

## BEST EVIDENCE TOPIC REPORTS

# Towards evidence based emergency medicine: best BETs from the Manchester Royal Infirmary

Edited by S D Carley

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Best evidence topic reports (BETs) summarise the evidence pertaining to particular clinical questions. They are not systematic reviews, but rather contain the best (highest level) evidence that can be practically obtained by busy practicing clinicians. The search strategies used to find the best evidence are reported in detail in order to allow clinicians to update searches whenever necessary. Each BET is based on a clinical scenario and ends with a clinical bottom line that indicates, in the light of the evidence found, what the reporting clinician would do if faced with the same scenario again. The BETs published below were first reported at the Critical Appraisal Journal Club at the Manchester Royal Infirmary<sup>1</sup> or placed on the BestBETs website. Each BET has been constructed in the four stages that have been described elsewhere.<sup>2</sup> The BETs shown here together with those published previously and those currently under construction can be seen at <http://www.bestbets.org>.<sup>3</sup> Four BETs are included in this issue of the journal.

- ▶ Role of flexion/extension radiography in paediatric neck injuries
- ▶ Use of troponin for the diagnosis of myocardial contusion after blunt chest trauma
- ▶ Scorpion envenomation: does administration of antivenom alter outcome?
- ▶ Scorpion envenomation: does antivenom reduce serum venom concentrations?

Mr S D Carley, Emergency Medicine, Hope Hospital, Manchester, UK; [s.carley1@btinternet.com](mailto:s.carley1@btinternet.com)

- 1 Carley SD, Mackway-Jones K, Jones A, *et al*. Moving towards evidence based emergency medicine: use of a structured critical appraisal journal club. *J Accid Emerg Med* 1998;15:220-2.
- 2 Mackway-Jones K, Carley SD, Morton RJ, *et al*. The best evidence topic report: A modified CAT for summarising the available evidence in emergency medicine. *J Accid Emerg Med* 1998;15:222-6.
- 3 Mackway-Jones K, Carley SD. [bestbets.org](http://www.bestbets.org): Odds on favourite for evidence in emergency medicine reaches the worldwide web. *J Accid Emerg Med* 2000;17:235-6.

## Role of flexion/extension radiography in paediatric neck injuries

Report by Elspeth Pitt, *Specialist Registrar*  
Checked by Shobhan Thakore, *A&E Consultant*

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### Abstract

A short cut review was carried out to establish the potential utility of flexion/extension views of the cervical spine in children with neck injuries. Using the reported search, 51 papers were found, of which three presented the best evidence to answer the clinical question. The author, date, and country of publication, patient group studied, study type, relevant outcomes, results, and study weaknesses of these best papers are tabulated. A clinical bottom line is stated.

### Clinical scenario

A child attends the department; he has been involved in a high speed road traffic accident, complains of neck pain and midline neck spinal tenderness, but has no neurological signs/symptoms. Static cervical spine radiology (lateral, AP, and odontoid views) reveal no abnormality. You wonder if flexion/extension x rays would show any significant injury/instability.

### Three part question

In [a neurologically intact child with neck pain following trauma but normal plain x rays] do [flexion/extension x rays] aid [diagnosis of ligamentous or soft tissue injury with instability]?

### Search strategy

Medline 1966-11/04 and Embase 1988-11/04 using the Ovid interface.

Medline: [exp neck injuries OR neck trauma.mp OR cervical spine trauma.mp OR exp spinal injuries OR exp spinal cord injuries OR exp spinal fractures OR exp fractures OR cervical spine injuries.mp OR exp dislocations OR exp cervical vertebrae OR cervical spinal cord trauma.mp OR exp spinal cord compression] AND [flexion-extension.ti OR dynamic cervical spine radiography.mp OR flexion-extension radiography.mp OR flexion-extension cervical spine radiography.mp OR flexion-extension radiographs.mp] AND [exp joint instability OR ligamentous injury.mp OR ligament injury.mp OR cervical vertebrae OR exp fractures OR ligamentous instability.mp OR exp soft tissue injuries OR soft tissue injury.mp] AND [BestBETs paediatric filter] LIMIT to human AND English language.

Embase: [exp neck injuries OR neck trauma.mp OR cervical spine trauma.mp OR exp spinal injuries OR exp spinal cord injuries OR exp spinal fractures OR exp fractures OR cervical spine injuries.mp OR exp dislocations OR exp cervical vertebrae OR cervical spinal cord trauma.mp OR exp spinal cord compression] AND [flexion-extension.ti OR dynamic cervical spine radiography.mp OR flexion-extension radiography.mp OR flexion-extension cervical spine radiography.mp OR flexion-extension radiographs.mp] AND [exp joint instability OR ligamentous injury.mp OR ligament injury.mp OR cervical vertebrae OR exp fractures OR ligamentous instability.mp OR exp soft tissue injuries OR soft tissue injury.mp] AND [exp child OR child\$.mp OR exp infant OR exp pediatrics OR pediatric\$.mp OR paediatric\$.mp] LIMIT to human AND English language.

### Search outcome

Altogether 32 papers were found from Medline and 19 from Embase, of which three were relevant and are shown in the table.

### Comment(s)

All studies are retrospective so the evidence base is limited. Flexion extension cervical spine radiography (FECSR) appears to have resulted in no permanent complications in

Table 1

Author, date, and country	Patient group	Study type (level of evidence)	Outcomes	Key results	Study weaknesses
Woods WA <i>et al</i> , 1998, USA	137 alert 0–18 year olds following blunt trauma who underwent static cervical spine radiography (SCSR) and flexion extension cervical spine radiography (FECSR)	Retrospective descriptive study	Radiological instability on FECSR	93 (70%) normal SCSR—all had normal FECSR 30% (40) abnormal SCSR of whom 7 (5%) had abnormal FECSR but none required invasive spinal surgery and all had satisfactory neurological outcome No complications of FECSR	Retrospective
Dwek JR & Chung CB, 2000, USA	247 1.6–18 year olds with history of trauma who had SCSR followed by FECSR done at the time the GCS permitted (could be delayed days)	Retrospective observational study	Radiological abnormality on SCSR and FECSR	All with normal SCSR—had normal FECSR	Retrospective Abnormality on FECSR assessed qualitatively by radiologists 8% of dynamic CSR inadequate—not further commented on other than no late instability in those attending at 2/52
Ralston ME <i>et al</i> , 2001, USA	129 patients <17 years of age with blunt trauma who had SCSR and FECSR within 7 days of injury	Retrospective review	Radiographic assessment of abnormality on SCSR and FECSR	83 suspicious SCSR led to 75 normal and 8 abnormal FECSR Normal SCSR unlikely to have an abnormal FECSR Of 46 normal SCSR, one had an abnormal FECSR (abnormal subluxation) but was given a clinical diagnosis of physiological subluxation based on clinical course. Abnormal SCSR—FECSR limited use in confirming injury but useful to rule out injury No permanent complications	Retrospective Don't correlate radiographic review with clinical findings Only 1 radiographic reviewer looked at all films

these studies. However, the utility of FECSR in patients with normal static cervical spine radiography (SCSR) is low. In the current era of imaging modalities such as CT and MRI, the need for FECSR may decline.

#### ► CLINICAL BOTTOM LINE

If SCSR is normal, FECSR is unlikely to be abnormal. If SCSR is equivocal/abnormal, FECSR is still unlikely to be abnormal but may help to rule out injury in an alert child with no neurological signs complaining of pain and neck tenderness.

**Woods WA**, Brady WJ, Pollock G, *et al*. Flexion-extension cervical spine radiography in pediatric blunt trauma. *Emerg Radiol* 1998;5:3814.

**Dwek JR**, Chung CB. Radiography of cervical spine injury in children: are flexion-extension radiographs useful for acute trauma? *AJR Am J Roentgenol* 2000;174:1617–19.

**Ralston ME**, Chung K, Barnes PD, *et al*. Role of flexion-extension radiographs in blunt pediatric cervical spine injury. *Acad Emerg Med* 2001;8:237–45.

## Use of troponin for the diagnosis of myocardial contusion after blunt chest trauma

Report by Lorna Jackson, *SpR in Emergency Medicine*

Checked by Alison Stewart, *SHO III in Emergency Medicine*

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#### Abstract

A short cut review was carried out to establish the utility of troponin levels in diagnosing myocardial contusion following blunt chest trauma. Using the reported search, 75 papers were found, of which six presented the best evidence to answer the clinical question. The author, date, and country of publication, patient group studied, study type, relevant outcomes, results, and study weaknesses of these best papers are tabulated. A clinical bottom line is stated.

#### Clinical scenario

A 45 year old man attends the emergency department after being involved in a road traffic accident. He has sustained a blunt chest injury during the impact and has bruising across his chest wall. His ECG shows non-specific ST segment changes and the chest radiograph are normal. You wonder about the benefit of performing a troponin level to aid the diagnosis or exclusion of myocardial contusion.

#### Three part question

Is [troponin] level a good indicator of underlying [cardiac damage] after [blunt chest trauma]?

#### Search strategy

Medline 1966-11/04 using the Ovid interface. [exp troponin OR troponi\$.mp] AND [exp Wounds, Nonpenetrating OR exp Thoracic Injuries OR blunt chest injury.mp OR blunt chest trauma.mp OR blunt thoracic injury.mp OR blunt thoracic trauma.mp] AND [exp Heart Injuries OR myocardial contusion.mp OR cardiac contusion.mp OR myocardial damage.mp]

Table 1

Author, date and country	Patient group	Study type (level of evidence)	Outcomes	Key results	Study weaknesses
Adams JE, 1997, USA	Patients with suspected cardiac trauma	Review article including 3 relevant papers	Serial TnT and total CK CK and Tnl over first 72 hours and ECHO Tnl, CK and CK-MB at 12 and 24 hours and ECHO TnT v Tnl	Sensitivity 0.63 and specificity 0.71 for TnT Sensitivity 1 and specificity 0.68 for Tnl Specificity 0.72 for Tnl Tnl specificity better than TnT specificity	Excluded those with pre-existing cardiac disease Very small numbers involved
Ferjani M <i>et al</i> , 1997, France	128 consecutive patients who had suffered blunt chest trauma. All patients had TnT measured at admission, 4 and 24 hours after admission. Cardiac contusion defined as abnormal echocardiography compatible with contusion, severe cardiac rhythm abnormality, severe cardiac conduction abnormality or haemopericardiumecutive patients who had suffered blunt chest trauma	Prospective observational study	Sensitivity and specificity of troponin T >0.5 ug over 1st 24 hours	ROC curve analysis performed AROC=0.69 with 95% C.I. of 0.56 to 0.80	Excludes patients with pre-existing coronary artery disease.
			Troponin versus CKMB	TnT of >0.5 ug has specificity of 0.91 but sensitivity of 0.31, indicating that it is unreliable Trop T had greater AROC than CKMB or CKMB/CK ration	Only measured TnT at admission, 4 and 24 hours. Used TnT not Tnl trop of >0.5 ug is a high level.
Mori F <i>et al</i> , 2001, Italy	32 patients with clinical or radiological signs of acute blunt chest trauma. All patients had cTnl measured at 6, 12, 24, 48 and 96 hours post injury. Cardiac contusion defined as abnormal trans-oesophageal echocardiography	Prospective observational study	Sensitivity of raised troponin	All with normal or minimally raised Tnl (<0.4 ng/ml) had a normal echo (mean 0.6 +/-1.4)	Excluded patients with pre-existing cardiac disease
			Specificity of raised troponin	Mean Tnl was higher in those with abnormal echo (mean 2.6 +/-1.6) p<0.0001 Animal studies suggest troponin may be useful. 2 Human studies show high sensitivity, 1 shows low spensitivity (but had questionable gold standard). Authors concluded cardiac troponins seem to be highly specific and sensitive for myocardial injury. They may offer the possibility of stratification of severity and risk of adverse outcome.	Small numbers included in the study.
Kaye P <i>et al</i> , 2002, UK	Patients with suspected myocardial contusion. ECG and ECHO used to define significant blunt cardiac injury.	Review article including 3 relevant papers	Utility of troponin to diagnose myocardial contusion	Animal studies suggest troponin may be useful. 2 Human studies show high sensitivity, 1 shows low spensitivity (but had questionable gold standard). Authors concluded cardiac troponins seem to be highly specific and sensitive for myocardial injury. They may offer the possibility of stratification of severity and risk of adverse outcome.	Papers used variable gold standards, abnormal ECG, clinically significant finding and/or ECHO.  1 paper looked at ventilated trauma patients and none had an abnormal echo
Velmahos G <i>et al</i> , 2003, USA	333 consecutive patients with significant blunt thoracic trauma. Tnl was performed on all patients at admission, 4 and 8 hours post admission. Significant blunt cardiac injury was determined by any of the following: hypotension in the absence of bleeding or a neurogenic cause, cardiac arrhythmia, echocardiographic abnormality, severe arrhythmia, or shock of unexplained origin	Prospective observational study	Clinical diagnosis of significant blunt cardiac injury. Serial ECG and Tnl analysis	None with normal ECG and Tnl at 8 hours were felt to have significant blunt cardiac injury. Tnl was considered abnormal if values were greater than 1.5 ng/mL	Small numbers involved in the trials The diagnosis of significant blunt cardiac injury was made clinically.
Sybrandy KC <i>et al</i> , 2003, Netherlands	Patients with suspected cardiac contusion	Review article including 2 further relevant papers	Utility of troponins to detect myocardial contusion	Sensitivity 100%, all with normal Tnl had no problems. Specificity 83-87.5%	High cut off for raised Tnl (1.5 ng/ml) One paper excluded intubated and haemodynamically unstable patients. Small numbers involved in the trials

OR myocardial injur\$.mp OR cardiac damage.mp OR cardiac injur\$.mp] LIMIT to human AND English language.

### Search outcome

Altogether, 75 papers were found, of which 20 were directly relevant to the three part question. Of these, three were literature reviews, which covered six of the papers found, five were letters relating to other papers included, three were case reports and three were journal articles. The three review articles and the three journal articles not included in the reviews are shown in the table.

### Comment(s)

There is no gold standard as yet for the diagnosis of myocardial contusion, which makes it difficult to assess the newer forms of detection of myocardial injury. Troponin T may be less sensitive than a troponin I in the context of blunt chest trauma. The diagnostic window for myocardial contusion appears to be smaller and occur earlier after the injury than in the case of myocardial infarction in some studies. Other papers suggest that levels should be taken at admission and at 4–6 hours.

### ► CLINICAL BOTTOM LINE

An abnormal troponin level seems to be a sensitive indicator of myocardial damage.

**Adams JE 3rd.** Utility of cardiac troponins in patients with suspected cardiac trauma or after cardiac surgery. *Clin Lab Med* 1997;17:613–23.

**Ferjani M,** Droc G, Dreux S, *et al.* Circulating cardiac troponin T in myocardial contusion. *Chest* 1997;111:427–33.

**Mori F,** Zuppiroli A, Ognibene A, *et al.* Cardiac contusion in blunt chest trauma: a combined study of tranoesophageal echocardiography and cardiac troponin I determination. *Ital Heart J* 2001;2:222–7.

**Kaye P,** O'Sullivan I. Myocardial contusion: emergency investigation and diagnosis. *Emerg Med J* 2002;19:s8–10.

**Velmahos G,** Karaiskakis M, Salim A, *et al.* Normal electrocardiography and serum troponin I levels preclude the presence of clinically significant blunt cardiac injury. *J Trauma* 2003;54:45–51.

**Sybrandy KC,** Cramer MJ, Burgersdijk C. Diagnosing cardiac contusion: old wisdom and new insights. *Heart* 2003;89:485–9.

## Scorpion envenomation: does administration of antivenom alter outcome?

Report by Bernard Foëx, *Consultant in Emergency Medicine (Manchester)*

Checked by Lee Wallis, *Consultant in Emergency Medicine (Cape Town)*

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### Abstract

A short cut review was carried out to establish the clinical utility of antivenom in scorpion poisoning. Using the reported search, 69 papers were found, of which four presented the best evidence to answer the clinical question. The author, date, and country of publication, patient group studied, study type, relevant outcomes, results, and study weaknesses of these best papers are tabulated. A clinical bottom line is stated.

### Clinical scenario

A woman presents to the emergency department after being stung by a scorpion, which was hiding in a bunch of bananas in her local supermarket. She is in great pain and feels sick. You wonder whether she should be given an antivenom.

### Three part question

After [scorpion envenomation] does the [use of antivenom] [improve outcome]?

### Search strategy

Medline 1966-11/04 using the OVID interface. [exp Scorpions OR scorpion.mp OR exp Scorpion Venoms OR scorpion venom.mp OR scorpionism.mp] AND [envenoming.mp OR envenomation.mp] AND [exp Antivenins OR antivenom.mp OR exp Immunization, Passive OR serotherapy.mp OR exp Immunoglobulins, Fab] LIMIT to human AND English language.

### Search outcome

Altogether, 69 papers were found, only four of which presented any comparison of treatment with or without scorpion antivenom.

### Comment(s)

While there are many case series and retrospective reviews in the literature suggesting that scorpion antivenom is safe and effective, there is only one randomised controlled trial of this treatment, which showed no improvement in symptoms or in preventing symptom progression. There was no difference in hospital admission rate or duration of stay, and no difference in mortality. Two other studies had similar results. Only Ghalim *et al* found any clinical improvement and this was mainly for local symptoms. Deaths in adults are very rare, and most patients have only local or mild systemic symptoms, which resolve with symptomatic treatment.

### ► CLINICAL BOTTOM LINE

In an adult who has been stung by a scorpion, there is very little evidence that giving antivenom will improve clinical outcome.

**Sofer S,** Shahak E, Gueron M. Scorpion envenomation and antivenom therapy. *J Pediatr* 1994;124:973–8.

**Belghith M,** Boussarsar M, Haguiga H, *et al.* Efficacy of serotherapy in scorpion sting: a matched-pair study. *J Toxicol Clin Toxicol* 1999;37:51–7.

**Abroug F,** Elatrous S, Nouira S, *et al.* Serotherapy in scorpion envenomation: a randomised controlled trial. *Lancet* 1999;354:906–9.

**Ghalim N,** El-Hafny B, Sebti F, *et al.* Scorpion envenomation and serotherapy in Morocco. *Am J Trop Med Hyg* 2000;62:277–83.

## Scorpion envenomation: does antivenom reduce serum venom concentrations?

Report by Bernard Foëx, *Consultant in Emergency Medicine and Critical Care*

Checked by Lee Wallis, *Consultant in Emergency Medicine*

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### Abstract

A short cut review was carried out to determine if antivenom reduces serum venom concentrations. Using the reported search, 69 papers were found, of which four presented the best evidence to answer the clinical question. The author, date, and country of publication, patient group studied, study type, relevant outcomes, results, and study weaknesses of these best papers are tabulated. A clinical bottom line is stated.

### Clinical scenario

A woman has been stung by a scorpion while buying bananas in her local supermarket. She is showing some signs of systemic envenomation and you wonder whether giving her antivenom will reduce her serum venom concentration.

Table 1

Author, date, and country	Patient group	Study type (level of evidence)	Outcomes	Key results	Study weaknesses
Sofer S <i>et al</i> , 1994, Israel	Children admitted to PICU after scorpion envenomation. Comparison of 52 children given antivenom between 10 July 1885 and 1 July 1989 and 52 children treated without antivenom between 1 July 1989 and Dec 31 1992	Cohort	Duration of PICU stay	No significant difference	Historical comparison. Children treated without antivenom may have benefited from improved supportive care
		Duration of hospital stay Full recovery	No significant difference 49 in antivenom group, 52 in control group		
		Death	2 in antivenom group, 0 in control group		
Belghith M <i>et al</i> , 1999, Tunisia	Patients participating in a study on the efficacy of high-dose hydrocortisone after scorpion sting. Matched pair comparison of 135 patients given scorpion antivenom in addition to their trial medication	Cohort	Clinical improvement	50% of antivenom group, 64% control group	Retrospective review of patients recruited into another trial. Results not stratified according to hydrocortisone treatment
		Prevention of progression of symptoms Duration of hospital stay Death	13% antivenom group, 10% control group No significant difference 1 in control group 55% antivenom group, 66% control group		
Abroug F <i>et al</i> , 1999, Tunisia	825 consecutive patients aged 10 or older presenting to a non-teaching hospital emergency department	Randomised placebo controlled trial of intravenous scorpion antivenom	Clinical improvement	55% antivenom group, 66% control group	Trial found to be underpowered to show any difference in mortality as mortality was so low
		Prevention of symptom progression Hospital admission	94% in antivenom group, 96% in control group 13% in antivenom group, 9% in control group		
		Duration of hospital stay Death	No significant difference 1 in each group		
		Effectiveness of antivenom according to sting admission interval	Antivenom more effective if sting admission interval <1 hour		
Ghalim N <i>et al</i> , 2000, Morocco	275 patients with scorpion envenomation, 179 of whom were treated with antivenom (IM, SC or both routes)	Prospective cohort	Local symptoms	Greater reduction in local pain and burning reported with antivenom	90% of patients had only grade I envenomation. No evidence that patients were randomised or that treatment was blinded. Statistical analysis of clinical features unclear. There appears to be a 50% baseline difference in incidence of systemic symptoms between the antivenom and no antivenom groups in favour of the antivenom group
		Systemic symptoms	Lower incidence of systemic symptoms in the antivenom group		

### Three part question

In [scorpion envenomation] does [antivenom serotherapy] [reduce serum venom concentration]?

### Search strategy

Medline 1966-11/04 using the OVID interface. [exp Scorpions OR scorpion.mp OR exp Scorpion Venoms OR scorpion venom.mp OR scorpionism.mp] AND [envenoming.mp OR envenomation.mp] AND [exp Antivenins OR antivenom.mp OR exp Immunization, Passive OR serotherapy.mp OR exp Immunoglobulins, Fab] LIMIT to human AND English language.

### Search outcome

Altogether, 69 papers were found, only four of which addressed the serum kinetics of scorpion venom after administration of antivenom.

### Comment(s)

The vast majority of patients had only grade I envenomation. Serum venom concentrations were higher in grade II than grade I envenomations.

Two studies showed that one dose of antivenom administered intramuscularly was not effective in reducing serum venom concentrations. Intravenous antivenom was effective in reducing serum venom concentrations compared to controls in two studies. Higher doses were more effective. Two studies documented clinical improvements with antivenom treatment.

### ► CLINICAL BOTTOM LINE

There is good evidence that intravenous administration of antivenom reduces serum venom concentrations. Whether this is clinically relevant is open to question.

Table 1

Author, date and country	Patient group	Study type (level of evidence)	Outcomes	Key results	Study weaknesses
De Rezende NA <i>et al</i> , 1995, Brazil	18 patients with signs of systemic envenomation	Cohort	Serum venom concentrations measured by ELISA before and after intravenous antivenom treatment Antivenom concentrations measured by ELISA before and after intravenous antivenom treatment	Venom antigens cleared 1 hour after antivenom  High antivenom titres persisted for 24 hours	No serum venom kinetics in a control group not treated with antivenom
Krifi MN <i>et al</i> , 1999, Tunisia	147 children under 15 years with grade II and III scorpion envenomation, divided into 6 groups according to whether given 1 or 2 doses of antivenom (IM or IV or IM and IV) and no antivenom	Cohort	Intramuscular administration	No significant effect on toxicokinetic curve or recovery time, when only one dose given	Unclear whether retrospective analysis or prospective study. No apparent blinding
Ghalim N <i>et al</i> , 2000, Morocco	275 patients, of which 179 were treated with antivenom. Antivenom administered intramuscularly (77.6%) or subcutaneously (6.2%) or both (16.2%)	Prospective cohort study	Intravenous administration  Epidemiology of envenomation	Rapid clearance of venom and shortened recovery time 247 showed only grade I symptoms. No patients with grade III symptoms	Venom kinetics not studied in grade II patients as they constituted only 10% of cohort
Hammoudi-Triki D <i>et al</i> , 2004, Algeria	182 patients (adults and children) stung by scorpions. Retrospective review of charts and blood results for those treated with intramuscular antivenom	Cohort	Toxokinetics in grade I envenomation  Clinical course  Epidemiology   Venom kinetics	Reduction in serum venom concentration. Greater effect of 10 ml versus 2–5 ml antivenom Symptoms improved with antivenom No grade III (severe) envenomations   10 ml of intramuscular antivenom did not alter venom kinetics	Retrospective review. Intramuscular rather than intravenous route used. Only one dose of antivenom given. Only 40 patients had post immunotherapy blood samples taken. Venom concentrations lower than in Krifi (1999) and Ghalim (2000) studies, although this may be due to ELISA differences

**De Rezende NA**, Dias MB, Campolina D, *et al*. Efficacy of antivenom therapy for neutralizing circulating venom antigens in patients stung by *Tityus serrulatus* scorpions. *Am J Trop Med Hyg* 1995;**52**:277–80.

**Krifi MN**, Amri F, Kharrat H, *et al*. Evaluation of antivenom therapy in children severely envenomed by *Androctonus australis garzonii* (Aag) and *Buthus occitans tunetanus* (Bot) scorpions. *Toxicon* 1999;**3**:1627–34.

**Ghalim N**, El-Hafny B, Sebti F, *et al*. Scorpion envenomation and serotherapy in Morocco. *Am J Trop Med Hyg* 2000;**62**:277–83.

**Hammoudi-Triki D**, Ferquel E, Robbe-Vincent A, *et al*. Epidemiological data, clinical admission gradation and biological quantification by ELISA of scorpion envenomation in Algeria: effect of immunotherapy. *Trans R Soc Trop Med Hyg* 2004;**98**:240–50.