# SDB and the Metabolic Syndrome
# Cerebral Blood Flow Protocol
# Procedure Manual

## 1.      INTRODUCTION

In this study, we will measure cerebral blood flow responsiveness to hypercapnia using transcranial Doppler ultrasound in members of the Wisconsin Sleep Cohort. The data will be collected and analyzed at the Pulmonary Physiology Laboratory at the Middleton VA Hospital.

## 2.      EQUIPMENT AND SUPPLIES

### 2.1      Equipment

### 2.11      Doppler ultrasound instrument

A 2-MHz pulsed Doppler ultrasound system (Neurovision 500 M, Multigon Industries, Younkers, NY) will be used to measure peak cerebral blood flow velocity (CFV) in the proximal (M1) segment of the middle cerebral artery. The middle cerebral artery will be insonated through the right temporal window using search techniques that have been described previously (Otis & Ringelstein 1996; see below). After obtaining the best-quality signal, the probe will be secured using a headband device to provide a fixed angle of insonation.

### 2.12      Instruments for monitoring and recording cardiovascular and respiratory variables

An electrocardiograph will be used for monitoring heart rhythm and measuring heart rate and an automated arm cuff will be used to measure blood pressure (Dinamap, Critikon, Tampa, FL). Infrared gas analyzers will be used to measure end-tidal $CO_2$ tension ($P_{ET}CO_2$) and end-tidal $O_2$ tension ($P_{ET}O_2$) (Models CD3A and S-3A/I, Ametek, Pittsburgh, PA). Each of the physiological signals will be routed to signal conditioner/amplifier modules, a physiological chart recorder, and a personal computer for data acquisition (sampling rate, 120 Hz).

### 2.13      $CO_2$ tank, regulator, and flow meter, wall $O_2$ source blender

This equipment will be used to supplement the $CO_2$ and $O_2$ concentrations of the inspired air. Nick: a diagram would be helpful

### 2.2      Supplies

Supplies can be divided into the following categories: 1) one-time purchases and 2) supplies bought on a repeat basis. One-time purchases include a stopwatch and elastic headbands (4).

A list of supplies that need to be reordered on a repeat basis follows:

a) mouthpieces
b) noseclips
c) blue ventilator tubing for breathing circuits
d) single-use flow sensors
e) Humid-vent filters
f) t-piece connectors
g) 22x15 mm connectors
h) 15 mm connector
i) disposable self-adhesive electrocardiogram electrodes
j) ultrasound gel
k) tissues
l) compact discs for data storage

## 2.3  Equipment Set-up (performed before each study)

Turn on $CO_2$ and $O_2$ analyzers, if necessary (see below).  This equipment must be allowed to warm-up for at least 1 hour before use.

Get reading of current barometric pressure from barometer in PFT lab, B-3107 VAMC.  Record the barometric pressure on the ***Subject Data Sheet and Protocol Checklist*** (see attached).

Make sure the bed has fresh linen and the head of bed is positioned at 30 degree angle from horizontal (full upright position).  Check that the temperature in the room is 20-$22^0$ C.

Turn on power to cardiovascular instrument rack.

Turn on transcranial Doppler device.  Adjust the offset to display a range of y-axis values from -40 to 160 cm/sec.  Increase the power ("T)" to 50%, and the gain ("R") and sensitivity ("S) to 30%.  Attach Doppler probe and select a clean elastic headband.

Attach new blue tubing to the breathing circuit.  Open flow meter valve labeled "Hyperoxia" until system flow meter indicates flow at 35-40 lpm.  Confirm $FIO_2$=40% by reading digital display on Mini-OX $O_2$ meter.  Adjust $FIO_2$ using gas blender labeled "Hyperoxia".  System flow may now be reduced or shut off until subject goes on mouthpiece.

Attach new mouthpiece and filter to breathing circuit.  Have new nose clip ready.  Pierce mouthpiece with $CO_2$ sample adapter and connect it to the $CO_2$ sample tube.  (Except for the tube, discard these single use items after trials are done.)

### 2.3.1  Setting up computer, paper recorder, and video recorder for data acquisition

Computer
Run the Config program to set up the naming string.  The drive path is C:\ms\******** , with ******** being the subject's cohort identifier.

To avoid having to re-optimize signal settings for every recording, "pre-name" the .cfg and .rcf files. From C:\ms\sample, copy sample.cfg and sample.rcf to C:\ms. Rename these 2 files ********.cfg and ********.rcf, with ******** being the subject's cohort identifier. Record the computer file name on the ***Subject Data Sheet and Protocol Checklist***.

Run CVAP to open the recording program.

<u>Paper recorder</u>
Check to make sure that at least 100 sheets of paper remain. The recorder must be in overlap mode and should be run at a paper speed of 2/5 mm/sec.

<u>Video recorder:</u>
Turn on power. Insert a new tape and rewind. Press the buttons indicated by red dot stickers to set the speed to "EP", reset the counter, go to memory mode, and select channel "AU". Note: This channel must be selected, or recording will NOT occur!

2.3.2 **Calibrating the equipment**

Press "S" to begin computer recording. Also record the cals on the paper record and the video tape.

<u>$CO_2$ and $O_2$ analyzers</u>
Perform and record on the computer calibrations of the $CO_2$ and $O_2$ analyzers (as appropriate using calibration gas). Set the zero for the $CO_2$ meter at exactly .03% and baseline for the $O_2$ meter at approx. 20.8%. Establish a low but steady flow from the calibration gas tank. Insert the $CO_2$ sample adapter into the calibration tube, partly occluding the tube's open end. Adjust the $CO_2$ gain to read 5.04% (or whatever is appropriate according to the current cal gas tank tag). Remove sample adapter to room air, then place again into the calibration tube for 3-5 seconds. Record the cal gas tank's $CO_2$ and $O_2$ values on the ***Subject Data Sheet and Protocol Checklist***.

<u>Flow sensor</u>
Open the Flow Calibrator valve to raise the float ball to 107 mm on the meter. This corresponds to 0.5 l/sec airflow. Detach the flow sensor from the circuit, and send airflow thru each side of the flow sensor, repeat 3-4 times. The cal signal values are 0.5, 0, and -0.5 l/sec.

<u>Doppler signal</u>
Press Alt-S on the Doppler keyboard to run the calibration for the cerebral blood flow signal. The cal signal values are: -40, 60, and 160 cm/sec.

When calibrations are complete, stop the computer recording by pressing "S", then "Q" then "Y" to quit, confirm. Stop the paper record and the video tape.

2.33 **Preparing for data collection**

After all calibrations are complete, reassemble the breathing circuit, turn on system flow to 35-40 lpm, confirm $FIO_2$=40%. The subject may now breathe on mouthpiece.

**2.4** **Care and Maintenance of Equipment**

At the end of the day, leave $CO_2$ and $O_2$ analyzers powered up.  Turn off computer monitor and HP patient monitor.  Stop gas flow by closing hyperoxia flowmeter.  Close main valve on CO2 tank.  Turn off gas sample pump at 5-10 min past end of breathing.  Turn off all other pieces of equipment.

Remove gel from the Doppler probe using a gauze pad.  Disconnect the probe from the base unit and store in black plastic case.  Wash used elastic headbands in warm, soapy water and lay flat to dry.

Make sure that the $CO_2$ tank is shut off.

**3.** **EXAMINATION PROTOCOL**

In the GCRC, the subject will complete portions of the ***Medical History Form*** (see attached) pertaining to past and recent medical history.  Blood pressure, heart rate, and respiratory rate will be measured and recorded on the ***Physical Exam Form*** by the GCRC nurse.  The subject will be escorted, along with a folder containing his/her 12-lead electrocardiogram, Health History Questionnaire, Medical History Form, and partially completed ***Physical Exam Form***, to the VA laboratory (Room B-3056) by the sleep lab technician.  S/he will be logged in using the ***Subject Data Sheet and Protocol Checklist***.  This checklist will be used to insure that all procedures are followed.

The subject will be seated and the following preparation will begin.  The protocol will be explained to the subject and s/he will be encouraged to ask questions.  The physician will be notified

History and Physical Examination
When the subject arrives at the VA laboratory Dr. Skatrud or his designee will be notified of the patient's arrival.  The physician will come to the laboratory and review the subject's 12-lead electrocardiogram, blood pressure, heart rate, and respiratory rate (previously recorded in the GCRC), and the subject's self-report of health history.  The physician will perform a brief physical exam.  The exam findings will be recorded on the ***Physical Exam Form***.

Criteria for Medical Stability and Ability to Proceed with Study
All items in the medical history are marked "No".
1. Patient is comfortable and in no acute distress
2. Systolic >90 and <200 mmHg; diastolic BP >60 and <105 mmHg
3. Heart rate >50/min and <100/min
4. Respiratory rate >8/min and <25/min

Options for "unstable" subjects
1. Contact house officer on-call
2. Contact project medical director
3. Refer to subject's physician in the morning

4.  File medical alert with project medical director

Placement of ECG Electrodes
Skin over the left and right distal clavicles and the left lower anterior rib cage will be prepped with an alcohol swab and disposable electrodes applied.  The lead wires will be attached so that the left shoulder electrode is the ground, the lower rib cage electrode is positive, and the right shoulder electrode is negative (Lead II).

Acquisition of the Doppler Signal
Standardized search criteria will be used to obtain Doppler signals from the middle cerebral artery through the temporal window above the zygomatic arch.  The initial settings for the Doppler instrument will be as follows:
- Range: -40 to 160 cm/sec (positive direction)
- Power: 50%
- Sensitivity: 30%
- Gain: 30%
- Depth: 5.6 cm (default value)
- Gate: as large as possible without introducing noise

The subject will sit in a straight-backed chair.  Ultrasound gel will be applied to the probe and the probe will be placed in contact with the subject's skin just above the zygomatic arch anterior to the right ear canal.  While maintaining a slightly anterior and superior orientation of the probe, the probe should slowly be moved in an anterior direction, staying parallel to the zygomatic arch.  If no Doppler signals are detected during this survey just above the arch, the probe should be moved cranially and another sweep made, again staying parallel to the arch.  If no signal is obtained on the second sweep, the subject's left side should be surveyed.

When a reasonably clean Doppler signal is obtained, the probe is placed in the plastic holder on the elastic band, and the band is placed on the subjects head.  The probe then can be manipulated in the x, y, and x directions, searching for the densest signal possible.  When an adequate signal is obtained with a depth of 3.0-6.0 cm and a positive direction of flow, the screw on the plastic probe holder is tightened to fix its position.

Using the track ball on the Doppler unit, the depth is increased from the default value until a bidirectional signal is located.  This point represents the bifurcation of the MCA and the ACA and confirms that the original sample volume was obtained from the MCA.  The depth is then reduced until the highest quality signal is obtained from the MCA.  The width should be adjusted to minimize noise and maximize the signal quality.

Protocol
The subject is then asked to stand and carefully move over to the bed when s/he will sit in a semi-recumbent position with legs slightly flexed using a pillow under the knee.  A cervical pillow that minimizes head motion will be positioned behind the head and the subject instructed to maintain this position for the duration of the study.

The ECG lead wires will then the attached and the blood pressure cuff applied to the left arm.

The protocol will be explained to the subject once again. S/he will be told that breathing air with increased $CO_2$ will cause an increase in the rate and depth of breathing and that it may cause warmth or flushing sensations. S/he will be instructed to remove the mouthpiece at once if s/he feels uncomfortable in any way. The subject is again given the opportunity to ask questions. Then, the mouthpiece is inserted and the nose clip is applied.

Supplemental oxygen ($FIO_2$=0.40) will be added to the breathing circuit from the wall oxygen outlet. The $FIO_2$ will be monitored using the blender settings and $O_2$ monitor.

Once a stable baseline recording has been obtained, 5 minutes of baseline data will be collected. During this time, the baseline level of $P_{ET}CO_2$ will be noted and marked on the paper record. Then $CO_2$ will be added to the inspired air to raise the $P_{ET}CO_2$ above the baseline level by 5 mmHg. The $P_{ET}CO_2$ will be monitored continuously and the supplementation adjusted as necessary to maintain $P_{ET}CO_2$ at 5 mmHg above baseline for 4 minutes. Then, more $CO_2$ will be added to the inspirate to increase the $P_{ET}CO_2$ to 10 mmHg above baseline. It will be kept at this level for 4 more minutes. $P_{ET}CO_2$ will be monitored continuously and the amount of supplementation adjusted as necessary. Nick: need details on the supplementation procedure

At the end of the protocol, the $CO_2$ supplementation will cease and the mouthpiece and noseclip will be removed. The subject's heart rate and blood pressure will be monitored for 5 minutes, or until they return to the baseline value. If heart rate and blood pressure have returned to baseline and the subject reports no symptoms, the sleep technician will be notified that the subject is ready to leave the testing site.

At the end of the cerebral blood flow study, the subject and the folder containing ECG, Health History Questionnaire, Medical History Form, and completed Physical Exam Form will be escorted back to the GCRC by the sleep technician.

4.     **LOGS AND RECORDS**

A Medical History Form and Physical Exam Form (see attached) will be completed for each subject prior to participation in the cerebral blood flow protocol. After the study is finished, these records will be stored in the Sleep Cohort offices.

A *Subject Data Sheet and Protocol Checklist* will be completed for each subject at the time of the study. This record will be stored in the VA lab. EAP and Excel files resulting from the data analysis for each study will be archived on CD. The CDs will be stored in the VA laboratory.

5.     **DATA ANALYSIS**

After completion of each study, the computer data record will be downloaded to CD. The data on the CD will be analyzed at the Pulmonary Physiology Lab at the VA Hospital using a custom-written program named "EAP".

File names are derived from the subject's cohort ID and the date. For example, a study of subject #A0223 from March 12, 2004, would be titled A0223MAR4.

Each study begins with two files:
1. A file containing calibration signals (file extension .D0).
2. A file containing the actual experimental data (file extension .D1).

There are 6 major steps involved in data analysis using the EAP program:
1. Calibrating the traces in the .d0 file.
2. Creating 3 new files (.d2, .d3 and .d4) from each .D1 file by splitting it into its component parts (eupneic breathing, +5 mmHg and +10 mmHg).
3. Setting the $CO_2$ delay.
4. Checking the traces in the .d2, .d3 and .d4 files to make sure the program detected them properly.
5. Creating text files that contain output reports
6. Analyzing the data in Excel.

## 5.1    Calibrating the Traces in the .d0 File

The following traces need to be calibrated:
- End-tidal $PCO_2$ ($CO_2$ pressure; yellow)
- Flow (breaths; red)
- Velocity (velo; blue)
- End-tidal $PO_2$ ($O_2$ pressure; purple)

5.11    Calibrating end-tidal $PCO_2$ (yellow tracing):

A. Click the $PCO_2$ button on the left hand side of the screen.
B. Choose "Tools" from the menu at the top of the screen, then select "Calibrate".
C. Locate the $PCO_2$ signal calibration on the polygraph printout, then find the corresponding location on the EAP screen.
D. Place both blue cursors on the zero baseline before the calibration signal on the screen.
E. Click "Insert" on the right hand side of the screen.
F. Enter the number written on the hard copy into the space provided. Click "OK".
G. Place both cursors on the upper step of the calibration signal.
H. Click "Insert".
I. Enter the number written on the hard copy (on top of the step) into the space provided. Click "OK".
J. Click "Label" on the right hand side of the screen. Change the units from "%" to "mmHg". Click "OK".
K. Hit "Save".

5.12    Calibrating velocity (blue tracing):

A. Click the "Velo" button.
B. Choose "Tools" from the menu at the top of the screen, then select "Calibrate".
C. Place both cursors on one of the bottom "steps" of the calibration signal.

D. Click "Insert" and enter the number "-40" in the space provided.
E. Repeat steps 3 and 4, using the corresponding middle and upper steps and inserting the values "60" and "160" respectively.
F. Click "Save".

5.13    Calibrating air flow (red tracing):

A. Click the "Flow" button.
B. Choose "Tools" from the menu at the top of the screen, then select "Calibrate".
C. Locate where the air flow calibration signal on the EAP screen.
D. Place both cursors on the lower step of the trace. Hit the "Insert" button. Enter the value "-0.5" in the space provided.
E. Repeat step 4 using the middle and upper steps of the calibration signal and entering the corresponding values "0" and "0.5".
F. Hit "Save".

5.14    Calibrating end-tidal $O_2$ (purple tracing):

A. Click the PO2 button on the left hand side of the screen. Choose "Tools" from the menu bar, then click "Calibrate".
B. Locate where the PO2 signal was calibration on the polygraph printout, then find the corresponding location on the EAP screen.  Place both blue cursors on the upper "zero" level just before the "dip" on the screen.
C. Click "Insert" on the right-hand side of the screen.
D. Enter the number written on the hard copy (before the dip) into the space provided. Click "OK".
E. Place both cursors on the lower level "the dip".
F. Click "Insert"
G. Enter the number written on the hard copy (on the dip) into the space provided. Click "OK".
H. Click "Label" on the right hand side of the screen. Change the units from "%" to "mmHg". Click "OK".
I. Hit "Save".

**5.2    Creating 3 New Files from the .d1 File**

A. Open the .d1 file.
B. Locate where eupneic breathing ended on the paper readout.
C. Find the corresponding location in the .d1 file using the $PCO_2$ (yellow) tracing as a guide.  Place the bright blue cursor in the trough of the breath before the $PCO_2$ starts to rise.
D. Go to "Edit" at the top of the screen and choose "Mark End". Make note of the time where the cursor is located.
E. Go back 4:00 to 4:02 minutes earlier in the file and place the cursor in the trough of the closest preceding breath.
F. Go to "Edit" and choose "Mark Start".
G. Go to "File" on the menu bar and choose "Save Section". This will create a new file with extension ".d2".

H. Repeat steps 2-7 using the end of +5 mmHg and +10 mmHg breathing for marking the end of the two remaining 4 minute segments. This will create files with extensions ".d3" and ".d4".

**5.3     Setting the $CO_2$ Delay (Note: this is done <u>only</u> for the .d2 file)**

A. Open the .d2 file.
B. Select "Analyze" from the menu bar and click "All".
C. Select "Tools" from the menu bar and click "Breath".
D. Using the arrow keys to highlight breaths, place the left cursor at the beginning of any expiration (on the red "flow" trace).  Valid breaths will have a rather smooth, sinusoidal appearance with inspiration up and expiration down.
E. Place the right cursor at the beginning of the following $CO_2$ (yellow) rise (use your best judgment).
F. Note the delta (time differential between the two cursors) value at the bottom right-hand side of the screen.
G. Repeat steps A to C for an additional 9 breaths, noting the delta value for each.
H. Find the average of the delta values (this need not be overly precise).
I. Select "Options" from the menu bar. Choose "Analysis", then click "miscellaneous".
J. Type the average delta in the space provided for the $CO_2$ delay (this value is in seconds) and click "Apply".

**5.4     Checking the traces in the .d2, .d3 and .d4 files to make sure the program detected them properly**

Open the .d2 file.  Select "Analyze" from the menu bar. Click "All" (if not already done when setting the $CO_2$ delay).

5.41    Checking the air flow trace (red tracing):

A. Select "Tools" from the menu bar. Click "Breath" (This will activate the "flow" trace.)
B. Use the right arrow key to move the blue cursors consecutively from one breath to the next.  Valid breaths will have a rather smooth, sinusoidal appearance with inspiration up and expiration down.
   1) If an invalid breath is counted, hit the "Delete" button on the right hand side of the screen.
   2) If a valid breath is not counted, hit the "Insert" button on the right side of the screen.

5.42    Checking the EKG (green tracing):

A. The "Computed HR" trace needs to be retrieved as one of the six channels shown on the screen. It will replace the PO2 channel.
   1)     Click the PO2 button on the left side of the screen.
   2)     Select "View" from the menu bar, then hit "Trace Properties". Using the drag-down menu, choose the "Computed HR" channel.

B. Choose "Tools" from the menu bar, then click "BP/ECG". Use "Shift" "Page Up"/"Page Down" to move the purple bars up or down in order to put them in line with the ECG trace (the purple bars should intersect the ECG trace). Anytime that a purple bar is significantly out of synch with the others (either too high or too low) is an indication that something *may* be wrong. In that case, move the blue cursor to the location of the disjointed bar (using the arrow keys) to determine whether a heartbeat was skipped or if a single heartbeat was counted twice.

    1) If a heartbeat was skipped, hit the "Insert" button on the right hand side of the screen.

    2) If a heartbeat was counted twice, hit the "Delete" button on the right hand side of the screen.

5.43 Checking Velocity (blue tracing):

A. Select "Tools" from the menu bar, then choose "Velocity".

B. Scan the velocity waves using the arrow keys. Look for any "messy" readings. This usually takes the form of vertical upward or downward spikes that distort the systolic or diastolic readings for that beat.

C. Hit the "Skip" button on the right hand side of the screen to deal with any messy waves. (Do not hit "Delete".) Make sure the word "skip" appears in the upper right hand corner of the screen after the entry "Beat #".

**5.5 Creating text files that contain output reports**

A. Select "Report" from the menu bar. Click "All". This will create three new text files (containing data) to be used in Excel:

    1) A022312MAR4_D2_Ecg

    2) A022312MAR4_D2_Respiratory

    3) A022312MAR4_D2_Velocity

B. Repeat steps 3 and 5-8 using the .d3 and .d4 files. The three new resulting files for each will incorporate the characters "D3" and "D4" into their file names (e.g. A022312MAR4_D3_Ecg).

**5.6 Analyzing the data in Excel**

5.61 Analyzing ECG.

A. Open the file "_D2_ECG" in Excel. (This is in the format of a text file. Select "File" from the menu bar and choose "Open". Go to "File of type" at the bottom of the pop-up window and hit the drag-down menu, then click "Text Files".) Click "Finish" when the "Text Import Wizard" pops up. (The file will later need to be saved as an Excel file.)

B. Locate column E (Heart Rate). Make sure that the number in the first row of this column is reasonably similar to the others. If it isn't, delete it.

C. Locate column J (Velocity). Make sure that the last number in this column is reasonably similar to the others. If it isn't, delete it.

D. Highlight column J by clicking the "J" above the spreadsheet.

E. Click the "Chart Wizard" on the tool bar at the top of the screen. Select the X-Y scatter plot option. Click "Next", then click "Cancel".

F.  Make sure the last 60 seconds of the plot is steady-state (has no obvious deviations). If it does, locate them in the column and delete them.
G.  Enter the word "mean" in column A at the bottom of the spreadsheet.
H.  Place the cursor at the bottom of column J. Click the "Function" icon on the toolbar, then click "Average" in the right-hand pop-up window. Enter the range of the column (e.g. J2:J221) in the next window which pops up. Repeat this procedure for the last 60 seconds of data (seconds are in Column C).
I.  Save the file as an Excel file using the "Save as type" drag-down menu.

5.62  Analyzing Respiration

A.  Open the file "_D2_Respiratory".
B.  Repeat steps C to H above, using columns H, Q, S, V and W. Check the last number in each of these columns to make sure they are reasonably commensurate with those above them. If they are not, delete them.
C.  Save the file as an Excel file.

5.63  Creating a Summary File
A.  Open a new Excel file in the subject's folder and name it (*********Summary).
B.  Create 2 worksheets in this file called "VTI&VE" and "MAP&HR" by copying data from the appropriate files (see examples below).

| Filename | Condition | PETCO2 (mmHg) | VTI (cm/sec) | VTI (% baseline) | VE (l/min) |
|---|---|---|---|---|---|
| .d2 | Normoxic baseline | 41.0 | 42.8 |  | 6.3 |
| .d3 | Hyperoxic baseline | 39.4 | 38.4 | 100 | 7.3 |
| .d4 | Plus 5 | 44.8 | 44.6 | 116 | 10.6 |
| .d5 | Plus 10 | 49.5 | 47.2 | 124 | 15.3 |

| File-name | Condition | PETCO2 (mmHg) | SP (mmHg) | DP (mmHg) | HR (b/min) | MAP (mmHg) |
|---|---|---|---|---|---|---|
| .d2 | Normoxic baseline | 41.0 | 41.0 | 115 | 43 | 84 |
| .d3 | Hyperoxic baseline | 39.4 | 39.4 | 122 | 42 | 82 |
| .d4 | Plus 5 | 44.8 | 44.8 | 128 | 44 | 88 |
| .d5 | Plus 10 | 49.5 | 49.5 | 129 | 46 | 91 |

C.  Using plot PETCO2 vs. all of these variables (one at a time) and determine the slopes of the relationships by plotting the linear trendline on each graph.

**5.7  General procedures for navigating EAP**

A.  To switch traces on the display, highlight the one you want to switch and hit Alt C.
B.  To change gain of a tracing: increase by highlighting the trace and hitting Ctrl-up arrow; decrease by hiting Ctrl-down arrow

C.  To change the screen position of a tracing, raise by highlighting the trace and hitting Ctrl-Page Up; lower by hitting Ctrl-Page Down

D.  To change the timebase of screen, increase by hitting Shift *; decrease by hitting the divide key (/)

E.  To shift the segment of data displayed: reposition the beginning of screen farther "down" in the record by positioning the bright cursor where you would like the screen to begin and hitting Ctrl-Page Down; reposition the end of the screen farther "up" in the record by positioning the bright cursor where you would like the screen to end and hitting Ctrl-Page Up

F.  To switch between the "bright" and "dim" cursors, hit space bar

## 5.8  Reporting data to database manager

The following values are to be reported for each study:
1. Cerebrovascular $CO_2$ reactivity (cm/sec/mmHg)
2. Cerebrovascular $CO_2$ reactivity (%/mmHg)
3. Hypercapnic ventilatory response (l/min/mmHg)
4. Mean arterial pressure at each level of $CO_2$
5. Heart rate at each level of $CO_2$
6. Baseline PETCO2
7. Baseline ventilation

The Excel files (*e.g.* A022312MAR4Summary" are to be emailed to the database manager in batches of how many?

## 6.  QUALITY CONTROL

Quality of the Doppler and the $PETCO_2$ signals for <u>all subjects</u> will be monitored during the first month of data collection by James Skatrud, MD.  A telephone call will be used to detail problems and suggest improvements.  Thereafter, a small random sample of studies will be selected during each month of data collection.

## 7.  COMMUNICATION CHANNELS

It is vital for effective exchange of questions and information that channels of communication be established. Following is a list of names addresses, and telephone numbers of all staff involved in the Cerebral Blood Flow Protocol, a sub-protocol of "SDB, Metabolic Syndrome and Vascular Function" (F.J. Nieto, Principal Investigator).

James Skatrud, MD
Room B-5056 VA Hospital
256-1901 ext. 11080

Barb Morgan, PhD
Room 5110 Medical Sciences Center
262-0013

Nick Puleo

Room B-3049 VA Hospital
256-1902 ext. 17547

Kathyrn Pluff
Room 103 502 N. Walnut
265-3045/263-0118

Stacey Brickson, PhD

## 8. ADDRESSES FOR SUPPLY ORDERING

Kathryn Pluff will be responsible for ordering the following supplies:

Hamilton Medical (single-use flow sensor model 53120)
TEL: 800 426-6331
FAX: 775-856-5621

Collins Medical Division of Ferraris Cardiorespiratory (mouthpiece stock #022255)
908 Main Street
Louisville, CO 80027
TEL: 800-574-7374
FAX: 800-574-7373

UW Hospital Central Supply: ECG electrodes, ultrasound gel, tissues, gauze pads (2x2 and 4x4), and alcohol swabs.

UW Respiratory Services: nose clips, blue ventilator tubing, t-piece connector, Huma-vent filters, 22x15mm connector, 15mm connector.

UW MDS: CD-R disks for data archiving.

## SDB and the Metabolic Syndrome
## Cerebral Blood Flow Protocol
## Subject Data Sheet and Protocol Checklist

Cohort ID _____ Computer Filename: _____

Date: _____ Time of Day: _____

Time since last meal: _____ Last cigarette: _____

Time since last caffeinated beverage: _____ Barometric pressure: _____

Before subject arrives:

- ❑   Turn on power to instrument rack, Dinamap

- ❑   Determine barometric pressure and record on data sheet

- ❑   Set up breathing circuit

- ❑   Set up computer, paper recorder and video recorder for data acquisition

- ❑   calibrate flow, $CO_2$, $O_2$, Doppler

- ❑   check position head of bed (30 degrees)

- ❑   change bed linens if necessary

Preliminary procedures:

- ❑   explain procedures; answer questions

- ❑   record time of day, time since last meal, cigarette, caffeinated beverage, meds (if any) on

    subject data sheet

- ❑   physical exam

- ❑   bathroom break (prn)

Subject instrumentation:

- ❑   ECG electrodes

- ❑   find optimal Doppler signal; place headgear

- ❑ move to bed

- ❑ apply blood pressure cuff

- ❑ go on mouthpiece

- ❑ apply noseclip

- ❑ optimize Doppler signal; depth _____, Power ____, Gate ____, mean velocity (~) _____

Protocol:

- ❑ familiarization period of normoxic eupnea (watch for stabilization of $PETCO_2$)

- ❑ Begin supplemental oxygen ($FIO_2$=0.40).

- ❑ Baseline data collection (at least 5 min of stable breathing)

- ❑ Make note of baseline $PETCO_2$ level and mark on paper record

- ❑ Record baseline HR _____ bpm and BP _____ mmHg.

- ❑ Increase PETCO2 to +5 mmHg over baseline; obtain 4 minutes of data at this level

- ❑ Increase PETCO2 to +10 mmHg over baseline; obtain 4 minutes of data at this level

Recovery procedures:

- ❑ Continue data recording until cerebral flow velocity returns to baseline

- ❑ Remove mouthpiece and nose clip

- ❑ Remove Doppler probe

- ❑ Continue to monitor ECG (continuously) and blood pressure (at 1-minute intervals) until HR and BP return to baseline values

- ❑ Discontinue ECG and blood pressure monitoring

Format of excel spreadsheets to be sent to database manager in batches:

| | |
|---|---|
| Cohort ID | |
| Study Date | |
| CCRabsolute | |
| CCRpercent | |
| HCVR | |
| PETCO2base | |
| VEbase | |
| MAPbase | |
| MAPplus5 | |
| MAPplus10 | |
| HRbase | |
| HRplus5 | |
| HRplus10 | |

Analyzed by: _____     Date: _____

# Medical History Form

Name_____     Age_____

## Recent Medical History

Have any of the symptoms below <u>newly developed during the past week,</u>
OR if you have had any of the symptoms before, have they <u>gotten worse over the past week</u>?

|  | Yes | No |
|---|---|---|
| **Eyes:** | | |
| Loss of vision | ___ | ___ |
| Double vision | ___ | ___ |
| **Respiratory:** | | |
| Shortness of breath | ___ | ___ |
| **Cardiac:** | | |
| Chest pain | ___ | ___ |
| Irregular heart beat | ___ | ___ |
| **Neurologic:** | | |
| Paralysis | ___ | ___ |
| Slurred speech | ___ | ___ |
| Seizures | ___ | ___ |
| Loss of consciousness | ___ | ___ |
| Lightheadedness | ___ | ___ |

## Do you have a personal history of any of the following?

| | No | Yes, but IS NOT A current serious Health problem | Yes, this IS a current serious health problem (please describe) |
|---|---|---|---|
| Lung disease | ___ | ___ | ___ |
| Asthma | ___ | ___ | ___ |
| Heart disease | ___ | ___ | ___ |
| Hypertension | ___ | ___ | ___ |
| Stroke | ___ | ___ | ___ |
| Diabetes | ___ | ___ | ___ |
| Kidney disease | ___ | ___ | ___ |
| Gastrointestinal condition | ___ | ___ | ___ |

# Physical Exam Form

**Name:**

**Age:**

**Vital Signs:** BP: _____    HR _____ (regular ____ irregular _____)    RR _____

**Constitutional:** Comfortable without acute distress:  Yes ____ No ____

**Cardiovascular:**

    Murmur:       Yes ___ No ___

    Carotid bruit:  Yes ___ No ___

**Respiratory:**

    Wheeze:       Yes ___ No ___

    Crackles:      Yes ___ No ___

    Breath sounds: Normal ___ Decreased ___

**Electrocardiogram:** No acute changes ___

**Physician Comments:**

Appropriate for study: Yes ___ No ___

_____          _____

Physician Reviewer                              Date