

Do you get shortness of breath? Yes or No If yes, describe _____

Attachment C

IV ADENOSINE STRESS TEST

NAME: _____

DATE: _____

PHYSICIAN: _____

An adenosine stress test was performed using _____ mg of adenosine given IV at rest. 2.5 minutes after the infusion was begun, 30.0 mCi of Tc99m myoview were injected IV. The patient also walked in place during the infusion to facilitate radionuclide distribution.

The patient (denied/ complained of) (chest discomfort / headache / nausea / dyspnea / flushing).

The blood pressure (decreased/increased/didnt change significantly/remained essentially unchanged) and the heart rate (decreased/increased/didnt change significantly/remained essentially unchanged) during the test.

The resting ECG was (normal / abnormal and showed _____ .)

There were (no/ significant) ST changes consisting of _____ mm (upsloping/ downsloping/ horizontal) ST (depressions / elevations) in leads _____ which developed at _____ min after the beginning of the infusion and persisted for _____.

IMPRESSION:

1. Adenosine Stress Test which is electrocardiographically (negative / positive/ non-diagnostic / suggestive of but not diagnostic) for myocardial ischemia (due to / resting ECG abnormalities / baseline artifact).
2. (No) Adenosine associated (chest discomfort/ headache / nausea / dyspnea / flushing).
3. (No) adenosine associated arrhythmias (consisting of _____.)

Physician Signature