

Hybrids and trauma... are they useful and useable?

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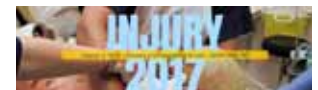


No conflicts of interest to declare

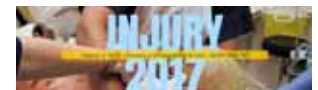


Outline

- Are hybrids useful for trauma?
 - Critical need?
 - Outcomes?
- Are they useable?
 - What works and what doesn't
 - Cost and model of use
- Summary



Hybrid suites...useful?



The bleeding, shocked patient requiring damage control tactics

- Control bleeding
- Control bleeding
- Control bleeding
- Balanced fluid/blood product resuscitation
- Control contamination

In general,

- The operating theatre has been the 'destination' of choice
- It's where 'major bleeding' has always been definitively controlled
- However,

Interventional Radiology

Has been playing an increasing and important role in haemorrhage control



Pryor JP et al. The evolving role of interventional radiology in trauma care. *J Trauma* 2005;59(1):102-4
Zealley et al. The role of interventional radiology in trauma. *Br Med J* 2010

Where to First ?



Resus Room

Operating Theatre



Interventional Radiology



?

Led to consideration for:

- Single venue for haemorrhage control
 - Multi-cavity operating theatre capable
 - Interventional radiology capable
- No location decision required “...should we take patient to OR or IR suite first?”
- ‘Hybrid’ theatre for trauma
...aka ‘RAPTOR’

RAPTOR suite

Resuscitation with

Angiography

Percutaneous

Techniques and

Operative

Repair

THE RAPTOR: RESUSCITATION WITH ANGIOGRAPHY, PERCUTANEOUS TECHNIQUES AND OPERATIVE REPAIR. TRANSFORMING THE DISCIPLINE OF TRAUMA SURGERY

Exsanguination and death are rapid consequences of untreated hemorrhage. At its simplest, successful treatment requires expedient localization

extensive training and experience in both diagnostic and therapeutic angiographic techniques, the emergent arrest of hemorrhage is encompassed within the very definition of "trauma surgeon." Considering that 70% of emergency angiographies occur in "off-hours," with less than 15% performed within 90 minutes of arrival, surgeons trained in emergent percutaneous endovascular

the differences between percutaneous damage control techniques used to arrest ongoing hemorrhage on an emergent basis, versus advanced repairs and stent grafting that should be performed by true content experts on a more delayed and time-friendly basis.

In an ideal scenario, these emergent percutaneous techniques should be performed in the

**The R.A.P.T.O.R. Suite:
Resuscitation With
Angiography,
Percutaneous
Techniques, and
Operative Repair**

To the Editor:

Most preventable deaths from trauma are a consequence of untreated hemorrhage and subsequent early exsanguination. At the most basic level, successful treatment requires expedient diagnosis of the site of bleeding, arresting the hemorrhage, and concurrent resuscitation. With the continued evolution of percutaneous therapies, the latest definition of trauma interventional radiology is "minimally invasive endovascular techniques used to arrest hemorrhage."¹ In essence, this involves: (1) blocking bleeding blood vessels/organs via arterial embolization and/or balloon catheters and (2) realigning blood vessels via stent grafts. These techniques have been successfully reported for injuries to the spleen, liver, kidney, and pelvis, as well as thoracic, abdominal, and peripheral vessels.

With the rapid advance of these techniques, the future of the trauma surgeon without advanced open vascular and thoracic skills is unclear. Although the majority of patients with vascular injuries who present with active hemorrhage are currently treated with open techniques, the importance of trauma surgeons

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Ball CG, Kirkpatrick AW, D'Amours SK. The RAPTOR: resuscitation with angiography, percutaneous techniques and operative repair. Transforming the discipline of trauma surgery. Can J Surg 2011;54:E3-4 [letter]

RAPTOR

- Hybrid suite: operating theatre and angiography lab
- Not a new concept in elective vascular, cardiothoracic and neurosurgery
- As separate entities- neither was new to trauma surgery
- Unique: one-stop bleeding control



Critical Need?

- Timeliness of haemorrhage control is important*
- Angioembolisation delays are problematic^
- Unclear which form of bleeding control is best for the patient...but quicker is better!

***Clarke JR, Trooskin SZ, Doshi PJ, Greenwald L, Mode CJ. Time to laparotomy for intra-abdominal bleeding from trauma does affect survival for delays up to 90 min. J Trauma 2002;52:420–5**

^Howell GM, Peitzman AB, Nirula R, et al. Delay to therapeutic interventional radiology postinjury: time is of the essence. J Trauma 2010;68(6):1296-300

Schwartz DA, Medina M, Cotton BA, et al. Are we delivering two standards of care for pelvic trauma? Availability of angioembolization after hours and on weekends increases time to therapeutic intervention. J Trauma Acute Care Surg 2014;76(1):134-9

RAPTOR

- Advantages for the injured patient who needs haemorrhage control
- No need to decide 'where to go first'
- No delays whilst moving patient to another location (bleeding continues?)
- Minimises inherent risk in multiple transfer

RAPTOR

- Flexibility- if first intervention decision results in suboptimal control of bleeding- try another!
- Plus...technology allows some rotational 'CT-like' imaging
- Brings expertise and technology to the patient rather than moving patient
- Allowing uninterrupted damage control

We've had a few years experience

- Liverpool Hospital
 - Planning of new building commenced 2006
 - Late 2010: new clinical building completed
 - 'Hot' floor: co-located ICU, OR, and IR suites
 - 2 hybrid units included in design
 - First hybrid suite commissioned 2011
- Parallel work in Calgary at the time (Ball, Kirkpatrick, Kortbeek)



HYBRID

- Initial Indications for use:
 - Haemodynamic / physiologic instability
- May include:
 - Pelvic #'s; +ve FAST
 - Abdominal or chest injury
 - External bleeding
 - Penetrating injury



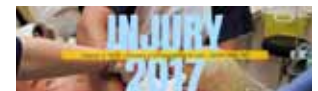
RAPTOR

- Unstable patient
- May be undifferentiated; source of bleeding not known
- Limited information:
 - patterns of injury
 - playing the odds



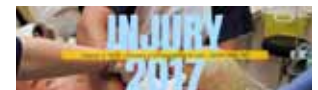


The hybrid for trauma-
considerations?



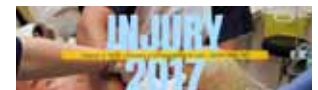
HYBRID...considerations?

- Outcomes
- What works / what doesn't
- Cost
- Model of care



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HYBRID- Outcomes

- Pieces of the puzzle
 - Earlier control of haemorrhage is better
 - Catheter-based technologies can be better for bleeding control in some situations
- Direct evidence demonstrating better outcomes for hybrids?

HYBRID...considerations?

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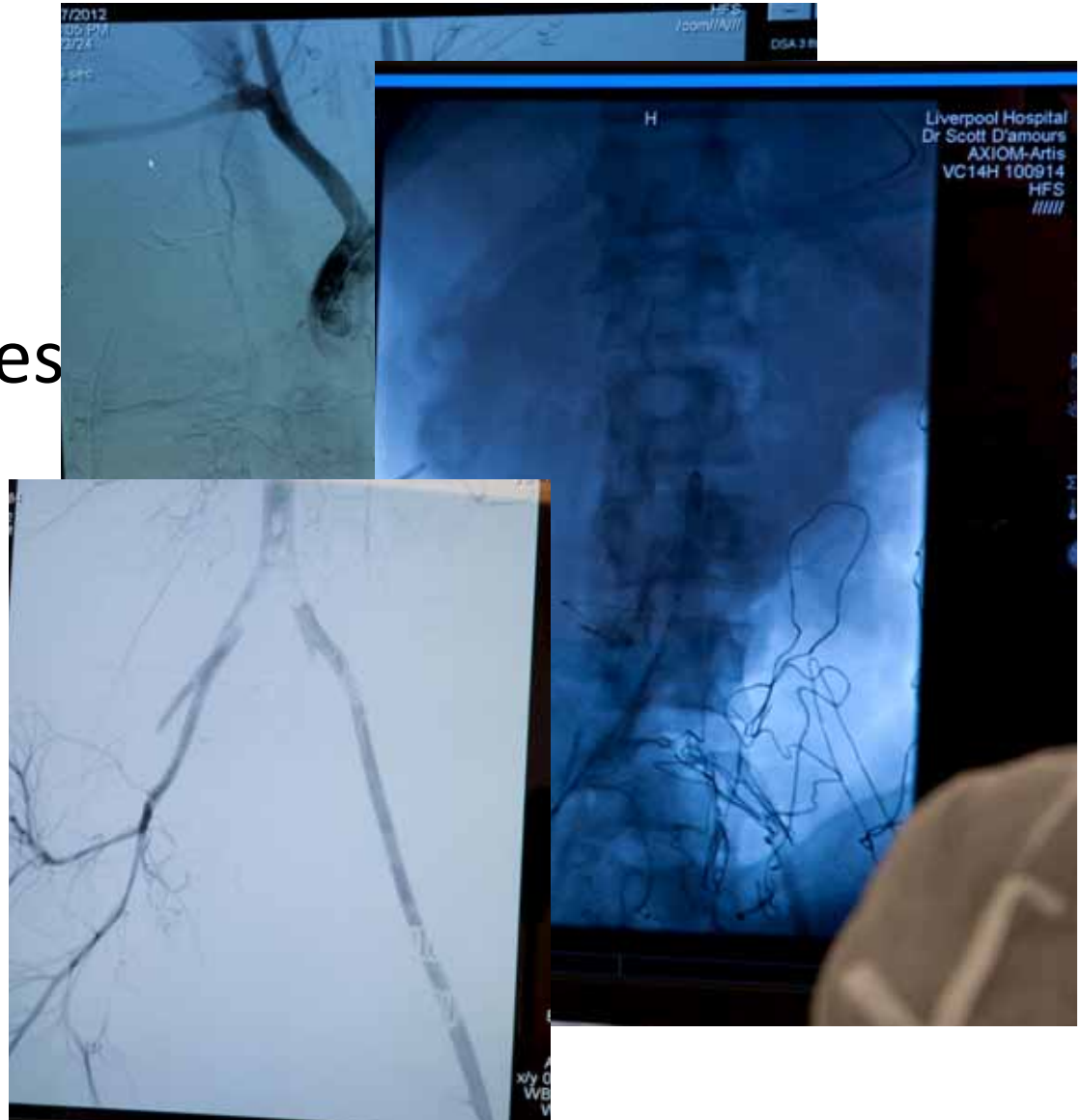
HYBRID- what has worked?

- Faster transitions between modalities (operative and IR)



HYBRID- what has worked?

- Better teamwork between specialties
- Surgery, anaesthesia, IR



HYBRID- what has worked?

- Better teamwork: radiographers, anaesthesia



HYBRID- what has worked?

- Rotational imaging in some patients
 - 'CT head' capability



RAPTOR

- Quality sufficient for immediate decision-making purposes
 - Patients undifferentiated ... may have lateralising signs
 - No time yet for formal CT brain
 - Craniotomy or not?



HYBRID- what needs work?

- Specifics of equipment:
- Table- pure floating or hybrid OR table



HYBRID- what needs work?

- Space and layout



HYBRID- what needs work?

- Enough space?





HYBRID- what needs work?

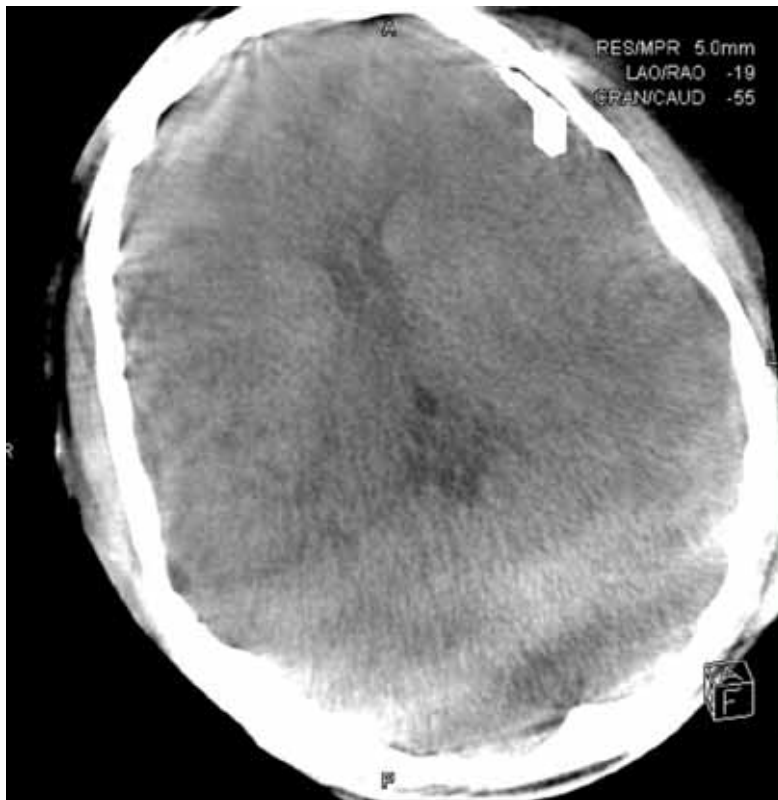
- Enough space?



HYBRID- what needs work?

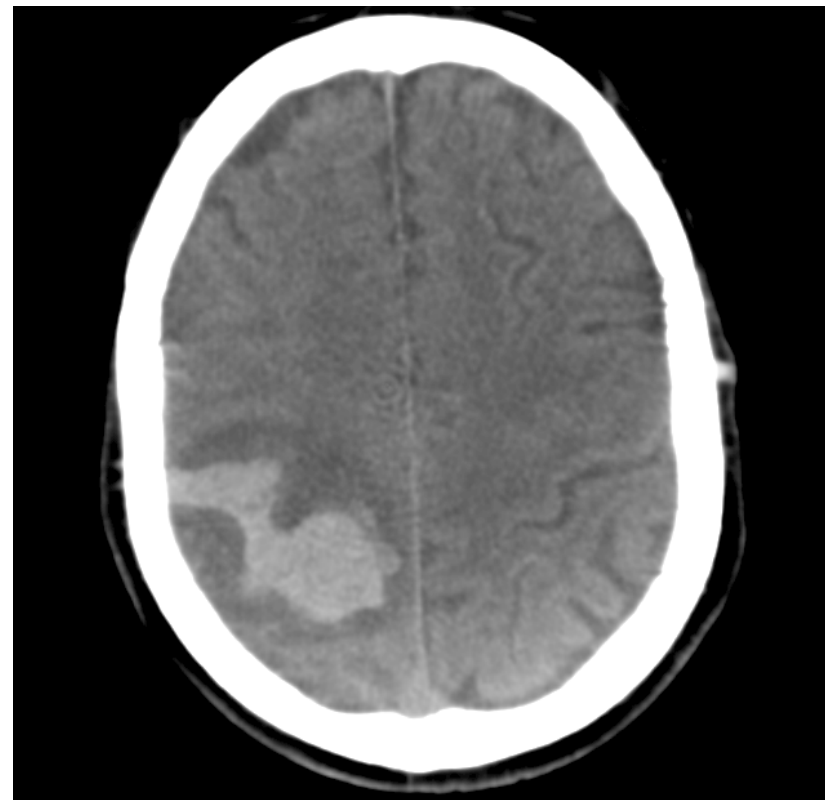
- Rotational imaging quality and consistency

This



or

this?



HYBRID- what needs work?

- Teamwork and planning
- More simulation and education- all parts of team

HYBRID- Calgary work



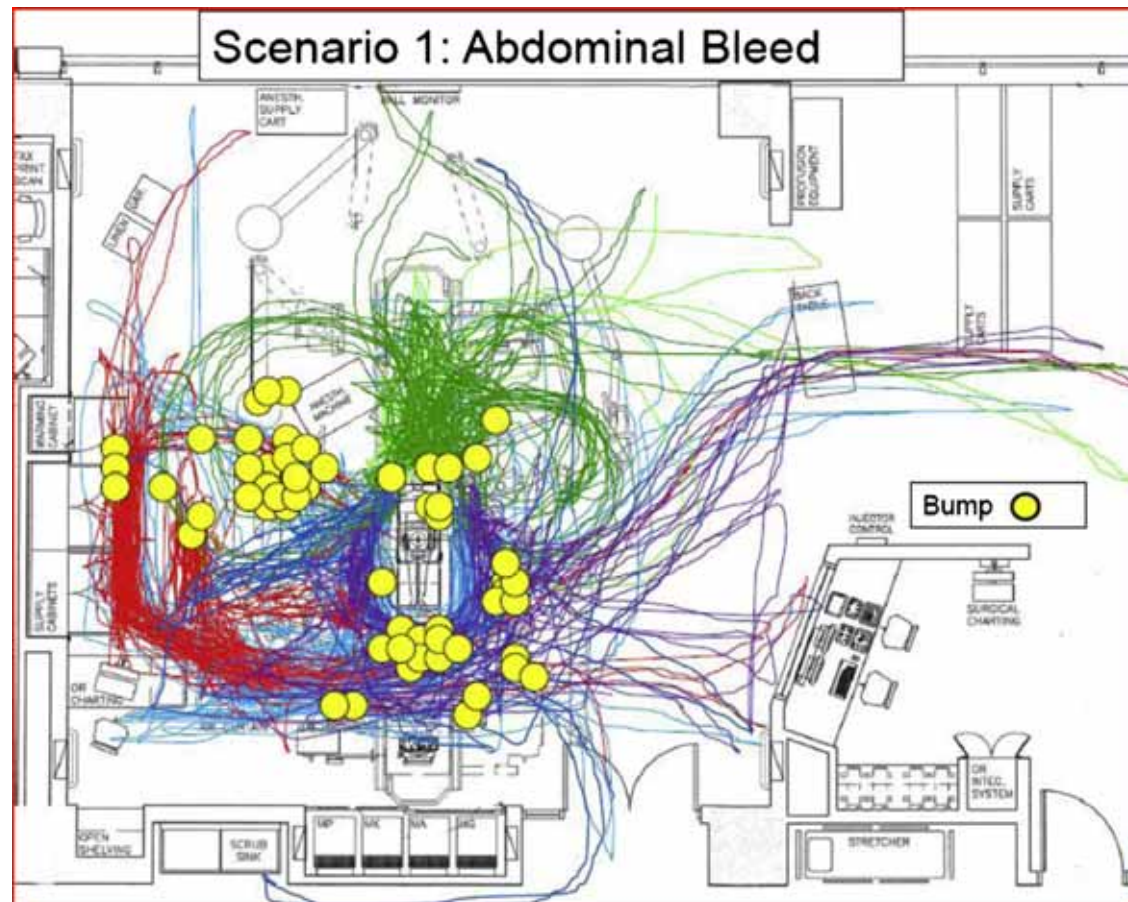
Kirkpatrick AW, Vis C, Dube M, et al. The evolution of a purpose designed hybrid trauma operating room from the trauma service perspective: the RAPTOR (Resuscitation with Angiography Percutaneous Treatments and Operative Resuscitations). *Injury* 2014;45(9):1413-21

HYBRID- Calgary work



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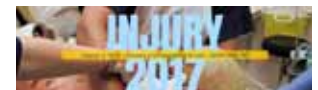
HYBRID- Calgary work- bring on the 'human factors' team



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HYBRID...considerations?

- Outcomes
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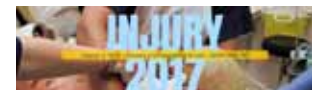


HYBRID- Cost

- Expensive
 - New build
 - Retrofit/refit
- Outright purchase or lease arrangement

HYBRID...considerations?

- Outcomes
- What works / what doesn't
- Cost
- Model of care



HYBRID- Model of care?

- System of trauma care locally and regionally?
 - Single hospital
 - Many or few trauma receiving hospitals
 - Expected numbers of suitable patients
- Consultant led team on site?
- Registrar led team with consultant on phone?

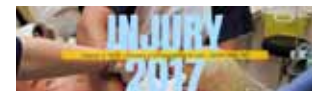
HYBRID- Model of care?

- Shared access
 - Elective and emergency cases; not idle
 - Access issues can arise
- Exclusive use
 - Access easier; no issues of 'ownership'; no fights
 - Expensive investment if not used enough
 - Training and familiarity of use for some team members?

HYBRID- unresolved considerations

- Who does the endovascular work?
- Adequacy of training?

In summary



Summary- hybrid operating theatres

- Potent tool- an advantage for 'at-risk' patients
 - Time saving potential
 - Less decision-making errors in terms of optimal venue for control of bleeding
- Technology great- but subject to rapid evolution; need to 'future-proof' if possible
- Do your homework!
 - Model of care
 - Careful planning
 - Training and education



Thank you