Vol 3 No 10 65-72 June 2004

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TRAUMA Grapevine

## Introduction

**Philosophically and practically speaking the emphasis in trauma care has changed in a small but significant way. There is an increasing desire not only to stop the bleeding as soon as possible but also to prevent recurrent haemorrhage in high-risk patients. Patients undergoing conservation management of splenic injury have such a risk of re-bleeding (or in many low volume persistent bleeding). In this issue we look at the splenic artery embolisation. This procedure has its indication and its appropriate use undoubtedly will increase non-operative splenic salvage. To optimise outcomes we really have to focus on rapid transfer of the injured to hospital, where rapid decision making will allow control of bleeding. We need to aggressively monitor perfusion and maintain resuscitation.**

**This can be a complex equation, especially if high-risk patients are involved in the trauma, such as the elderly or the obese. The delivery of consistent trauma care is achievable in part through commitment, education and practice guidelines.**

# *The Role of Splenic Artery Embolisation in Blunt Trauma Patients*

Clement Tsang and Michael Sugrue, Department of Trauma, Liverpool Hospital.

### Introduction

Splenic function has been firmly established to be an integral part of our immune system in its battle against capsulated bacteria. Splenic injury is one of the most common intra-abdominal injuries in trauma surgery. The management modality for blunt splenic injuries has continued to change over the last two decades with a push towards non-operative management and splenic conservation. This is largely due to the success of non-operative management of splenic injuries in paediatric patients. It was reported that 65% of blunt splenic injuries could be managed non-operatively, with a success rate of 98%[2]. Advances in CT have allowed the identification of not just patterns of injury but also patterns of haemorrhage. While we previously identified CT predictors of the need for surgery based on an index of the grade of injury multiplied by the volume of the haemoperitoneum[1], it is only more recently that CT has identified different patterns of bleeding as demonstrated by vascular blush. This has led to the more liberal use of angiography identifying the importance of pseudoaneurysms as a cause of delayed haemorrhage and "rupture" of the spleen[2,3,4].

The role of angiography in the non-operative management of patients has until recently not been clear, due in part to the confounding concern of associated potential intra-abdominal injuries. These injuries include small and large bowel, diaphragm, pancreatic, mesenteric or bladder injuries. However, concomitant intra-abdominal injury is an uncommon entity. Miller and colleges established that splenic injury is infrequently associated with small bowel or pancreatic injury. It is more often associated with diaphragmatic injury with an incidence of 1.7%. There were no missed injuries in 271 patients, with splenic injury alone managed conservatively[5]. Similarly Watts in Virginia found that less than 1% of all patients who presented with blunt trauma will have hollow viscus injury, and only 0.3% of all blunt trauma patients will have a perforated small bowel injury[6].

### Who should have Splenic Angiography and Embolisation?

The first and most important criteria is that the patient is haemodynamically stable. Unstable patients in resuscitation need a FAST or diagnostic peritoneal aspiration (DPA) to confirm haemoperitoneum, and if present immediate surgery is required. At this point only those who might be candidates for non-operative management should be considered for CT scanning to delineate the injury sustained.

Peitzman and Colleagues[(3)] conducted a multi-institutional study and found that the successful non-operative management was associated with the following criteria:

Continued page 66

- Higher initial blood pressure
- Normal hematocrit
- Less severe injury based on ISS
- Better Glasgow Coma Scale
- Better grade of splenic injury
- Smaller haemoperitoneum

In a haemodynamically stable patient a triage high quality CT scan will identify the need for angiography. The presence of a vascular blush or extravasation should indicate the need for angio-embolisation. This should only be undertaken in a centre with experience in the technique. With appropriate use of angiography and embolisation, Hann in Baltimore have noticeably increased their non-operative management of splenic injury from 37% to 74%[7]. If you don't have access to angiography in the presence of a vascular blush on CT scanning, you should operate immediately. Angiography must be readily available if it is going to be used.

The Baltimore group recommended to routinely angio patients with Grade III or greater splenic injury. It is important to have some consistency in the grading of injury as recent reports have identified the possibility of significant inter-observer variability when grading these injuries. Recent advances in abdominal ultrasound, with the evolution of FAST to include organ scanning with the aid of colour code mode may be able to identify pseudoaneursym (BOAST Bed side Organ Assessment of Sonography in Trauma). It is important to remember that angio-embolisation can fail, but the failure rate is currently reported to be less than 10%[1,8].

**Role of Computer Tomography**

CT is an important modality in selecting patients for non-operative management. The splenic injuries demonstrated on CT scan include intraparenchymal or intraperitoneal contrast extravasations, pseudoaneursym formation, vessel truncation or AV fistulae[9,10]. The presence of a splenic vascular blushing on CT scan has been found to correlate with failure of non-operative management[2]. In fact, patients with a blush are 24 times more likely to fail non-operative management[4]. This is because the incidence of contrast blush is significantly related to the grade of splenic injury[11]. The amount of haemoperitoneum can be quantified to indicate the degree of bleeding as shown in Figure 1. In this patient surgery is obviously required not for the Grade IV splenic injury, but because of the amount of haemoporitoneum seen on the CT scan.

Ideally if you are not going to angio your higher-grade splenic injuries then CT scan should be repeated on day 2-3 to check for pseudoaneursym. Those with contrast blushing can be managed with laparotomy and splenorraphy or splenectomy. Unfortunately the longer you observe your patient the less likely you are to succeed with operative splenic salvage as shown in Figure 2, where a spleenorrhapy was easy due to early surgery. The other option is management by angiography and coil embolisation[2]. Note, however, that contrast blushing is almost always an absolute indication for an operation or radiological intervention. Factors such as patient's age, grade of injury and the presence of hypotension need to be taken into consideration in the management of these patients[11].

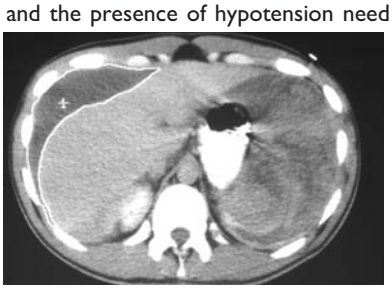
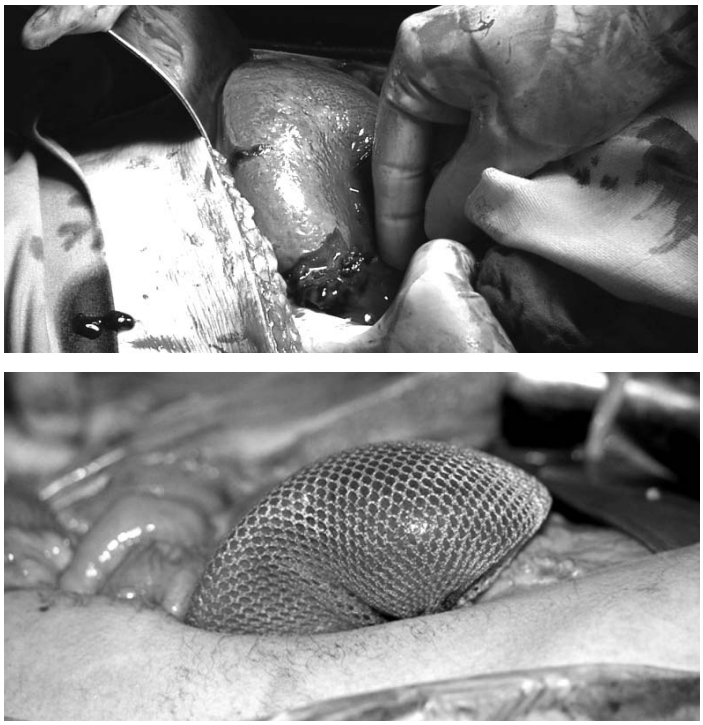


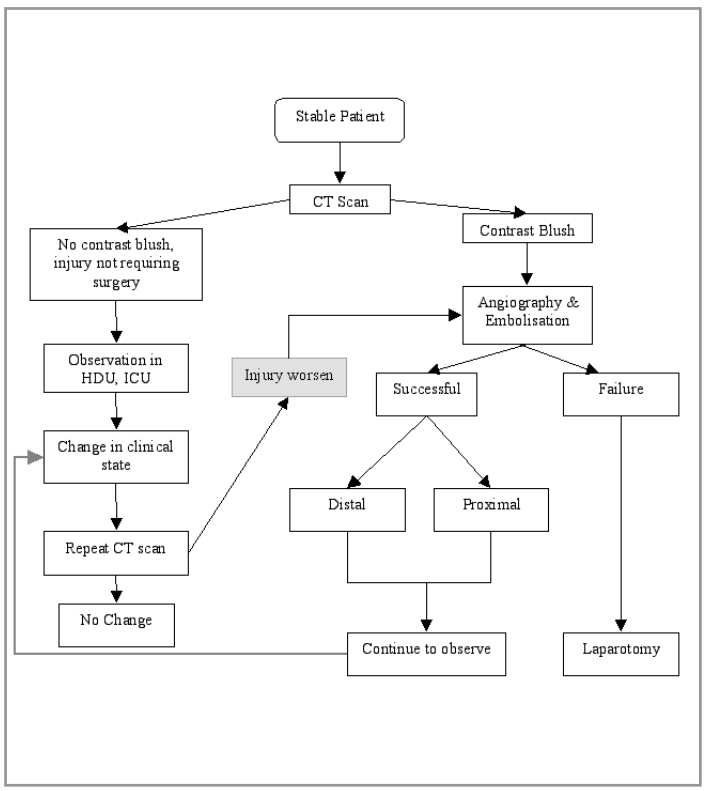
**Figure 1**
The volume of blood in the right upper quadrant is large and has been circled to give a volume estimation.

**Figure 2**
Mobilisation of spleen and repair with a mesh.



**When and How Patients are Selected**

The following is an algorithmic approach to patient selection
**Figure 3**



**Proximal or Distal Splenic Embolisation**

The technique of embolisation varies in different grades of splenic injuries and in different centres. Embolisation of the main splenic artery is the accepted method to achieve haemostasis rapidly. Main splenic arterial coiling was used if hilar injury was seen, or if greater than three separate peripheral vascular injuries were identified, or if greater than 50% of the gland was involved[7]. This temporarily decreases blood flow to the spleen by reducing the arterial blood pressure gradient of the spleen, which allows for haemostasis to occur. With proximal embolisation the presence of perisplenic collateral circulation is protective of the splenic parenchyma. The collateral circulation from the left gastric artery to the short gastric branches of the distal splenic artery, from the dorsal pancreatic artery and the pancreaticoduodenal arcades to the transverse pancreatic, and the pancreatic magna branches to the distal splenic artery, as well as the omental and gastroepoploic collaterals, all provides alternative blood flow to the spleen[13].

In general, distal or sub selective embolisation is not generally preferred for peripheral injuries or intra-peritoneal contrast extravasation. The reason for this approach was because of the uncertain immunologic effect of main coil embolisation on the spleen[12]. Nonetheless, there is evidence from small studies and case reports that the immunological function of the patients with splenic artery ligation did not differ to normal healthy patients[14,15,16]. The material used in embolisation includes metallic coil, gelform, super absorbent polymermicrosphere (SAP-MS). The current recommendation, therefore, is for main stem coiling.

**Complications of Splenic Embolisation**

The complications of non-operative management are delayed rupture of the spleen, abscess, pseudo-cyst formation and arterial venous fistulae. Complications specific to angiography include splenic infarctions. Based on CT scan findings Killeen, et al found that splenic infarcts occurs in 63% of patients after proximal embolisation and 100% after distal embolisation. However, most infarcts resolved without sequelae. A minority of this group subsequently developed abscess formation[10]. Coils can be dislodged into the other vessels such as the popliteal artery[3].

**Discharge and follow up Computed Tomography**

The length of in-hospital stay varies considerably depending on the different grades of splenic injuries, different institutions and also individual surgeons. This is an area that needs to be addressed. A recent study conducted by Haan, et al looked at patients with an Injury Severity Score of less than 20 managed by protocol and comparison with prior matched group managed with admission angiography. The protocol included early admission CT scan, angiography and repeat CT scan before discharge. The length of stay in the protocol driven group was 3.3 days and the non-protocol group had an average length of stay of 6.8 days. They found that repeating CT scan did not show progression of disease[7]. Pachter, et al and most authors also found that follow-up CT scans performed to assess the progression of injury are non-productive. Repeat CT scan should be limited to patient who exhibit a change in their clinical state, providing information as to whether the patient requires re-angiography or has other intra-abdominal pathologies. Repeating CT scan 8 weeks after injuries for patients who wishe to participate in contact sport is warranted to exclude splenic pseudo-cyst, however, this is rare[2,7].

**Conclusion**

In summary, haemodynamic stability is crucial before you opt for non-operative management of splenic injury and an algorithm for management is outlined in Figure 3. CT scan is an important tool to identify the grades of splenic injury, the degree of haemoperitoneum, and other visceral organ damage. With improved understanding of the natural history of splenic injury and the use of angio-embolisation, non-operative management of splenic injury has improved dramatically from 37% to 74%, of which 98% can be treated successfully. Remember, however, that it is bleeding, rather than organ injury that will determine the outcome, and using a splenic injury index may be useful1[6]. Early angiography should be used in day 2-3 for Grade 3 or 4 injuries. In the future, ultrasound may become useful in detecting splenic artery pseudoaneurysms.

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# LETTER TO THE EDITOR

Dear Editor,
Re: Early or late: the management of posterior urethral injuries
I enjoyed reading the recent review article by Chabert, et al on the controversy relating to the optimal management of urethral injuries[1]. The summary recommended a delayed approach to repair with an initial suprapubic cystotomy. I feel, however, that there remain a few points that may have escaped the attention of your readers and which might alter their interpretation of your conclusions.

Firstly, although Chabert, et al describe many of the classical signs of urethral trauma in males, the important association between vaginal bleeding and a possible urethral injury in females is not made explicit in the section on diagnosis[2]. Whilst this usually occurs in association with a pelvic fracture, another opportunity to alert a treating clinician to the possibility of urethral injury should not be missed. There is also some evidence in children that posterior urethral injuries occur more commonly in girls than in boys, in marked contrast to the adult experience with these injuries[2,3].

Secondly, one of the key references cited in the review in support of the delayed approach to urethral injuries dealt exclusively with post-traumatic posterior urethral strictures in children[4]. The conclusion of the experienced author for this very specific group of patients was to attempt a bulboprostatic anastomosis via a perineal approach. This was performed primarily in 20 cases (29%) with acceptable results.

I suspect that the reference that Chabert, et al intended to quote at this point was a detailed evaluation by the same author of the management of urethral injuries in association with pelvic fractures in both adults and children[5]. This review included a personal series of 100 male patients with an age range of 3 years to 62 years, together with a further 771 patients cited from 25 articles in the peer-reviewed literature[5]. The author concluded that whilst partial rupture was optimally managed by cystostomy, a complete rupture with marked displacement should be repaired primarily[5]. This seems to me to be at odds with the recommendations made by Chabert, et al[1].

I accept that the issue remains highly controversial with a requirement to individualise treatment dependent on the experience of the surgeon and the general condition of the patient.

Yours sincerely,

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Reply:

Dear Dr Holland,
Re: Early or late: the management of posterior urethral injuries
Many thanks for your interesting comment on the above-mentioned article. As you have pointed out there does exist a relationship between pelvic fracture and vaginal bleeding, a significant clinical sign which when present should increase the clinical suspicion of urethral injury.

In view of the rare nature of this injury type in females (in less than 2% of patients), however, our review concentrated on aspects related to the more predominate male population. As you correctly point out females less than 17 years of age have an increased risk of urethral injury with comparison to those older than 17. This is thought to be due to the greater compressibility of the pelvic bones.

The suggested guidelines for management of these injuries are aimed at the majority of clinicians who might not be familiar with the technique of primary realignment. With this group in mind a more conservative approach is favourable, rather than creating false passages and risk damaging either the external sphincter or the internal sphincter. Delayed endoscopic realignment, to an experienced urologist in the first 10 days after the patient is stable, appears to have gained wide acceptance in some centres. Despite this, in experienced hands suprapubic cystostomy and delayed urethral repair is successful 95-98% of the time in the long term.

It has been suggested by Koraitim, a learned colleague in this field, that primary realignment and suprapubic cystostomy were not mutually exclusive, but complimentary. His recommendations for primary realignment included a wide separation of urethral ends or associated bladder neck or rectal injury. Alternatively, where the urethral rupture is complete, urethral separation is minimal or the urethra cannot be realigned easily, suprapubic cystostomy is recommended.

In view of these recommendations and the relative rare occurrence of the condition locally we concluded that unless there exists a surgeon significantly experienced with primary realignment it should not be attempted unless the aforementioned indications exist.

Dr Charles Chabert
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# What's New in Trauma

**Dr. Manjul Joshipura, Rowan Nicks Scholar, Trauma Department, Liverpool Hospital**

**T. Wright Jernigan, Dept. of Surgery, University of Tennessee, Memphis.**

## Staged management of Giant Abdominal Wall Defects Acute and Long term Results

The authors describe a staged approach encompassing acute management through definitive abdominal wall reconstruction for massive abdominal wall defects, which may often result following visceral oedema as a result of shock resuscitation. The proposed management scheme consists of three stages. Stage I: absorbable mesh insertion for temporary closure (if oedema resolves quickly then the mesh is gradually pleated), Stage II: absorbable mesh removal in patients with without oedema resolution, and Stage III: definitive reconstruction after 6 –12 months by using modified components separation technique. Two hundred and seventy four consecutive patients between 1993 to 2001 were included in the study and outcomes were analysed with emphasis on wound-related morbidity and mortality, and fistula and recurrent hernia rates. The average defect size was 20 x 30 cms. In the Stage I group, 108 (92% of all deaths) patients died because of shock. The remaining 166 patients had temporary closure with polyglactin, 910 woven absorbable mesh. As visceral oedema resolved, bedside pleating of absorbable mesh allowed delayed primary fascial closure in 37 patients (22%). In the Stage II group, 9 died (8% of all deaths) from multiple organ failure. 96% of the remaining 120 had split thickness skin graft placed over the viscera. No wound related mortality occurred. In the Stage II there were 14 fistulae. In the Stage III group 73 of the 120 had definitive abdominal wall reconstruction using modified components separation technique. There were no deaths in these patients. Recurrent hernias developed in 5% of these patients (average follow up 24 months, range 2–60 months). They conclude that the staged management of patients with giant abdominal wall defects, without the use of permanent mesh results in a safe and consistent approach for both initial and definitive management with low morbidity and technique related mortality.

Ann Surg 2003; 238: 349-357.

## Intubation after cervical spine cord injury: to be done selectively or routinely?

Velmahos et al, LAC and USC Medical Centre, Los Angeles.

Patients with cervical spinal cord injuries (CSCI) often develop respiratory failure and require intubation. The authors studied the role of routine early intubation in CSCI patients. The medical records of 68 patients with CSCI were reviewed. Univariate and multivariate analyses were used to identify independent risk factors for the need of intubation. Statistical significance was considered at $P < 0.05$. Fifty patients (74%) required intubation and 27 (40%) developed pneumonia. Of patients with CSCI above C 5, 87.5% required intubation compared with 61% patients with CSCI at C5 – C 8 ($P = 0.026$). Similarly, of patients with complete quadriplegia, 90% required intubation compared to 48.5% patients with incomplete quadriplegia or paraplegia ($P < 0.001$). Of 31 patients not presenting with overt signs of acute respiratory failure on admission, 13 (42%) decompensated later and were intubated eventually up to 53 hours after admission. Six of these 13 patients had emergent intubation due to acute desaturation and developed pulmonary complications associated with emergent intubation. There were 3 independent risk factors for the need for intubation: Injury Severity Score > 16, CSCI higher than C5 and complete quadriplegia. The combination of the 2 latter risk factors resulted in intubation in 21 of 22 patients (95%). The majority of patients with CSCI require intubation. The authors recommend that patients with CSCI above C 5 and complete quadriplegia, intubation should be offered routinely and early because delays may cause preventable morbidity.

American Surgeon 2003 ; 69 : 891-894.

# The Effect of Interfacility Transfer on Outcome in an Urban Trauma System

Avery B. Nathens, MD, PhD, MPH; Ronald V. Maier, MD; Susan I. Brundage, MD, MPH; Gregory J. Jurkovich, MD; David C. Grossman, MD, MPH.

**Background**
Transporting all trauma patients to Regional Trauma Centres is inefficient. However, the bypass of nearer, non-designated hospitals in deference to Regional Trauma Centres decreases mortality in the severely injured. One approach to improving efficiency is to allow the initial assessment of selected patients at lower level (Level III/IV) designated centres. We set out to evaluate whether patients initially assessed at these centres and then transferred to a Level I facility were adversely affected by delays to definitive care.

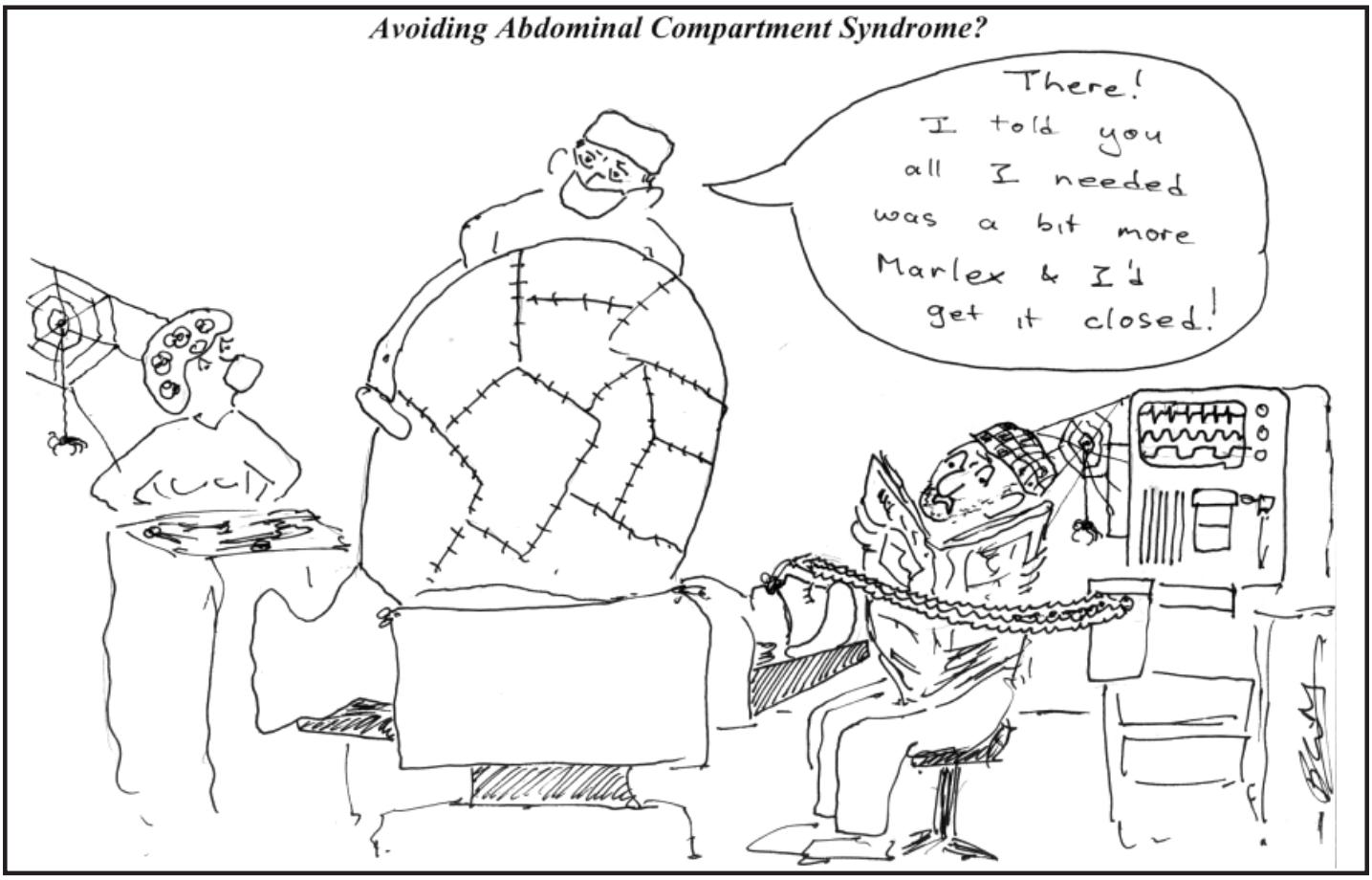
**Methods**
This is a retrospective cohort study in which the primary exposure being evaluated is initial assessment at a Level III or IV trauma centre before transport to a Level I centre in an urban setting. The outcomes in this transfer cohort were compared with outcomes in patients transported directly from the scene to a Level I centre (direct cohort). The outcomes of interest were mortality, length of stay, and hospital charges. Multivariate analyses were used to adjust for differences in baseline characteristics across these two cohorts.

**Results**
Crude length of stay was comparable, whereas mortality was lower and charges were 40% higher in the transfer cohort (n = 281) compared with the direct cohort (n = 4,439). After adjusting for confounders, mortality and length of stay were similar and total charges were significantly greater in the transferred patients.

**Conclusion**
Interfacility transfers in a mature urban trauma system do not appear to impact on clinical outcome. However, transfer patients use significantly greater resources as measured by hospital charges. This effect is likely because of the nature of their injuries or, alternatively, delays in reaching definitive care.

**J Trauma 2003; 55 (3): 444-449.**

***See you at World Congress on ACS in December in Noosa!***




*(Art by Dr Blair Mumford)*

# Case of the Month

**A 21 year old male.**
**Pre-Hospital Information**

| | | |
|---|---|---|
| **Mechanism** | **(M)** | Motorbike into car |
| **Injury** | **(I)** | Chest Abdomen r arm |
| **Signs** | **(S)** | P 120 BP 80 RR 28 GCS 15 |
| **Treatment** | **(T)** | Oxygen C Collar Gelofusine 500 |

Pre Hospital Scene Time 14 min

**Resus Room**
**Primary Survey and Early Management**

| | | |
|---|---|---|
| Airway | - | Intact |
| Breathing | - | In some distress SaO2 99%, |
| Circulation | - | Pulse 130/m BP 85 |
| Disability | - | GCS 15 |

He looked unwell yet was fully orientated. He complained of difficulty breathing.
His CXR and pelvic Xray were normal. He received a further 500 Gelofusine, and was considered unstable and commenced on blood. At 10 minutes a FAST is positive.

Here is how he looked. He is very tender in the right upper quadrant.

**Secondary Survey**
Slightly reduced breath sounds right side and tender abdomen. Laceration with a fracture right elbow.

**What is the probability of injuries?**

**What are you going to do?**

# Meetings

**Definitive Surgical Trauma Care Course (DSTC)**

| | |
|---|---|
| Liverpool, Sydney | 28th and 29th July 2004 |
| Auckland | 2nd, 3rd and 4th August, 2004 |
| Melbourne | 16th and 17th November, 2004 |

**Email:**
**charmaine.miranda@swsahs.nsw.gov.au**

**SWAN 12**
SWAN 12 will be held on the 30th and 31st July 2004. Bringing to you nine of the world leaders in trauma care from overseas. Registration is limited, so get in early!
Contact: Thelma Allen
Email: thelma.allen@swsahs.nsw.gov.au
Phone: (61 2) 9828 3927
http:// www.swsahs.nsw.gov.au/livtrauma

**World Congress on Abdominal Compartment Syndrome**
December 6-8th Noosa Queensland 2004
Contact: Michael Sugrue or Charmaine Miranda (61 2) 9828 3928
Email: charmaine.miranda@swsahs.nsw.gov.au

**Remember if you are not a member of Australasian Trauma Society - you could be!**
Contact: (08) 8222 4408 phone
(08) 8222 4970 fax
Email: bmitchel@mail.rah.sa.gov.au http://www.atsoc.com.au

# BACKCHAT

The Trauma Department at Liverpool Hospital would like to welcome Stephanie O'Regan as the new Area Trauma Co-ordinator and Katherine Smith as the new Data Manager. We also welcome our Nursing Scholar from Japan, Tomoko Goto.