BWH Monitoring Practices

James H. Philip, M.E.(E.), M.D., C.C.E.
Anesthesiologist and
Director of Bioengineering, Brigham and Women's Hospital
Medical Liaison, Partners Department of Biomedical Engineering
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Gas Man and Med Man Simulations, Inc. are a nonprofit Charitable Organization.
I have performed research on many of the drugs and devices described.
Through the BWH Ventures Office, I have a financial interest in some of the products described.
This lecture can be found at: www.bwhanesthesia.org - Education tab - Anesthesia Technology
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Please mentally substitute “Nurse Anesthetist” for “Anesthesiologist” if this applies to you
Part 1 - Monitoring Principles

See full lecture for details
Same intranet site as this
Title:
Monitoring Principles Slides
Anesthesia = "without sensation"

By loss of sensation, anesthesia allows the patient's brain to tolerate pain that the body was not designed to survive
General Anesthesia

Requires continuous resuscitation during the ongoing administration of lethal drugs
General Anesthesia

Requires continuous resuscitation during the ongoing administration of lethal drugs

Every drug I administer is dangerous

Therapy I provide is life-preserving
Monitoring Goal

Protect the patient against adverse outcomes
The Acute Patient Care Loop describes the anesthesiologist’s actions.

clinical management

Patient → Anesthesiologist → Monitor → Patient

measurements → interpretation

In the distant past

We monitored our patients using only our senses
A finger on the pulse
A hand on the reservoir bag
Listening to sounds through a stethoscope.
Observing color of skin and lips
In the 1960s

We began to monitor the cardiovascular system
We measured it in many ways

We believed that detecting cardiac arrest fast was important
I was an HP (Hewlett Packard) Engineer back then
We really did work hard to detect a stopped heart

We did not yet realize that under anesthesia cardiac arrest is almost always the result of lack of ventilation or lack of oxygen

For a long time without detection
In the 1970s we learned
Most anesthesia mishaps are due to human error
Equipment contributes little to the problem
Better designed equipment can detect errors
Vigilance aids can improve outcome by detecting problems before they occur
This applies especially to airway problems

Cooper JB. Critical Incident Studies (Anesthesiology) 1976-1990. (Harvard Data)
The greatest danger was circuit disconnection
Which we could easily miss with the technology we had, then
Especially at times of decreased vigilance.
In the early 1980s patients learned Anesthesia is dangerous 1,000 times more dangerous than in an airplane 30,000 feet in the air.

ABC Television 20/20 Report, 1982
In the 1980s we learned

Two monitors could make a difference

Capnography (airway CO2) detects many problems early

Pulse oximetry detects most problems, but does so late

Standards could improve outcome

1985 Harvard Anesthesia Monitoring Standard

1) **Continuous presence** of a dedicated anesthesia care provider
2) Blood pressure and heart rate **CV measured & recorded** at least every **five minutes**
3) Electrocardiogram **ECG continuously displayed**
4) Circulation **continuously monitored** - any technique
5) Ventilation **continuously monitored** - any technique
6) **Disconnect**-detecting device used during mechanical ventilation
7) **Oxygen** in the breathing circuit **monitored with alarm**
8) Temperature monitoring capability
Standards for Patient Monitoring During Anesthesia at Harvard Medical School

John H. Eichhorn, MD; Jeffrey B. Cooper, PhD; David J. Cullen, MD; Ward R. Maier, MD; James H. Philip, MD; Robert G. Seeman, MD
Standards for Patient Monitoring During Anesthesia at Harvard Medical School

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Anesthesia Safety Saving Lives

Nine doctors hope others will adopt standards
By Judy Foreman
Globe Staff

As many as 1400 anesthesia deaths could be avoided each year if doctors nationwide abided by minimal but strict safety standards, says a team of nine Harvard doctors in a new report.
Boston Globe front page headline could have read

Sloppy docs mop shop
or
Killer docs - cleaning up their act too little and too late

We were fortunate.
The press was supportive
1986 ASA Monitoring Standard

Extended the Harvard Monitoring Standard

Encouraged the use of
Pulse Oximetry
Capnography
Airway gas flow or volume
1989 Amendment to ASA Mon. Std.

**Required** pulse oximetry to assess blood oxygenation during general anesthesia.
1990 Amendment to ASA Mon. Std.

Required CO2 measurement to verify correct placement of the tracheal tube.

Encouraged use of CO2 monitoring throughout case.

http://www.asahq.org/publicationsAndServices/sgstoc.htm or
http://www.asahq.org/publicationsAndServices/standards/02.pdf
Most authorities believe

Anesthesia mortality has fallen from 1/3,000 in 1985 to 1/30,000 or 1/300,000 in 1996

ICPAMM Report, 1996
(Intl Comm Peri-op Anes M&M)
Most authorities believe

Anesthesia mortality has fallen from 1/3,000 in 1985 to 1/30,000 or 1/300,000 in 1996.

\[ \frac{1}{295,118} = 6 \sigma \]
Most authorities believe Anesthesia mortality has fallen from 1/3,000 in 1985 to 1/30,000 or 1/300,000 in 1996. 
\[
\frac{1}{295,118} = 6 \sigma
\]
Anesthesia is a Six Sigma Specialty™
Anesthesia insurance rates fell and remained stable.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>$20,000</td>
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</tr>
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### Anesthesia insurance rates

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Why? The rates fell and remained stable.
Anesthesia insurance rates fell and remained stable:

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Why? We stopped hurting people!
Most anesthesia injury & death today is caused by

Failed airway management
Other complex events
Many require additional resources
Including
  Equipment, supplies, help, consults
  LMA (laryngeal mask airway)
  Special intubating scopes & devices
Surgical Airway
Again, **Most anesthesia injury & death today** is caused by

Failed airway management
Other complex events
Airway and CV complications may occur with regional anesthesia
High Spinal or High Epidural block
Intravascular Injection
**Unconscious** sedation
Part 2
BWH Monitoring Practices
Monitoring Practice

Cardiovascular Monitor
Gas Monitor ($F_iO_2$, $p_{ET}CO_2$, Anes gases)
Ventilation Monitor
Neuromuscular with paralytic drugs
Brain Monitor, when indicated
Specialty-specific monitors

GE Solar 8000
ADS* or Solar SAM
ADS* Flow, Vol, Pressure
blockade
NMB Monitor
BIS
Cerebral $O_2$, EEP

*ADS = Anesthesia Delivery System = Anesthesia Machine + Breathing Circuit
Physiologic Monitor

GE brand is standard throughout Hospital General Electric
Solar and Dash are the models (OR, ICU, Floors)
Generally OK
Occasionally problematic
Beware of Alarm Silence / Pause
Publicized MGH Death January 2010
Not in OR
Alarms were turned off
Alarm Silence / Pause - OR Mode

SILENCE ALARM key functions as follows

Press x 1 = 5 minute pause
Press x 2 = 15 minute pause
Press x 3 = permanent pause
Press x 4 = alarms on, again
Select New Case Setup for each case

Avoid incorrect alarms, intervals, filters, etc.
Select New Case Setup for each case to avoid incorrect alarms, intervals, filters, etc.

This is yesterday’s case and monitor has not been reset to New Case.
More menus
New Case Setup
5 Leads
RA, LA, LL for I, II, III
RL as reference lead
V5 as lateral V lead

ECG
ECG for PACU

5 Leads
RA, LA, LL for I, II, III
RL as reference lead
V5 as lateral V lead
LEADS DISCONNECTED means, in this order

- Right Leg Lead is disconnected from pad
- Right Leg pad disconnected from skin after moving patient
  or
- Cable to wires Block is disconnected
- Cable is disconnected from monitor
- Two leads are disconnected somewhere

Right Leg will no longer be special when we change from TRAM Brick to PDM (hourglass shape Patient Data Module) in next few weeks
Noninvasive Blood Pressure NIBP, NBP

Don’t use Go/Stop quick key to start monitoring - measures once and only once!
Set interval as desired, 1 min, 2 min, 2.5 min, 5 min
Use STAT to measure BP q 20 sec for 5 minutes then monitor reverts to your set interval
Trim Knob and Quick Keys
NIBP Go/Stop
Never press Go/Stop to begin monitoring

One BP only, then Stop
or, Stop current measurement
STAT mode gets NIBP fast

Invoke Stat mode
NIBP as fast as it can
Typically every 20 seconds
After 5 minutes reverts
to previous Auto Interval

Use at times of observed or expected change
STAT Mode button
STAT mode NIBPs
STAT NIBP helps understanding
View Tabular with one Quick Key
Observe data as tables, trends using screen and buttons
Select patient parameters for graphs

Not an easy task
Select patient parameters for graphs - press:

More menus
Patient Data
Graphic Trends
Select Parameters
Unselect unwanted Parameters
Unselect most
Unselect HR
Unselect SpO2
Select CO2, O2, Agent (after turned on)
Change Time Period
Select Time Period 6 minutes
Beautiful gas trends
What a pain!
More menus
Graphic Trends
Select Parameters
Unselect unwanted Parameters
Unselect most
Unselect HR
Unselect SpO2
Select CO2, O2, Agent (after agent is turned on)
Change Time Period
Select Time Period 6 minutes
Beautiful gas trends - 6 minutes tells all
Beautiful gas trends - 6 minutes tells all
We just selected graphic trend of gases for 6 minutes

More menus
Patient Data
Graphic Trends
Select Parameters
Unselect unwanted Parameters
Unselect most
Unselect HR
Unselect SpO2
Select CO2, O2, Agent (after turned on)
Change Time Period
Select Time Period 6 minutes
Beautiful gas trends
Make other adjustments that are easier
SpO2 Averaging Time
SpO2 selected
Average 8 sec
Change Averaging Time
Change Averaging time to 2 sec
SpO2 Averaging Time is now 2 seconds
Tabular Trends with one Quick Key.
# Tabular Trends

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>HR</th>
<th>NBP-S</th>
<th>NBP-D</th>
<th>NBP-M</th>
<th>NBP-R</th>
<th>SP02-%</th>
<th>SP02-R</th>
<th>TP1-1</th>
<th>TP1-2</th>
<th>ST-I</th>
<th>ST-II</th>
<th>ST-III</th>
<th>ST-V5</th>
<th>ST-AVR</th>
<th>Alarm</th>
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<tbody>
<tr>
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<td>82</td>
<td>82</td>
<td>88</td>
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<tr>
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<td>57</td>
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**Notes:**
- **HR:** Heart Rate
- **NBP-S, NBP-D, NBP-M, NBP-R:** Blood Pressure
- **SP02-%, SP02-R:** Oxygen Saturation
- **TP1-1, TP1-2:** Electrocardiogram (ECG) Traces
- **Alarm:** Indicators for abnormal values

**Buttons:**
- View Older
- View Newer
- Time Interval 5 Mins
- Specific Time
- Sort Data: All Data
- Display Older Data

**Monitoring Parameters:**
- **ECG:** Electrocardiogram
- **CO2:** Carbon Dioxide
- **N2O:** Nitrous Oxide
- **Sev.:** Sedation Level
- **Rate:** Heart Rate
- **Sensor:** Monitoring Sensor
- **Temp.:** Temperature
Quick keys between Wave, Graph, Tabular

“Wave” is Main Menu
Gas Display

Has trouble differentiating Isoflurane from Desflurane.
Both have similar Infrared Absorption.
User must choose between them.
Isoflurane is the default between these two.
Gas Display Iso
Select Des if you will use it and not Iso

Des has been targeted for decreased use
Choose between Iso & Des
Trim Knob and Quick Keys to Choose Gas
Don’t adjust ECG Filter unless you know about it
ECG Filter can be set

Filter window opens
Here, I changed ECG Filter mid-screen
GE Idiosyncrasies

Sevo MAC and MAC Fraction are wrong
MAC = 1.7% but should be 2.1%
After 96 NIBPs, the 97th throws away the first
NIBP cannot be displayed on 6 minute trend graph

Web lecture shows these in pictures
Learn More - Anes Department Web Site

http://bwhanesthesia.org and click Education Anesthesia Technology
Thank you

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