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# Chapter 5 Management and Diagnostic Work-up

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## EXECUTIVE SUMMARY

The number of patients undergoing head CT has increased on an annual basis:

- The ratio of abnormal to normal aortograms is extremely high by international standards.
- Diagnostic peritoneal lavage is widely practised at Liverpool Hospital with 383 performed in 5 years.
- Non-therapeutic laparotomies increased in 1999. The number of laparotomies per annum is fairly constant around 60.
- 55 patients required urgent or Emergency Room thoracotomy.
- The survival rates for those undergoing thoracotomy for blunt trauma was 42% and 67% for penetrating trauma.

## Activation of Trauma Team Response at Liverpool Hospital

The Trauma Team consists of key members of medical, nursing and paramedical personnel who are summoned to the emergency resuscitation room to receive, assess and provide early resuscitative treatment for patients with serious injuries. The criteria for activation of Trauma Team response may be based on history, vital signs or injuries.

- HISTORY:**
- 1 MVA ejected from vehicle
  - 2 Pedal cyclist, motor cyclist or pedestrian hit by car or truck
  - 3 Fall > 5 metres
  - 4 Fall from horse
  - 5 Interhospital transfer
- VITAL SIGNS**
- 6 Airway obstruction
  - 7 Shallow or retractive breathing
  - 8 Cyanosis
  - 9 Skin pallor or slow capillary refill > 2 sec
  - 10 Systolic blood pressure < 90 mmHg
  - 11 Pulse >130 <50/minute
  - 12 Depressed level of conscious or fitting
  - 13 Pupils dilated or unreactive
  - 14 Trauma score 12 or less
  - 15 Deterioration in the Emergency Department
- INJURIES**
- 16 Injury to two or more body regions
  - 17 Fracture to 2 or more long bones
  - 18 Spinal cord Injury
  - 19 Crush injury or amputation of a limb
  - 20 Penetrating injury to head, neck chest abdomen, pelvis groin or back
  - 21 Burns to airway or smoke inhalation (>15% in adults, 10% children)
  - 22 Blood loss >500ml
  - 23 MVA with deceased

The table below represents the number of patients admitted to Liverpool Hospital each year with Blunt and Penetrating trauma and whether there was a Trauma Team response.

Type of Trauma	Year											
<b>Blunt Injury</b>	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Trauma Team Attended	406	66.6	431	65.0	437	66.2	497	67.3	503	64.7	2274	65.9
Trauma Team Not Called*	50	8.2	53	8.0	47	7.1	61	8.3	71	9.1	282	8.2
N/ap No criteria	154	25.2	179	27.0	176	26.7	180	24.4	204	26.2	893	25.9
<b>Blunt Total</b>	610	100	663	100	660	100	738	100	778	100	3449	100
Type of Trauma	Year											
<b>Penetrating Injury</b>	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Trauma Team Attended	50	92.6	69	90.8	73	94.8	80	96.4	52	96.3	324	94.2
Trauma Team Not Called*	2	3.7	3	3.9	4	5.2	1	1.2	1	1.9	11	3.2
N/ap No criteria	2	3.7	4	5.3	0	0.0	2	2.4	1	1.9	9	2.6
<b>Penetrating Total</b>	54	100	76	100	77	100	83	100	54	100	344	100

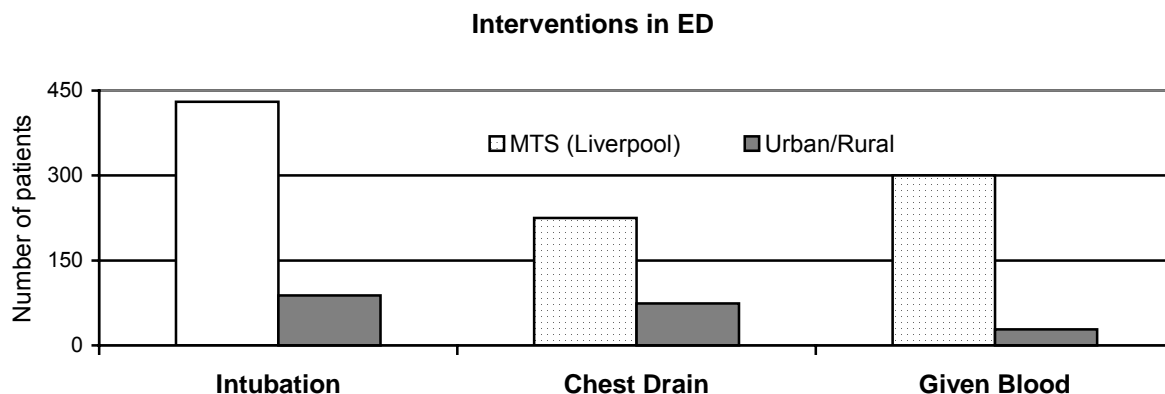
Trauma Team Not Called\* refers to patients who failed to have trauma team activation despite meeting criteria.

### Liverpool Hospital Trauma Team Activation

Type of Case	1995	%	1996	%	1997	%	1998	%	1999	%
Trauma Team Attend ISS ≥16	127	26.4	169	32.1	175	32.3	166	27.0	183	31.2
ISS ≤15	329	68.4	331	62.8	335	61.9	411	66.8	369	62.9
ISS ≥16 Failure to activate	13	2.7	12	2.3	12	2.2	22	3.6	17	2.9
ISS ≥16 No criteria	12	2.5	15	2.8	19	3.5	16	2.6	18	3.1
<b>Total</b>	456	100	500	100	510	100	577	100	552	100

## INTERVENTIONS DURING RESUSCITATIVE PHASE

The graph below represents the number of resuscitative and diagnostic interventions at Liverpool or one of the Urban or Rural hospitals.



### Cardio-Pulmonary Resuscitation

#### Patient receiving Cardio-pulmonary Resuscitation in ED

Trauma Type	Survived	%	Died	%	Total	%
Blunt	0	*	32	100	32	68.1
Penetrating	1	6.7	14	93.3	15	31.9
<b>Total</b>	<b>2</b>	<b>2.1</b>	<b>46</b>	<b>97.9</b>	<b>47</b>	<b>100</b>

47 patients required Cardio-pulmonary Resuscitation in the Emergency Department during the 5 year period. 36 (75%) of the patients were admitted to Liverpool Hospital and 4 patients to each of Bankstown, Campbelltown and Fairfield hospitals. Mean ISS 45.3 (range 16 to 75). Mean age 33 (1 - 79). The sole survivor was an 18 years old patient with penetrating gunshot wound. He sustained perforation to left external iliac artery and right internal iliac vein as well as arterial bleeding mesocolon and small bowel lacerations. His ISS was 17 and TRISS 0.0322. One patient went first to Campbelltown and survived long enough to be transferred to Liverpool Hospital but subsequently died in operating theatre. This was a 18 years old driver who sustained severe compound fracture of skull, Le Forte III fractures, lung contusions, lacerations to large and small bowel and mesentery with massive blood loss. Her ISS was 34 and TRISS 0.0679.

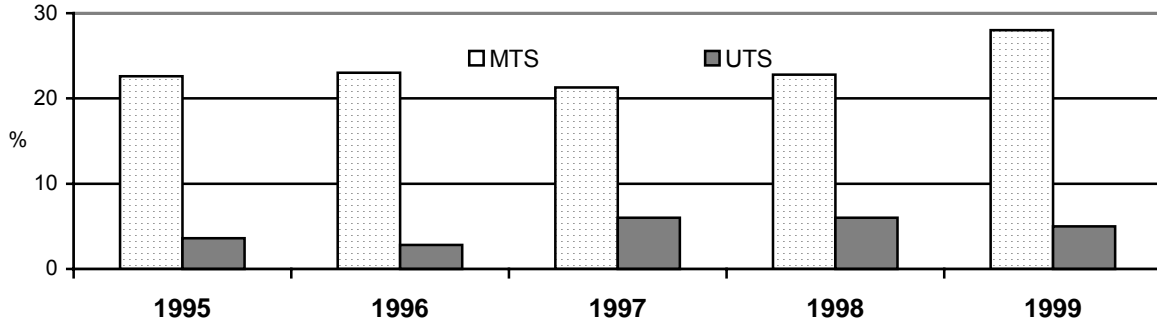
### Airway Intervention in ED

EDAir	Liv'pool	%	Bankst'n	%	Cbtn	%	Ffield	%	Bowral	%	Camden	%	Total	%
Oxygen	2031	53.5	255	27.7	207	23.5	141	29.9	160	37.0	32	20.9	2826	42.5
Guedel/ Bag mask	5	0.1	0	0.0	0	0.0	3	0.6	1	0.2	0	0.0	9	0.1
Intubation	426	11.2	27	2.9	32	3.6	9	1.9	17	3.9	2	1.3	513	7.7
Surgical airway	4	0.1	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	5	0.1
Prior intubation	136	3.6	4	0.4	4	0.5	3	0.6		0.0		0.0	147	2.2
Nil intervent'n	862	22.7	493	53.6	289	32.9	197	41.7	107	24.7	35	22.9	1983	29.8
Not Document	330	8.7	140	15.2	347	39.5	119	25.2	148	34.2	84	54.9	1168	17.6
<b>Total</b>	<b>3794</b>	<b>100</b>	<b>920</b>	<b>100</b>	<b>879</b>	<b>100</b>	<b>472</b>	<b>100</b>	<b>433</b>	<b>100</b>	<b>153</b>	<b>100</b>	<b>6651</b>	<b>100</b>

## DIAGNOSTIC INVESTIGATIONS: RESUSCITATIVE PHASE

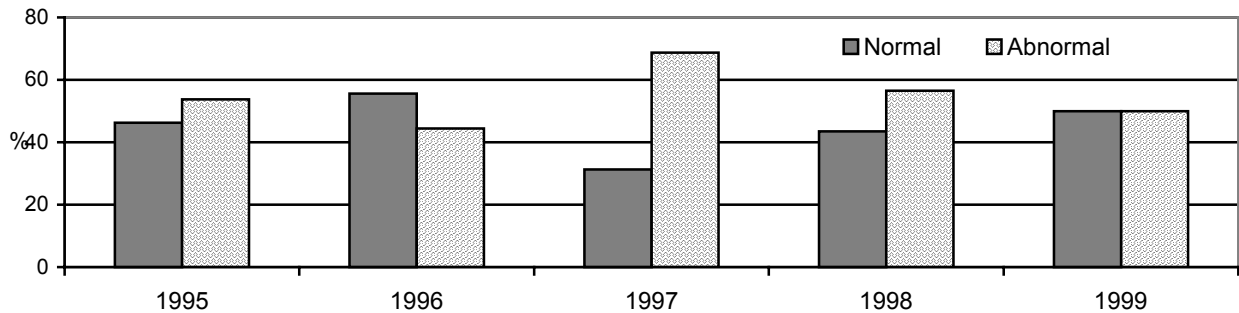
The following graph represents the number of admitted trauma patients in Major injury category who undergo CT scan of Head, Abdomen, Diagnostic Peritoneal Lavage (DPL) or Aortogram at Liverpool Hospital during the resuscitative phase of care.

**Patients Undergoing Head CT**



The graph above shows the proportion of patients admitted to either Liverpool Hospital (MTS) or to an urban/rural hospital (UTS) who underwent Head CT during resuscitative phase. The graph below shows the proportion of Head CT results with normal or abnormal result.

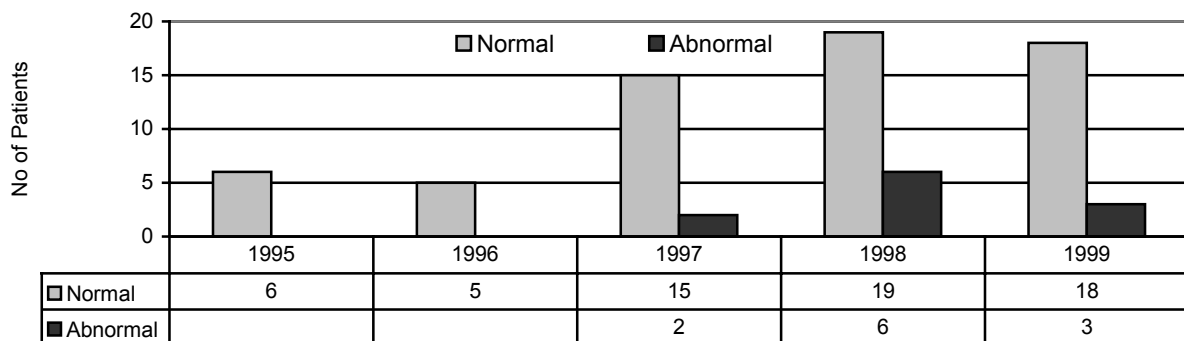
**Head CT Result** n=1040



### Arch Aortogram

74 patients underwent Aortograms. The number of patients each year and the result is shown below.

**Aortogram**

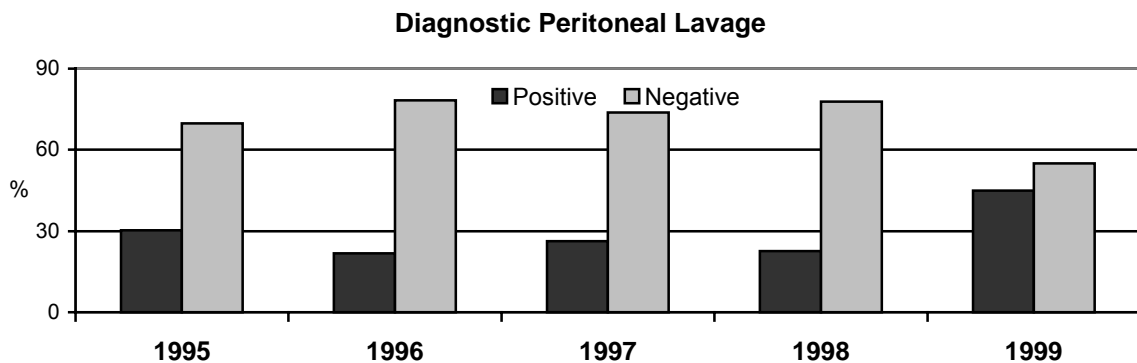


## ABDOMINAL TRAUMA LIVERPOOL HOSPITAL DIAGNOSTIC TESTS

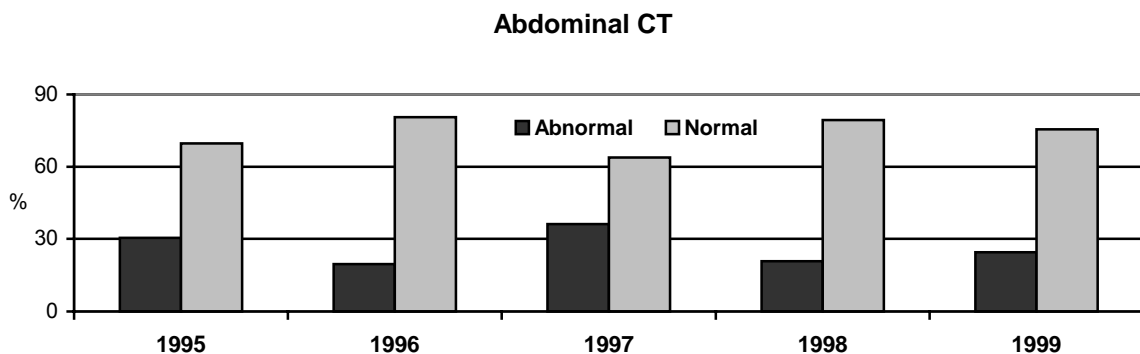
In this section we examine the pattern of investigation for abdominal trauma. At Liverpool we generally prefer Diagnostic Peritoneal Lavage (DPL) rather than Abdominal CT scanning for evaluation of blunt abdominal injuries. This is especially the case when bowel injury is suspected. We use CT scanning preferentially where we plan non-operative management (for example with isolated spleen or liver injury) and for visualization of retroperitoneal structures or renal outline.

Of the 3,794 patients in Major injury category admitted to Liverpool Hospital during the 5 years reviewed, 875 (23%) had either a DPL or Abdominal CT scan or both performed during the resuscitative phase of admission. The result for each patient is coded as either a positive (abnormal) or negative (normal) result.

383 patients underwent Diagnostic Peritoneal Lavage during the 5 years. A DPL is considered positive either when frankly positive (>10mL of frank blood is aspirated) or on laboratory analysis (RBC > 100,000mm<sup>3</sup> or WCC > 500mm<sup>3</sup>).



580 patients underwent early Abdominal CT scan at Liverpool Hospital.



### FAST

The usefulness of Focussed Abdominal Sonograph in Trauma (FAST) as a diagnostic tool for medical officers in the emergency room is being evaluated. A total of 158 patients, 60 during 1998 and 98 during 1999 underwent FAST. The findings are not reported in the trauma registry.

## ABDOMINAL TRAUMA LIVERPOOL HOSPITAL

874 patients admitted to Liverpool hospital during 1995 to 1999 underwent either Abdominal CT scan or Diagnostic Peritoneal Lavage (88 patients underwent both procedures). The following two tables represent the number of patients undergoing each of these diagnostic procedures for these patients.

### Abdominal CT Performed in Emergency Department

Abdominal CT	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Performed	69	50.7	82	48.5	94	57	135	75.4	200	88.9	580	66.4
Not performed	67	49.3	87	51.5	71	43	44	24.6	25	11.1	294	33.6
Total	136	100	169	100	165	100	179	100	225	100	874	100

### Diagnostic Peritoneal Lavage (DPL) Performed

DPL	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Performed	75	55.1	110	65.1	95	57.6	62	34.6	40	17.8	382	43.7
Not performed	61	44.9	59	34.9	70	42.4	117	65.4	185	82.2	492	56.3
Total	136	100	169	100	165	100	179	100	225	100	874	100

### Both Abdominal CT and Diagnostic Peritoneal Lavage Performed

DPL and CT	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Both Performed	8	5.9	23	13.6	24	14.5	18	10.1	15	6.7	88	10.1
Total	136	100	169	100	165	100	179	100	225	100	874	100

## LAPAROTOMY

### Laparotomy at Liverpool Hospital: Therapeutic vs Non-Therapeutic

Laparotomy	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Therapeutic	46	79.3	57	86.4	56	86.2	42	85.7	52	80.0	253	83.5
Non-therapeutic	12	20.7	9	13.6	9	13.8	7	14.3	13	20.0	50	16.5
Total	58	100	66	100	65	100	49	100	65	100	303	100

303 patients underwent laparotomy following trauma during the 5 years. Of these 303 patients undergoing laparotomy, 253 had "therapeutic" and 50 had "non-therapeutic". The following table displays the diagnostic interventions used prior to therapeutic and non-therapeutic laparotomies.

### Therapeutic Laparotomy

Diagnostic Tool	No DPL	%	Positive DPL	%	Negative DPL	%	Total	%
No CT	92	36.4	77	30.4	10	3.9	179	70.7
Positive Abdo CT	50	19.8	9	3.6	2	0.8	61	24.1
Negative Abdo CT	6	2.4	6	2.4	1	0.4	13	5.1
Total	148	58.5	92	36.4	13	5.1	253	100

### Non Therapeutic Laparotomy

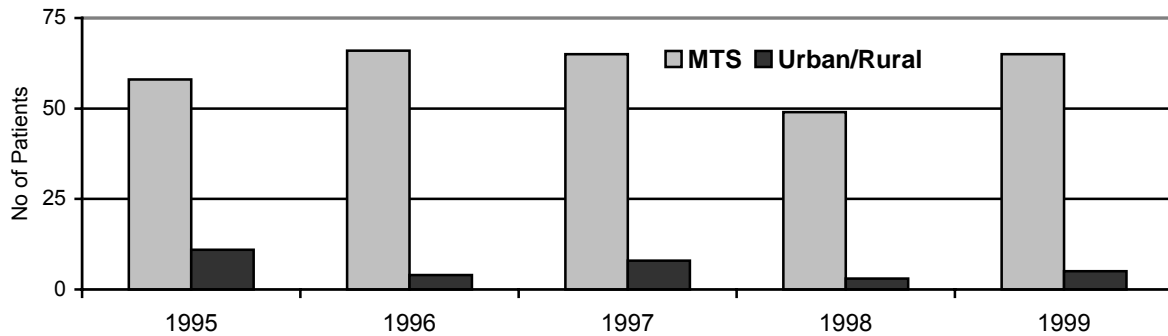
Diagnostic Tool	No DPL	%	Positive DPL	%	Negative DPL	%	Total	%
No CT	31	62	6	12	2	4	39	78
Positive Abdo CT	7	14	1	2	0	0	8	16
Negative Abdo CT	1	2	2	4	0	0	3	6
Total	39	78	9	18	2	4	50	100

## OPERATIONS

### Laparotomy

A total of 334 patients admitted following trauma underwent laparotomy during the 5 years. 303 (90.7%) laparotomies were performed at Liverpool Hospital, 31 (8.3%) were performed at Urban or Rural Trauma Service.

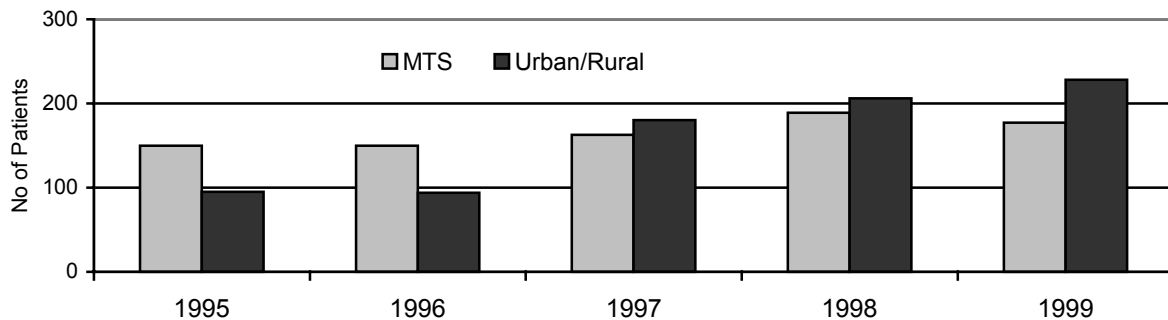
**Patients Undergoing Laparotomy**



### Fracture Fixation

1,632 patients underwent reduction/fixation of long bone fractures. 829 (50.8%) of these were performed at Liverpool Hospital. These figures do not include Minor category Injury patients, many of whom had orthopaedic injuries but this element of data is not collected.

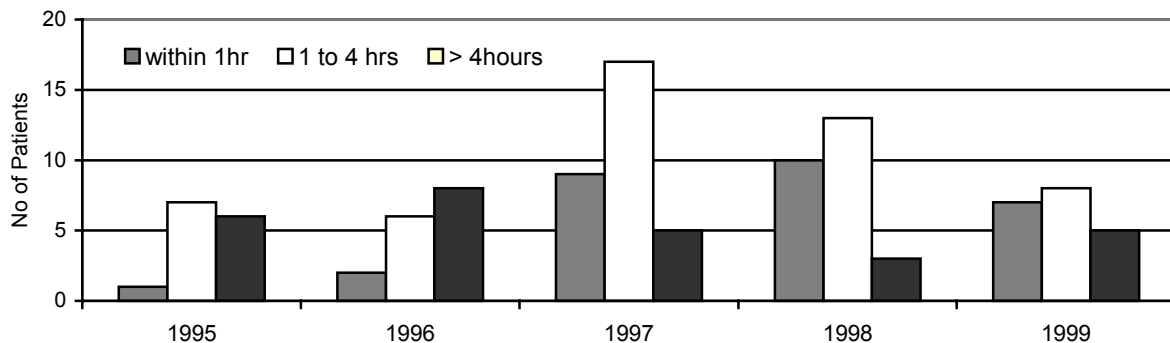
**Long Bone Fracture Fixation**



### Craniotomy for Acute EDH or SDH

107 patients underwent craniotomy for acute Extradural or Subdural haematoma at Liverpool Hospital. 29 (27.1%) of operations occurred within 1 hour of arrival in Emergency Department, 51 (47.6%) between 1 and 4 hours of arrival, and 27 (25.2%) more than 4 hours after arrival. In a further 75 patients intracranial pressure monitor was inserted.

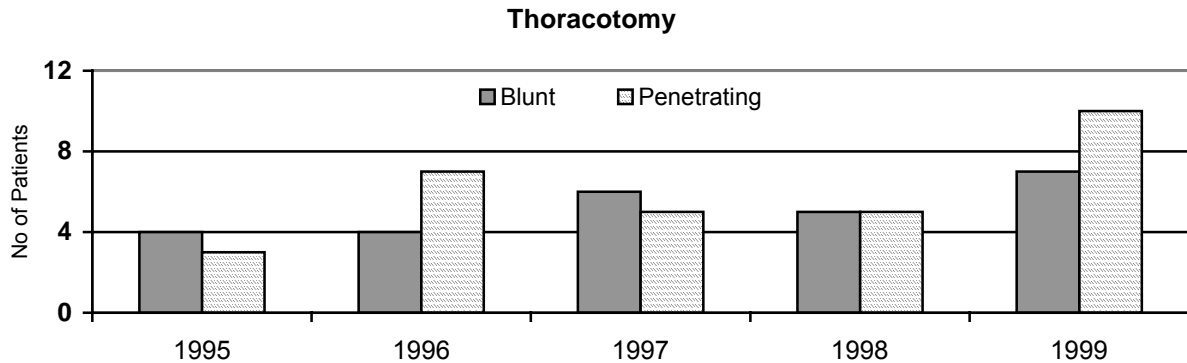
**Craniotomy Time from Arrival**



## OPERATIONS

### Urgent Thoracotomy

55 patients required urgent or emergency room thoracotomy. 54 were performed at Liverpool Hospital (7 of these in the Emergency Department) and one at Campbelltown (by a team of surgeons from Liverpool who were transported to the patient). 26 (46.4%) were for patients following blunt injury and 30 (54.6%) for patients following penetrating injury. Of the 26 patients requiring thoracotomy following blunt injury, 10 (42.3%) survived. Of the 30 patients with penetrating injury 20 (67%) survived. Injury severity for patients was mean ISS 39 (9-75). Mean length of stay in hospital for survivors was 35 days (1-213) and for patients who died was 1.7 days (1-14).



### Thoracotomy: Outcome for Blunt and Penetrating Injuries

Thoracotomy	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
<b>Blunt trauma</b>												
Survivors	2	50	1	25	2	33.3	1	20	4	66.7	10	40
Deaths	2	50	3	75	4	66.7	4	80	2	33.3	15	60
Total	4	100	4	100	6	100	5	100	6	100	25	100
<b>Penetrating trauma</b>												
Survivors	3	100	5	71.4	2	40	4	80	6	66.7	20	69
Deaths	0	0	2	28.6	3	60	1	20	3	33.3	9	31
Total	3	100	7	100	5	100	5	100	9	100	29	100
<b>Total</b>	<b>7</b>		<b>11</b>		<b>11</b>		<b>10</b>		<b>15</b>		<b>54</b>	

## Operations - Liverpool Hospital

### Laparotomy

There were 303 trauma laparotomies performed during the 5 years from 1995 to 1999 at Liverpool Hospital. 216 (71.3%) of these followed blunt trauma and 87 (28.7%) for penetrating trauma. 50 (16.5%) of all the laparotomies were non-therapeutic. Of the 216 laparotomies performed following blunt trauma 28 (9.3%) of were non-therapeutic. Of the 87 laparotomies performed following penetrating trauma, 22 (7.3%) were non-therapeutic. The following table shows the number and percent for each year for therapeutic and non-therapeutic laparotomy and the number and percent for blunt and penetrating injuries.

#### All Patients Undergoing Laparotomy

Laparotomy	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Nontherapeutic	12	20.7	9	13.6	9	13.85	7	14.3	13	20	50	16.5
Therapeutic	46	79.3	57	86.4	56	86.15	42	85.7	52	80	253	83.5
<b>Total</b>	<b>58</b>	<b>100</b>	<b>66</b>	<b>100</b>	<b>65</b>	<b>100</b>	<b>49</b>	<b>100</b>	<b>65</b>	<b>100</b>	<b>303</b>	<b>100</b>

#### Blunt Trauma

Laparotomy	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Nontherapeutic	8	19.0	4	8.9	6	12.5	3	10.7	7	13.2	28	13.0
Therapeutic	34	81.0	41	91.1	42	87.5	25	89.3	46	86.8	188	87.0
<b>Blunt Total</b>	<b>42</b>	<b>100</b>	<b>45</b>	<b>100</b>	<b>48</b>	<b>100</b>	<b>28</b>	<b>100</b>	<b>53</b>	<b>100</b>	<b>216</b>	<b>100</b>

#### Penetrating Trauma

Laparotomy	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Nontherapeutic	4	25.0	5	23.8	3	17.6	4	19.0	6	50.0	22	25.3
Therapeutic	12	75.0	16	76.2	14	82.4	17	81.0	6	50.0	65	74.7
<b>Penetrating Total</b>	<b>16</b>	<b>100</b>	<b>21</b>	<b>100</b>	<b>17</b>	<b>100</b>	<b>21</b>	<b>100</b>	<b>12</b>	<b>100</b>	<b>87</b>	<b>100</b>

### Craniotomy

There were 107 craniotomies performed for drainage of acute subdural or extradural haematoma during the 5 years from 1995 to 1999 at Liverpool Hospital. The following table shows the number of patients requiring craniotomy for drainage of acute extradural or sub dural haematoma each year and the time to craniotomy from arrival in the Emergency Department.

#### Time to Craniotomy for Acute Subdural and Extradural Haematoma

Craniotomy	1995	%	1996	%	1997	%	1998	%	1999	%	Total	%
Within 1 hour	1	7.1	2	12.5	9	29	10	38.5	7	35	29	27.1
Between 1 - 4 h	7	50	6	37.5	17	54.8	13	50	8	40	51	47.7
More than 4hours	6	42.9	8	50	5	16.1	3	11.5	5	25	27	25.2
<b>Total</b>	<b>14</b>	<b>100</b>	<b>16</b>	<b>100</b>	<b>31</b>	<b>100</b>	<b>26</b>	<b>100</b>	<b>20</b>	<b>100</b>	<b>107</b>	<b>100</b>