The Lost Art of Techniques

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AEC Technique Strategy
or
“The Phototimer Technique Game”

- Best way to learn bucky/mobile techniques
- Start by looking at readout after exposures and then go back and look at patient again
- Now truly play the “Technique Game”
  - Not allowed to make the AEC exposure until you have said what technique would be
  - Make the exposure and see if you were correct

AEC Does Not Know What You Want

- Just takes in radiation and averages out between all cells that are turned on
- When 1 mR (or less) is reached, the exposure is terminated

What Cells To Use

- PA chest – both outer cells (except CHOMP)
- Lateral chest – center cell
Other Views

- Abdomen – 2 outer cells
- BE – all 3 cells
- AP stomach – top right and center cell (unless your patient is PA)
What will happen if you don’t center the AEC cells

- A perfect example is a badly positioned AP lower rib view centered too high.

So what do you do when you’re using the AEC and you’re not able to center over the thinnest or thickest part?

- A perfect example of this is centering for a proximal femur using a 14 x 17 on a patient with a large belly.

Or what do you do when you are once again using the AEC and know the exposure is going to come out having used too much mAs?

- An example of this is putting a small child up against the upright bucky for a PA chest but the patient does not cover the two outer cells.
This will force you to use the center cell, causing an over exposure.

On all three of these examples what should the tech have done?

**Plus and minus density buttons**

- Need to learn how all different control panels have the + and – densities set up.
- All x-ray equipment vendors have historically given you 100% darker (100% more mAs) and 50% lighter (1/2 the mAs).
The art of using these buttons

- This is how you communicate with your AEC.
- In the digital world the minus buttons would be used to cut the dose (if one of the 3 previous examples are going to happen or your AEC is not set up perfectly to give the minimum DEI exposure or you know that).

Letting The AEC Do Everything For You

- Some control panels have all the buttons with body parts on them
- Much better to totally set the AEC up yourself (or at least know how to)
  - Set the kV, which photo cells, large or small focal size and if any + or – density is needed
- Remember that the control panel does not have a button to tell it if your patient is young or old

Terminology

- When increasing technique:
  - 25% more = up ¼
  - 50% more = up ½
  - 100% more = doubled
  - 200% more = tripled
  - 300% more = quadrupled

Terminology – Continued...

- When decreasing technique:
  - 25% less = cut a ¼ (not ÷ a ¼)
  - 50% less = cut in ½
  - 100% less = zero (impossible)

Another Way Of Looking At It

- 50% darker is the opposite of 25% lighter
- 100% darker is the opposite of 50% lighter

You Can’t Always Get What You Want

- Occurs generally with portable abdomens
- Analogue Ports have a build in 100 mA station.
  - 320 mAs takes 3.2 seconds
  - 50 mAs takes ½ a second
- Portable has no control of time
  - Since the portable has a built in 100 mA station, you’re really just pushing a timer button
  - Now you have to seriously worry about motion
  - Only thing left to do is to go out of the optimum kV range
What Is Optimum kVp?

- Optimum means the best!
- **Every repeat** caused from a technique or AEC problem is a mAs problem.
  - It’s *never* the kVp, it’s *always* the mAs.

Changing techniques

- mAs is directly proportional to itself.
- If you have 20 mAs and you want to make the density twice as dark (or S# from 200 to 100 or LgM from 1.8 to 2.1), you just double 20 to 40.
- If you want to make the next exposure 50% darker (S# 200 to 150, LgM 1.8 to 1.95), you just add ½ of 20 (which is 10), which will give you 30.
- If you want to make the next exposure 25% darker (S# 200 to 175, LgM 1.8 to 1.88), you just add ¼ of 20 (which is 5), which will give you 25.

kVp Is Indirectly Proportional

- Necessary to figure out 15%
  - For example: 70 kV is the same as 70.0
  - If you move the decimal over one you get:
    - 7.0 kV = 10%
    - 3.5 kV = 5%
    - 10.5 kV = 15%

kVp/15%/What 1 kVp is Worth chart. These figures work most efficiently between 60-90 kVp

<table>
<thead>
<tr>
<th>kV</th>
<th>15%</th>
<th>1 kVp =</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>7.5</td>
<td>13.30%</td>
</tr>
<tr>
<td>60</td>
<td>9</td>
<td>11.10%</td>
</tr>
<tr>
<td>70</td>
<td>10.5</td>
<td>9.50%</td>
</tr>
<tr>
<td>80</td>
<td>12</td>
<td>8.30%</td>
</tr>
<tr>
<td>90</td>
<td>13.5</td>
<td>7.40%</td>
</tr>
<tr>
<td>100</td>
<td>15</td>
<td>6.60%</td>
</tr>
<tr>
<td>110</td>
<td>16.5</td>
<td>6.00%</td>
</tr>
<tr>
<td>120</td>
<td>18</td>
<td>5.50%</td>
</tr>
</tbody>
</table>

The (infamous) 15% Rule

- The Rule states that if you want to double the density with film-screen or double the DE number with DR or CR, you need to add 15% more kV.

How the 15% Rule is generally used

- The 15% Rule is usually used in conjunction with mAs.
- If you want to keep the same density with film-screen or the **same DE number** with DR or CR, you need to add 15% more kVp and cut your mAs in half.
- Adding 15% more kV doubles the technique while cutting the mAs in half takes the technique right back where it started.
The not so famous (Bowman’s) 7½% Rule

- Instead of using the 15% Rule the “full” way you can always use half of each.
- 74 kV @ 20 mAs
- 85 kV @ 10 mAs \(\rightarrow\) 15% Rule
- 80 kV @ 15 mAs \(\rightarrow\) 7½% Rule
- It works every time and will give you the same DE number every time.

Reasons (and how) to use the 15% Rule

- Portable abdomen on a large patient who is unable to follow breathing instructions (or a young woman and you are trying save dose).
- 80 kV @ 60 mAs \(\rightarrow\)
- 92 kV @ 30 mAs
- 106 kV @ 15 mAs or 99 kV @ 7.5 mAs

Portable Small Bowel story...
- 75 kV @ 80 mAs
- 86 kV @ 40 mAs
- 99 kV @ 20 mAs
- 114 kV @ 10 mAs or 106 kV @ 15 mAs
- 131 kV @ 5 mAs or 122 kV @ 7.5 mAs

Steps

- The next click up or down in mAs is also called a “step.”
- This was because we went up one step in time on the old control panels.
- If you go up 3 steps that generally will increase your technique 100% (double).
Some Of The Different mAs & kV Choices

<table>
<thead>
<tr>
<th>mAs</th>
<th>kV</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>60</td>
<td>22.2%</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>63</td>
<td>21.60%</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>64</td>
<td>20.95%</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>66</td>
<td>20.30%</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>68</td>
<td>19.65%</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>70</td>
<td>19.00%</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>72</td>
<td>18.50%</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>74</td>
<td>18.00%</td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>76</td>
<td>17.55%</td>
<td></td>
</tr>
<tr>
<td>9.0</td>
<td>80</td>
<td>17.10%</td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>80</td>
<td>16.65%</td>
<td></td>
</tr>
<tr>
<td>12.0</td>
<td>85</td>
<td>16.20%</td>
<td></td>
</tr>
<tr>
<td>16.0</td>
<td>90</td>
<td>15.85%</td>
<td></td>
</tr>
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</table>

New Steps

<table>
<thead>
<tr>
<th>mAs</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>2.8</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>3.6</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>14%</td>
<td></td>
</tr>
</tbody>
</table>

What Kind Of Math Did It Take To Get Those Percentages?

Here is an example for figuring out the mAs:
- **2.0 → 2.5**
  - Starting at 2.0, if you added another 2.0 you would now be 100% more exposure
  - The difference between 2.0 and 2.5 is .5
  - .5 goes into 2.0 four times or it’s 1/4th
  - Divide 100% by 4 and you get 25%

Let’s Do One More....

- **10 → 12**
  - Starting at 10, if you added another 10 you would be 100% more exposure
  - The difference between 10 and 12 is 2
  - 2 goes into 10 five times so it’s 1/5th
  - Divide 100% by 5 and you get 20%

Math continued....

Here’s an example to figure out the kVp:

- **We will start with 70 kV → 72 kV.**
- **If you look at the previous “15% - What 1 kVp is Worth” chart you’ll see that at 70 kV, 1 kV is worth 9.5%**.
- **Since we went up 2 kV you just do 9.5% times 2.**
- **This gives you 19%**.

Differences In PCXR Techniques

<table>
<thead>
<tr>
<th>kV @ mAs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>1.0 mAs — 50% lighter</td>
</tr>
<tr>
<td>80</td>
<td>1.5 mAs — 25% lighter</td>
</tr>
<tr>
<td>80</td>
<td>2.0 mAs — 0</td>
</tr>
<tr>
<td>85</td>
<td>2.5 mAs — 25% darker</td>
</tr>
<tr>
<td>85</td>
<td>3.0 mAs — 42.5% darker</td>
</tr>
<tr>
<td>85</td>
<td>3.2 mAs — 60% darker</td>
</tr>
<tr>
<td>85</td>
<td>2.5 mAs — 67.5% darker</td>
</tr>
<tr>
<td>85</td>
<td>4.0 mAs — 100% darker</td>
</tr>
<tr>
<td>85</td>
<td>3.2 mAs — 102.5% darker</td>
</tr>
<tr>
<td>85</td>
<td>4.0 mAs — 142.5% darker</td>
</tr>
</tbody>
</table>
I Left One Technique Off The Chart

- Let’s add on one more technique.
- Where would 80 kVp @ 5 mAs go?
- It would go at the very bottom.
- Since the kVp stayed at 80 there is no change there
- The mAs went from 2 to 5 which increases the density 150%

Technique-ing A Repeat

- If a image was phototimed and it needs to be repeated because of Dose Exposure number issues or it has mottle, the repeat should be manually technique.
- Since you now have the technique readout from the original mistake, it’s just a matter of correctly ascertaining the new mAs, keeping the kV the same.
- Doing this actually makes repeating for technical reasons exciting.

Believe The DE numbers, Not The Technical Factor numbers!

- Here’s an example of what I’ve seen way too many times...
- A tech shoots an extra large patient’s cross table L-spine (swimmers, x-table lateral hip).
  - They use 90 kVp @ 180 mAs and it’s way very mottley.
  - Viewing the image you figure out from the DE number that the repeat will need to double and is half the mAs.
  - The tech meanwhile just thinks “Wow, 180 mAs was grainy but this time I’m going to use 300 mAs!!”
- Even though that sounds like a big technique (and generally it is), for this patient you should be using 450 mAs.

Your Personal Technique/Positioning Book

- The best are the small 3” x 5” binders with removable paper and abc’s.
- The big 5:
  - Size of patient
    - sm +     med - lg +
  - Male / female
  - Muscular / fat
  - Distance
  - Kind of IR (screen, detail, CR, DR, grid or bucky)
- It’s always good to know how to technique your own body.

More About Your Book

- Each body part needs to have its own page.
- Even though this will make your book thicker, it’s all about getting to the information quickly and efficiently.
- Front of page will be all your techniques.
- Back side of page can be the positioning routines and criteria.
Extra’s – Good Things To Know

- KUB = Pelvis (but hips will be over exposed)
- Knee = Shoulder (unless shoulder is muscular)
- Toes = Fingers
- Elbow = Increase mAs 33% more than an ankle
- Hips = Distal Femur = Go down 5 kV and cut mAs in half
- AP Pulmonary = Y View = Increase mAs 2.5 times
- PA, Lat Obset = Increase mAs 2.5-3 times
- AP, Lat Abdomen = Increase mAs 2.5-3 times
- PA, Lat Hand = Increase mAs 2.5-3.5 times
- depending if phalanges or metacarpals are of interest
- AP, Lat Elbow = Decrease mAs in half
- C-Spine = Large tube
- C-Spine AP, OLL, Lat = Same technique if using same distance
- Dry Plaster Cast = Increase mAs 2 time and increase 3 kV
- Wet Plaster Cast = Increase mAs 3 time and increase 3 kV
- Fiberglass Cast Wet or Dry = Increase mAs 33%

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