FULL FAT OR TRIM?

REDUCING RADIATION EXPOSURE OF CT THORACIC ANGIOGRAMS FOR AORTIC DISSECTION IN THE EMERGENCY SETTING: A COMPARISON OF TWO PROTOCOLS

Amy Sevao MBChB

Lucy Modahl MD, PhD

Auckland City Hospital, Auckland, New Zealand

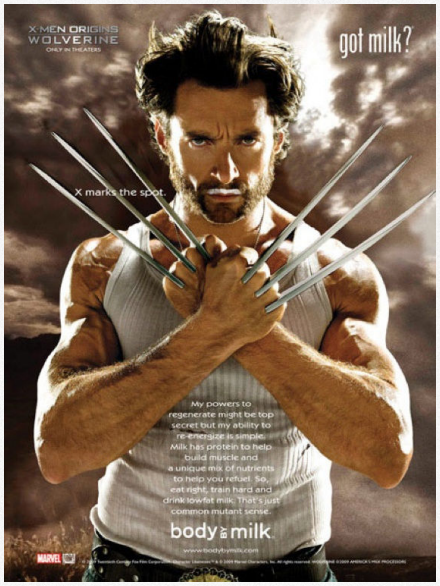
Disclosure of interest

Amy Sevao: nothing to disclose

Lucy Modahl: nothing to disclose

What kind of milk do you drink?

I love milk. So does Wolverine. Milk is a good source of calcium and protein, and having a glass is good common sense.



Wolverine for Body by Milk: http://marvel.com/news/movies/7751/wolverine_rocks_the_milk_mustache | 3

Choices, choices

In today's market, there are many types of milk to choose from.

I want to get the goodness of full fat milk but with less fat.

So I drink trim milk.

It's the same with CT thoracic angiogram (CTA) protocols. There are many to choose from, and we must use the ones that delivers the same benefits with less radiation.

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Aortic dissection: death and calamity

Up to 26% and 58% of those managed surgically and medically die in hospitals.

Survival is dependent on how quickly the patient is diagnosed and treated.

Fortunately, aortic dissection is rare. Only 5 to 27 cases per million people per year is affected.

Fig 1. The classic appearance of a dissection flap

Finding the killer within

CT thoracic angiogram is the modality of choice for initial assessment of suspected aortic dissection.

However, only 2-6% of all CTAs for aortic dissection is positive.

If we use a high dose protocol for every patient with suspected aortic dissection, many will be unnecessarily over-irradiated.

Is there a "trim'" option to detect aortic dissection that minimises radiation exposure?

Fig 2. CTA image demonstrating a Type A dissection

How can we trim the fat from CTA?

To answer this question, our study aims to compare the sensitivity, specificity and radiation exposures between two CTA protocols, one "full fat" and the other "trim", to detect aortic dissection in the emergency setting.

How we did it: methods

Time frame: *1st Jan 2011 – 29th Feb 2012*

Included studies: *312 CTA for aortic dissection performed at Auckland City Hospital*

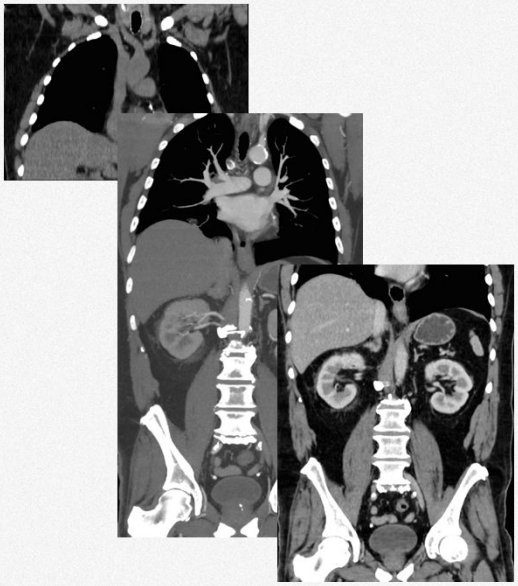
Studies were categorized as either protocol A or B studies.

All studies before May 2012 were performed with protocol A, and all after with protocol B.

Protocol A

Protocol A acquires images over long scan lengths, in multiple phases.

1. *Non-contrast: thyroid cartilage to lung bases*
2. *Arterial phase: thyroid cartilage to lesser trochanters of femurs*
3. *Portal venous phase: lung bases to lesser trochanters.*



Protocol B

Protocol B was devised after an institutional review, with shorter scan length and 2 phases.

1. *Non-contrast: top of aortic arch to aortic root*
2. *Arterial phase: thoracic inlet to immediately below the renal arteries*

Institutional review: Sevao A, Modahl L. CT thoracic angiogram for aortic dissection in the emergency setting: detection rate and radiation exposure. Royal Australia and New Zealand College of Radiologists NZ Branch Annual Scientific Meeting; 2012

Detection of aortic dissection

All studies were interpreted to be positive or negative for aortic dissection according to CTA images, radiology reports and clinical notes.

Other acute aortic disorders were recorded if present.

Sensitivity, specificity, positive predictive value and negative predictive value were calculated.

Radiation dose and workflow differences

To evaluate radiation dose and workflow we recorded:

1. *Dose Length Product*
   - *Which was then converted to effective dose*
2. *Acquisition phases*
   - *Such as non-contrast, arterial, portal venous, delayed, that was used for each study*
3. *Number of PACS images*
   - *To reflect delay between time of image acquisition and availability for interpretation by radiologists*

"In God we trust, all others must bring data": Results

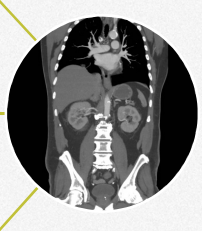
Out of the 281 protocol A studies, 18 were positive for dissection (6.4%), 247 negative (88%) and 16 had other acute aortic disorders.

- 18/281
- 6.4%

AD+

- 247/281
- 88%

AD-



- 16/281
- 4.6%

Other aortic D/O

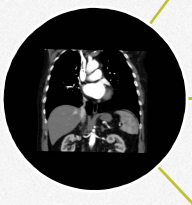
Quote from W Edwards Deming, statistician.

As good as it gets

From the 30 protocol B studies, 1 was positive for dissection (3.3%), 29 negative (96.7%), and none had other acute aortic disorders.

AD+

- 1/30
- 3.3%



AD-

- 29/30
- 96.7%

Other aortic D/O

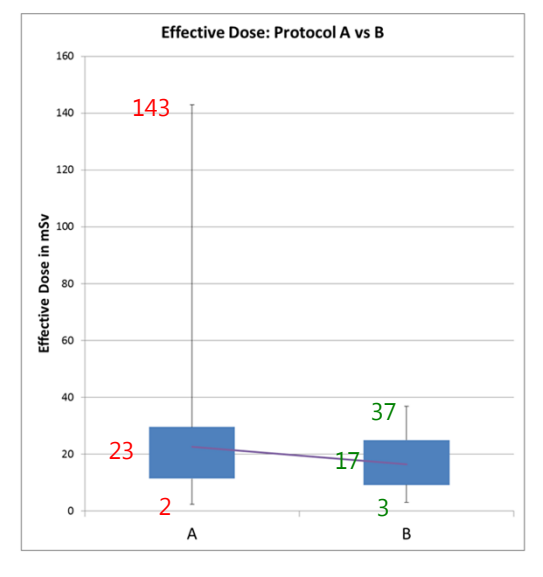
- 0/30

No false-positive or false-negative cases were identified for either protocols, resulting in sensitivity and specificity of 100% respectively.

Radiation differences

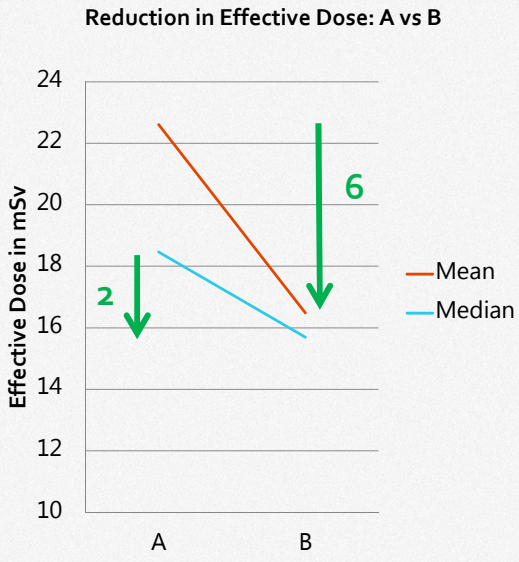
Protocol A:
Mean dose = 23mSv
(median dose 18mSv),
Maximum dose = 143mSv
Minimum dose = 2mSv

Protocol B:
Mean dose = 17mSv
(median dose 16mSv),
Maximum dose = 37mSv
Minimum dose = 3mSv



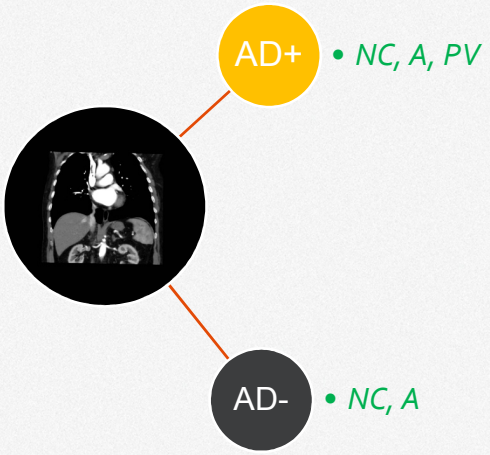
After trimming the fat:

We have reduced the mean radiation dose by 6mSv, and the median radiation dose by 2mSv per patient.



Using the right phases

While the one protocol B study which was positive for aortic dissection included portal venous imaging as well as non-contrast and arterial phases, none of the protocol B studies negative for aortic dissection had portal venous imaging. Which is the way it's supposed to be!



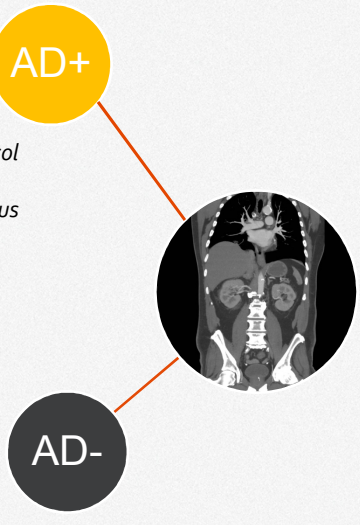
…or not

- *NC, A, PV (5)*
- *NC, A only*

Only 5 out of the 18 protocol A studies positive for dissection had portal venous imaging

Of those negative for dissection, 31 of them had portal venous imaging, and 5 of them had additional delayed imaging, which was not required in either protocols.

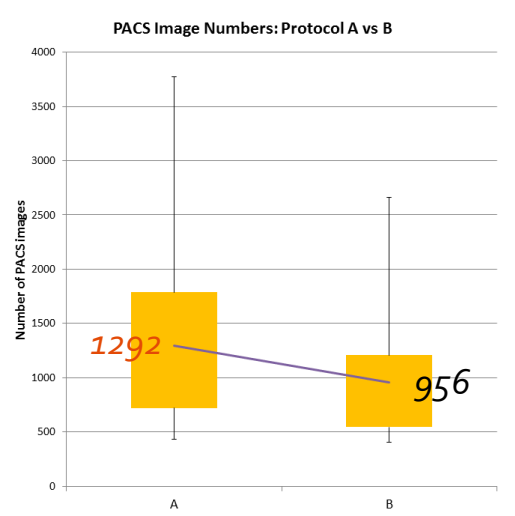
There was one study that only had one non-contrast scan, and another that only had an arterial phase study. These would not have detected either a dissection flap or an intramural haematoma.



Lightening the burden

This graph shows the mean number of images uploaded to PACS for each protocol.

The mean number of images for protocol A is 1292, which dropped to 956 for each protocol B study.



Our Conclusions

The trim protocol, protocol B, reduced radiation dose by 6mSv per patient.

It also improved workflow by streamlining the decision making process. This is shown by the reduced variability in multiphase imaging.

Protocol A was more expansive and complex, which allowed for "tweaking". While customizing an imaging protocol to suit the clinical situation is important, in this case, customization did not improve diagnostic accuracy.

Protocol B significantly decreased the number of images sent to PACS, reduces delay between image acquisition and diagnosis, and lessens the burden placed on the PACS system.

"Hiding within those mounds of data is knowledge that could change the life of a patient, or change the world."

Quote from Atul Butte, Stanford.

Even though it is necessary for these patients to undergo CTA to diagnose possible dissection, it is satisfying to know that as radiologists, we can change our practice to minimize harm for them without compromising diagnostic accuracy.

We believe that our study has successfully demonstrated that trimming the fat from the CTA protocol has improved our services, both for the patient and ourselves.

Thank you for your time.

Please help reduce excessive radiation exposure by choosing a trim CTA protocols for aortic dissection at your department.

Image gently.