Oxford Centre for Clinical Magnetic Resonance Research (OCMR)
Adenosine use in stress CMR

WORK INSTRUCTION 04	Revision: First Issue Version 2.0	Date: 02/10/17

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1.0 PURPOSE

The purpose of this document is to provide instructions for adenosine use in stress cardiac MR imaging at OCMR.

2.0 SCOPE

This work instruction should be referred to when carrying out adenosine stress cardiac MR (ensuring compliance with SOP OCMR_004 Minimum Attendance Policy).

3.0 RECORDS

The batch number and expiry date, time and person administering should be recorded on the adenosine stress record sheet for each patient/ participant.

4.0 ASSOCIATED DOCUMENTS

This document should be read in conjunction with SOP OCMR_001 MR Scanning and SOP OCMR_004 Minimum Attendance Policy (available on the OCMR website).

5.0 RESPONSIBILITY

This work instruction is maintained and reviewed by the OCMR SOP committee.

6.0 INSTRUCTIONS

6.1 General Points

6.1.1 Stress scans should take place within the normal OCMR working hours (Monday to Friday 8am – 6pm) unless specific permission has been granted by the OCMR project steering committee on a named project basis.

6.1.2 Check there is unimpeded access to the emergency trolley.

6.1.3 Check the defibrillator, the crash trolley and emergency drugs on the day stress studies are performed.

6.1.4 Two OCMR staff qualified in magnet evacuation training (minimum one doctor) should be present within the control room and ready to go into the MR scanner room immediately (i.e. no keys, coins etc. in pockets). In addition, the doctor should have up to date ALS or BLS training and the radiographer(s) should have up to date ILS training. A third person should be in the department (not necessarily in the control room except when scanning at 3T when they should be within the control room during the administration of Adenosine) ready to help if needed. The clinician in charge of the study should designate roles to the other attending staff in case of emergency (e.g. designate at the beginning of the list that person 1 will call for help and arrest team, person 2 will begin evacuation of the subject from the magnet bore while other help arrives).

6.2 In preparation to scan high-risk patients/ participants

6.2.1 The evacuation path should be cleared of all potential obstacles before the scan, including unlocking of all doors on the relevant control room and clinical room.

6.2.2 The clinical room should be cleared of obstacles (such as the sharps bin and the supply trolley) away from the path of the evacuation to resuscitation stretcher.

6.2.3 Alert others of a potential call for help and to attend the control room quickly if the alarm rings.

6.3 Patient/ participant Preparation

6.3.1 Contraindications and explanation of the procedure

- Explain the procedure in detail, with particular emphasis on adenosine related side-effects (table 1)
- Check for any contra-indication (table 2) and DO NOT administer adenosine if present.

- All subjects should have an ECG as part of their preparation, except in-patients with recent ECG's (within 72 hours). Check ECG for exclusion criteria (table 2)
- Make particularly sure that the patient/ participant has no high-grade atrioventricular (AV) block on ECG or asthma / obstructive COPD as these are the main contraindications to adenosine.
- Ensure the patient/ participant has refrained from caffeine containing products (e.g. coffee, tea, chocolate) and drugs that could alter the vasodilating effect of adenosine (e.g. xanthines, theophylline) for 24 hours prior to the scan

Table 1. ***Adverse effects of adenosine***	
Common effects (usually not serious)	flushing chest pain palpitations breathlessnes
More severe side effects (usually transient)	heart block hypotension sinus tachycardia bronchospasm

Table 2. ***Contraindications to Adenosine***
Known or suspected bronchospastic or bronchoconstrictive disease (asthma, COPD)
Known hypersensitivity to adenosine
2nd or 3rd degree AV block on resting 12 lead ECG
Sinus bradycardia < 45 bpm
Systolic blood pressure < 90 mmHg
Signs and symptoms of unstable angina with resting chest pain

6.4 IV Lines

6.4.1 Two IV lines will be required, one for contrast administration (16-18G green cannula), and the second for adenosine infusion (18-20G pink cannula). A smart site valve should be connected between the venflon and the infusion so that lines can be disconnected easily in the event of an emergency. Whenever possible these should not be in the same arm (ideally placed in both the left and the right antecubital veins). This is to avoid a bolus injection of adenosine when the contrast agent is flushed in, which could lead to high-grade AV block. Alternatively access on the back of the hand can be used for administration of adenosine but it is NOT recommended for the injection of contrast.

6.4.2 Where venous access is limited or contraindicated on one side, then one cannula with a 3 way tap is acceptable. The contrast should be connected in line with the venflon such that gadolinium is injected directly via the 3-way valve into the vein and the adenosine on the side port (and not the other way around to avoid injecting gadolinium at a high rate at a 90^0 angle with a risk of blowing off the connections). Ensure that the 3-way tap is open to all 3 ports (see Figure 1). The adenosine infusion should be stopped immediately prior to the contrast injection to minimise the risk of heart block due to the potential administration of a bolus following the contrast injection.

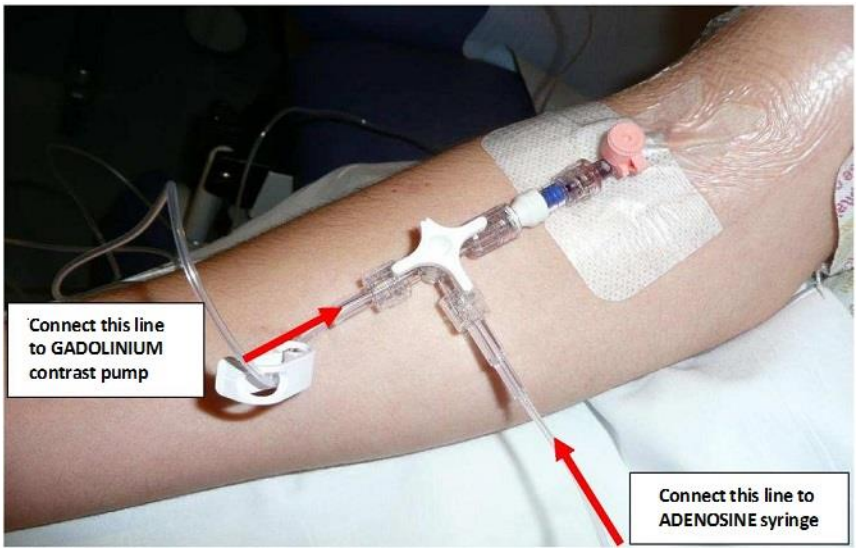


Figure 1: A 3-way tap connected via a blue smart site valve to an IV cannula inserted into a vein in the antecubital fossa of a subject's right arm. A line is connected to each port. In a set-up for adenosine stress perfusion CMR imaging using a 3-way tap, the side port should be used to administer gadolinium contrast agents via the pump injector at a rate of 4-6 ml/sec. The 3-way tap is shown open to all 3 ports

6.5 Preparation of the Graseby infusion pump and contrast injector

6.5.1 Prepare the Graseby pump for adenosine and set the rate of infusion to 140µg/kg/min, enter the patient/ participant's weight in kg and the concentration of adenosine (3mg/ml). The pump is situated outside the scanner room and is connected via three 200cm extension lines through the wave guide. The volume of adenosine to prime the line itself is ~ 4.5ml. Please see table 3 for a guide of the volume needed based on body weight. For clinical scans consider an increase up to 170µg/kg/min if after 2–3 minutes to a maximum of 210µg/kg/min if the HR does not increase by 10 bpm and/or blood pressure does not drop by >10mmHg).

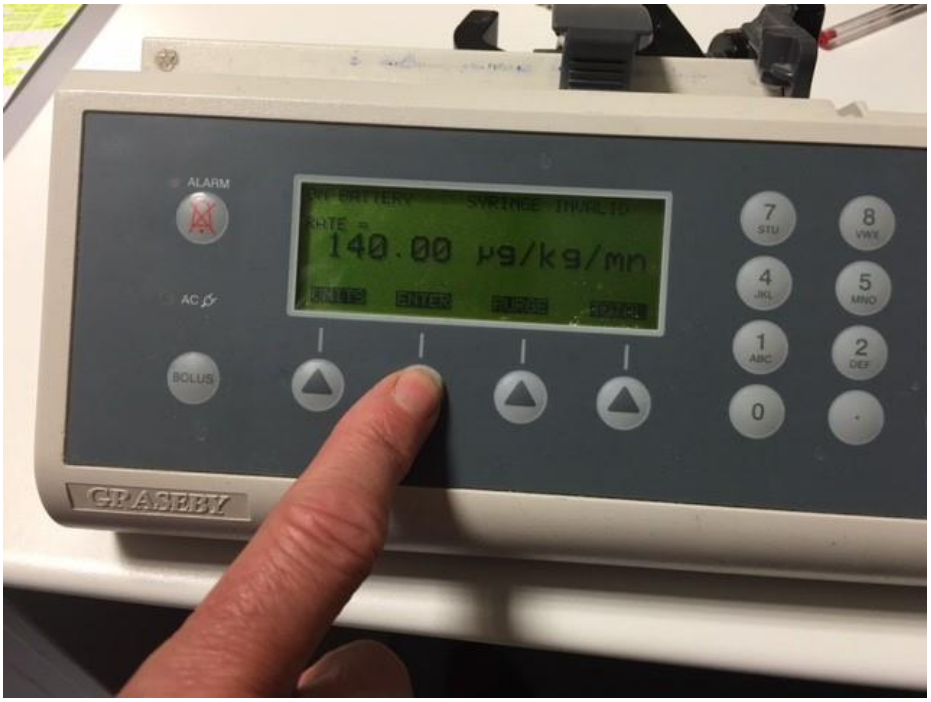
Table 3: Infusion rate :140ug/kg/min								
Weight (kg)	**4 mins**	**Vol to prime line 3 x extn lines**	**Total Volume**	**No of Vials**	**6 mins**	**Vol to prime line 3 x extn lines**	**Total Volume**	**No of Vials**
50	9.33	4.2	13.53	2	14	4.2	18.2	2
55	10.3	4.2	14.5	2	15.4	4.2	19.6	2
60	11.2	4.2	15.4	2	16.8	4.2	21	**3**
65	12.1	4.2	16.3	2	18.2	4.2	22.4	3
70	13.1	4.2	17.3	2	19.6	4.2	23.8	3
75	14	4.2	18.2	2	21	4.2	25.2	3
80	14.9	4.2	19.1	2	22.4	4.2	26.6	3
85	15.9	4.2	20.1	3	23.8	4.2	28	3
90	16.8	4.2	21	3	25.2	4.2	29.4	3
95	17.7	4.2	21.9	3	26.6	4.2	30.8	4
100	18.6	4.2	22.8	3	28	4.2	32.2	4
105	19.6	4.2	23.8	3	29.4	4.2	33.6	4
110	20.5	4.2	24.7	3	30.8	4.2	35	4
115	21.4	4.2	25.6	3	32.2	4.2	36.4	4
120	22.4	4.2	26.6	3	33.6	4.2	37.8	4
125	23.3	4.2	27.5	3	35	4.2	39.2	4
130	24.2	4.2	28.4	3	36.4	4.2	40.6	5
135	25.1	4.2	29.3	3	37.8	4.2	42	5
140	26	4.2	30.2	4	39.2	4.2	43.4	5
145	27	4.2	31.2	4	40.6	4.2	44.8	5
150	28	4.2	32.2	4	42	4.2	46.2	5

For patients 50 -79 kg = 2 vials
For patients 80 - 130 kg = 3 vials
For patients >131 = 4 vials

For patients up to 59 kg = 2 vials
For patients 60 - 94 kg = 3 vials
For patients 95- 129 kg = 4 vials
For patients >130 = 5 vials

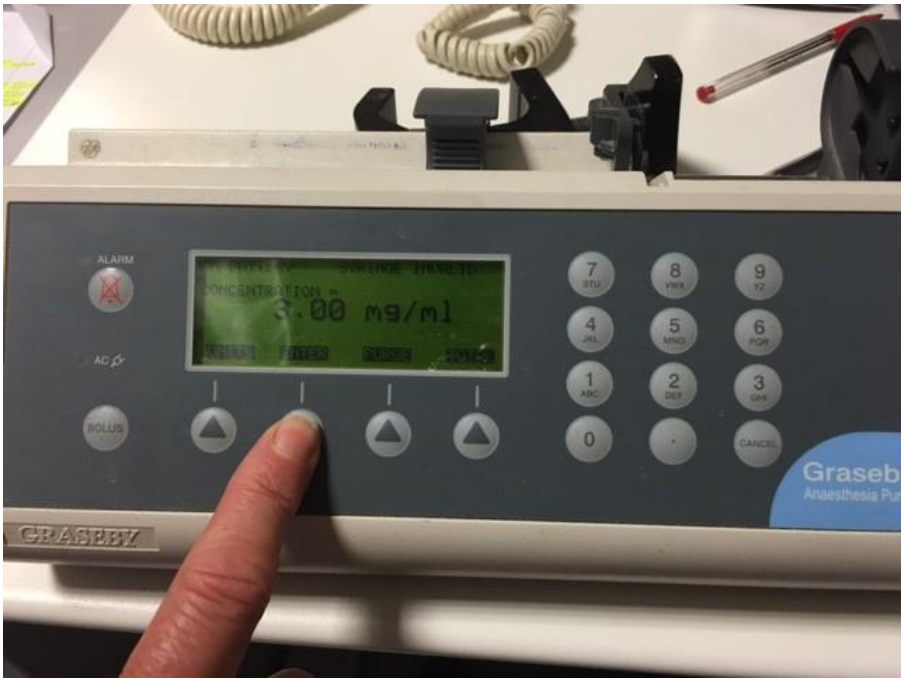
6.5.2 Set the infusion pump to ON

6.5.3 Set the rate to 140µg/kg/min



6.5.4 Enter the weight.

6.5.5 The concentration of adenosine is 3mg/ml.



6.5.6 Start the infusion.

6.6 Inside the control room

6.6.1 Prepare the power injector for the administration of gadolinium based contrast agent (see work instruction 01 – Gadolinium use in OCMR). Contrast administration (rate 4-6ml/sec) needs to be followed by a normal saline flush (20ml at the same rate) to ensure that the entire contrast agent dose is injected. These doses/volumes/rate of injection may vary according to the research protocol.

6.6.2 Connect the lines for adenosine and contrast via the smart site valve.

6.6.3 Place the blood pressure cuff on the arm with the contrast agent, to avoid interference with the administration of adenosine.

6.6.4 Place ECG electrodes on the chest and make sure you have a good quality tracing. Optimal ECG triggering is essential for a successful CMR perfusion scan.

6.7 Patient/ participant monitoring

6.7.1 Talking to the patient/ participant throughout is very important to reassure them during the adenosine infusion.

6.7.2 Blood pressure should be measured:

- Before the adenosine infusion (at least one baseline measurement)
- During stress every minute (but not during image acquisition)
- Post stress at least once

6.7.2. ECG should be monitored continuously.

6.7.3 Most patients/ participants reach maximum vasodilation after 2 minutes of infusion, but in order to reach a steady state of vasodilation the infusion should ideally be continued for 3 minutes before acquisition of perfusion data. Maximum single duration of the infusion is 7min 30s.

6.8 Criteria for early termination

- Persistence of symptomatic AV-block
- Significant drop in blood pressure
- Severe respiratory difficulty
- Patient/ participant request

6.9 At the conclusion of the scan

All used syringes, sharps and equipment (infusion pump, gad injector) must be disposed of and tidied appropriately.