

SUPPLEMENTARY MATERIAL for

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## **Functional weakness: clues to the mechanism of symptom formation from events at onset**

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These examples are given to be read in conjunction with the paper “**Stone J, Warlow C, Sharpe M. Functional weakness: clues to the mechanism of symptom formation from events at onset**”.

All patients were investigated by consultant neurologists and the diagnosis of functional weakness made where appropriate on the basis of signs of internal inconsistency and supportive negative investigations<sup>1</sup>.

All case descriptions have had details anonymised, for example gender changed and identifying details removed (except for Case 4 for which consent for publication was obtained).

### **Panic, dissociation and non-epileptic attacks at onset**

In 34% of patients with functional weakness (and 59% of sudden onset patients) there were clear symptoms of panic at the moment of onset – that is symptoms diagnostic of a DSM-IV diagnosis of a panic attack. In many cases the symptoms of panic, dissociation and a blackout / non-epileptic attack merged in to each other.

In this first example there was clear evidence of a panic attack during which the patient experienced heaviness over his chest, left arm and left leg. He was off work for four months following this and still had mild weakness seven months later.

*A middle aged man developed sudden left-sided weakness while sitting at work talking to colleagues. He felt an ‘acid burning’ in his stomach, then an incredibly heavy sensation over his chest, left arm and leg. It felt as if someone was standing on his chest and that his “brain was sending out millions of signals at once”. He felt dry, hot and then cold and was sweating. He said the office “didn’t seem right” and he felt “spaced out”. His body felt detached and he didn’t feel that his left hand belonged to him. His left arm felt weak. He was having problems breathing, and two people in the office thought he might be having a heart attack. He was rushed to hospital where a nurse said to him “you have to lie still because we can’t get an output”. He said “a couple of people had to hold me down because I was shaking so much” and he was given morphine and oxygen. He thought he was going to die, he felt as if his brain has switched off and he had lost control completely of his body. When the fear subsided he felt weak in his left arm and leg. A cardiac or gastrointestinal cause for his chest pain was subsequently ruled out. Relating the story seven months later clearly upset him.*

In this next example, the patient had dissociative symptoms which lead on to panic with hyperventilation. Unilateral pins and needles occurred at this point in the attack and later she was more aware of weakness:

*A young woman recalled having a “fuzzy head” that ‘wasn’t right’ for two days prior to onset She was working when she found that she could not hear a customer talking to her. He sounded muffled. She said that “everything was spinning” and “I didn’t know where I was”. She said that it was “as if I wasn’t there” and began to feel very frightened as if she might die with breathlessness. She noticed some pins*

*and needles in her right arm and leg. She noticed her speech was a little slurred and then over a 15 to 20 minute period developed right arm weakness. An hour or two later she noticed her right leg was also weak.*

In this next example the patient had episodes with prominent dissociative symptoms, again followed by panic which sometimes led to a blackout (which might be labelled a non-epileptic attack) and sometimes led to weakness:

*A 36 year old woman had recurrent attacks of left sided weakness with persistent weakness in between, as well as blackouts occurring three or four times a month particularly during exertion and sex. A 'blackout' attack began with a sensation that she was "floating". During the attacks she often felt "as if I'm outside my body" "looking from the outside". She felt that during these periods "time was slowing down" and everything was "not real". Her partner noticed that that her breathing became slow. The sense of unreality was followed by an unpleasant overwhelming sensation as if she was going to die and she tried to calm herself down. Sometimes, if she failed to be able to do this she then lost consciousness for anything between minutes to half an hour. During this time she was observed to be motionless by her partner. On other occasions the attacks evolved with headache, the same dissociative symptoms and a sudden feeling of lack of control over the left arm and leg which was bad enough to make her fall over but didn't lead to a blackout.*

In this next example there was prominent and prolonged dissociation, with some panic and a period of relative amnesia.

*A 38-year-old lady was making a phone call when suddenly the phone fell out of her left hand. She felt as if "some one had pulled the plug out of my neck" and "drained my whole body". She thought 'Oh my god I'm dying' and had a "weird feeling". She only had vague memories of the next three to four hours. She said she could hear people talking but could not see them and felt as if she was not there. While she waiting to see the GP in this state she found that her left leg became weak, 'as if I had been lying on it'. This progressed to a feeling of weakness down the whole of the left hand side. She was told she may have had a "mini stroke" which frightened her even more. It gradually recovered over a week but on the first day that she returned to work (two to three days later) she felt "really numb all over" and had the weird feeling again. She felt "confused" like a "girl in a school ground".*

In this last example there was a more clear cut non-epileptic attack interposed between symptoms of dissociation, panic and weakness

*A 29-year-old woman was told about a terrorist attack on the news. She said that this "did not really register" and she carried on talking to her sister-in-law "about babies and other things". Fifteen minutes later she started to "not feel right". She felt that she couldn't hear things properly and her eyes became sore. She "felt something was going to happen to me" "but no idea what". She said that everything was odd and it was as if she was 'on the outside looking in'. She went to a different room because she was anxious for the attack not to occur in front anyone and remembers looking for somewhere to fall down. She was then unresponsive for about 10 minutes and was seen jerking with her*

*eyes rolled up during this episode. There was no incontinence or tongue biting. She slept in the ambulance and had no memories until she came round in hospital. As soon as she came round she thought "I've only got half a face" and she noticed that her left arm and leg felt weak. She felt very frightened about the attack and about the weakness. Subsequent attacks were witnessed on the ward during which her eyes rolled upwards, her whole body shook and she breathed fast for about 10 seconds before coming round again and being able to talk within a minute or two. These were documented with EEG as non-epileptic attacks. The left sided weakness persisted for a few weeks.*

### **Pain and physical injury at onset**

Another repeated scenario in the sudden onset group was that of patients who developed their weakness either at the instant of a physical injury or in relation to acute pain in the limb

#### ***Injury***

The injuries were often trivial but the shock felt by the patients often great. The injuries included the following:

Injuries specific to the site or side of weakness onset

- Hot water burn to lateral ankle – requiring dressing but not grafting
- Intramuscular injection in to buttock
- Sprained ankle on road kerb while running to help son
- Tyres rolled repetitively off dorsum of foot
- Fell off horse with bruising and tingling to left face. No loss of consciousness
- Dental anaesthetic
- Side impact injury in car accident. Bruises only

Non specific injuries

- Punched in the chest by partner
- Assaulted by partner
- Fell off horse - head injury - no loss of consciousness
- Whiplash injury from a road traffic accident
- Acute back pain after trying to lift a heavy bin

Here are some case examples. The first is particularly interesting because of the combination of physical injury, dissociation (with dissociative amnesia), panic and subsequent ‘discovery’ of his arm weakness by a physiotherapist.

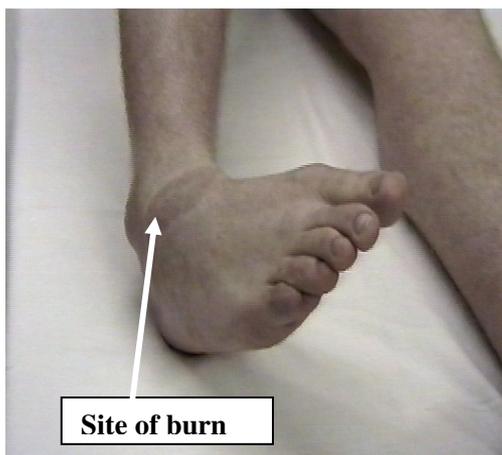
*A young man developed functional right foot dystonia and leg weakness after a scald to the lateral aspect of his right ankle. Some boiling water had entered his boot which he maintained was the fault of*

*an engineer on site. His work colleagues had taken his clothes off and hosed him down with cold water. He was clearly conscious and was talking although he was not able to have a conversation with them. According to his girlfriend who was on the scene shortly thereafter he was panicking and was extremely distressed at the scene of the injury with shouting and screaming. He himself couldn't remember the injury actually happening and subsequently had amnesia for an hour. The first memory he had was of being in hospital and seeing the ceiling of the casualty department He was nauseous and light-headed and had a 'buzzy feeling' in his head. He was kept in hospital one night and his scald required simple dressing only. . He was told not to weight bear on his right foot and walked with crutches or sat with his feet up*

*Over the next six weeks he never looked at the scald although he recalls everyone else looking with horror at it whenever the bandages were dressed. When he went to hospital to have the dressing changed he was given "gas and air". In the weeks after the injury his right ankle started inverting because it was a slightly more comfortable position to be in and because he was worried about the wound (on the lateral aspect) getting worse. On the first occasion he was asked to weight bear by a physiotherapist the wound burst and 'lots of pus' came out. After this he was reluctant to weight bear again. His right fixed ankle inversion became gradually worse over the next couple of months with increasing weakness of the whole right leg and subsequently back pain and insomnia. . Several months in to this illness a physiotherapist noticed that his right arm was also weak, something he himself had not been aware of.*

*Diagnoses of a 'slipped disc' and of dystonia were suggested and a legal case was ongoing. He was subsequently cured with physiotherapy and persuasion (which included intravenous sedation to show him that his ankle could straighten again without anything 'snapping' (Figure 1)) He remained well following this and in full time employment for the subsequent 4 years despite having had this problem for 2 years prior to successful treatment*

**Figure 1. Functional dystonia associated with functional leg weakness before and during intravenous sedation (this case gave consent to publication)**



*Before*



*During Anaesthesia*

In the next case, there is a rapid onset of leg weakness in relation to acute pain in the ipsilateral buttock.

*A 35-year-old lady was referred to neurology after developing an acutely weak right leg during a surgical admission for abdominal pain and vomiting. She had severe somatisation disorder having had a pan proctocolectomy in the absence of definite disease as well as non-epileptic attacks leading to ITU admission, 4-5 admissions a year with abdominal pain, ovarian cystectomy, hysterectomy age 26 and complex regional pain with a 'clenched fist'*

*On this occasion she had been in hospital for 7 days on morphine injections. She was given an IM injection of Nefopam in to her right buttock (upper outer quadrant) after which she developed severe pain down the right leg followed after 2 minutes by descending paralysis and numbness of the right leg over a minute. She describes this as terrifying. Within five minutes both legs were completely paralysed*

In the next case there was hardly an injury at all but the symptoms appeared to arise after a mild sprain and a period of iatrogenic immobility. There may have even been a temporary nerve injury although by the time of investigation, if there had been one it had gone.

*A 31-year-old man developed complete paralysis of his right ankle after rolling car tyres down his body and flicking them with his foot to a friend for a few minutes. After he finished he noticed that he was tripping over when he walked, and that his foot was completely numb below his ankle. As he was driving home he had to lift his foot from the hip to work the accelerator and brake pedals and thought "that's weird" but had no sense of unreality. He initially thought it was an ankle strain and not something serious but later on that night when it did not get better he went to casualty. Their management was to place a plaster on his ankle to keep the foot at 90 degrees and the next day put his ankle in a splint which remained for several weeks. When his foot came out of the splint he had no movement of the ankle in any direction with complete numbness below mid-shin.*

The final case illustrates the onset of weakness after a more general injury.

*A 51-year old man with no significant past medical history developed profound weakness of his left leg and mild weakness of his left arm following a fall from a horse. He had had numerous falls from horses in the past. On this occasion he was thrown over the front of the horse and remembers going through the air but then said that "everything went black" for a few seconds. When he came round he put his hand to his head and thought it was bleeding. In fact it was just his hand that was bleeding. When he stood up and tried to walk he found that his left leg wouldn't move at all. He was initially able to hobble on his right leg. He was admitted to hospital where his left leg weakness seems to have deteriorated over the next day or two to the point where he had no movement at all. He also had reduced sensation in a "trouser leg distribution" from his left groin downwards and began developing some left lower quadrant abdominal pain.*

Injuries of course may be focused on by patients who are pursuing some kind of monetary compensation. It is therefore worth noting that this applied in only four of the eleven patients who had a physical injury prior to onset.

## **Pain**

In other patients with functional weakness, pain appeared to be an important factor at onset even though there was no specific injury. The following cases are illustrative and demonstrate that bed rest or resting of a limb was often present in combination with pain:

*A 21-year-old man presented with a fourteen-month history of right shoulder pain and weakness. He had his first injury whilst horse riding aged fifteen. He landed on his right shoulder and although the x-ray was normal seems to have been told that he had a problem with the right sternoclavicular joint. He could not use the arm properly for about six months but it did recover reasonable function. He then hurt it again aged sixteen playing rugby and was out of action for a month or two. The same thing happened a year later when he fell off a motorbike. He had never had weakness with these shoulder injuries. At the time the arm weakness came on he could not think of any specific precipitant. He was working as checkout operator and going to the gym regularly. He recalls just waking up one morning with the symptoms of pain in his right shoulder again radiating down to the whole of his right arm. He then experienced gradual onset of weakness over several weeks presenting eventually when he was unable to move the arm at all.*

In this next example, low back pain in combination with bed rest precedes the onset of leg weakness. Similar stories were found in a number of patients:

*A 41-year-old woman presented with a 7-month history of multiple symptoms including right leg weakness. She described how 7 months previously she had come home from work, ran up 40 stairs, and kicked off her left shoe. This was associated with severe pain over her whole back "like a knife". She was screaming with pain and vomited and felt light-headed, was clammy, sweaty, and incontinent of urine and remembers being very frightened. Following this she spent the best part of the next 3 months in bed in various hospitals mostly for investigation of back pain. About 3 months after the onset of back pain and during this period of immobility she became increasingly aware that she could not move her right leg.*

In this final example acute back pain is clearly linked with the onset of weakness in a patient who is vulnerable to catastrophisation about symptoms because of his medical history and the reaction of family and professionals around her. There is a mild episode followed later by a more acute episode:

*A 25-year-old man had his left scapula removed because of a bone tumour three years prior to left leg weakness. Two months prior to the onset of weakness, he developed gradual onset lumbar back pain. On the day of onset he was sitting at home with friends when he developed pins and needles in his left leg, which felt heavy with no other symptoms. He was admitted to hospital with a clear concern that he may have had a recurrence of his tumour. His admission lasted two weeks and he had a bone scan and MR scan of her spine, which were normal. He was discharged walking with crutches with mild leg weakness but no firm diagnosis. He continued to have niggling lumbar back pain. One month later he was lying on a couch watching TV. He experienced "the most incredible pain" in his lumbar spine. He then tried to stand up and realised that he couldn't move his left leg at all. The GP that came to see him told him that he "couldn't get a pulse". He went to hospital again where they again thought there was a strong possibility of tumour recurrence. Subsequent investigations were however normal and clinically there was marked functional left leg weakness.*

### **General Anaesthetic**

In two cases, weakness was noted on coming round from an anaesthetic. This is now a well described occurrence in non-epileptic attacks. We have also seen a patient enter a psychogenic coma for five days after a brief general anaesthetic for insertion of a suprapubic catheter. Here is one of the cases

*An 18-year-old female with a history of childhood sexual abuse, overdoses and an uncertain diagnosis of epilepsy developed left-sided weakness following an anaesthetic for termination of pregnancy. She had not told her parents about the termination as she felt they would be disappointed in her. She remembers on coming round from the anaesthetic being able to hear people speaking but not being able to open her eyes. Although she knew they were speaking English she could not really understand what they were saying as the words were not "going to her brain". It felt "pretty scary". Initially she said that she was not very worried but then everyone seemed to be panicking and then she panicked. She said 'I was there but not quite there', 'it was like I had no control over my body', and 'my mind was in someone else's body'. Medical staff observed her to be unusually unresponsive for a period of several hours. The rest of that day was rather hazy and she feels that quite a period of time was missing. When she became more aware later that day her left arm and leg did not feel as if they were "part of my body" for a while but fully recovered within a few days.*

### **Arising from sleep paralysis**

Two patients gave a description of weakness that appeared to start after a recurrent experience of sleep paralysis on waking. In both cases there was sleep disturbance with disruption of normal sleep architecture that would have made sleep paralysis more likely. It is not possible to say whether the feelings of paralysis arose from sleep paralysis per se or simply the leaden limbed feeling that many of us have when we are forced to wake up earlier than we might have otherwise wished. In this example the patient had previously experienced paralysis of unknown aetiology which may have 'primed' him for the second episode.

*A 31 year old man had previously been experiencing increasing fatigue, concentration problems and worsening back pain. One day he collapsed in his house - his legs seemed to just 'give way' and he was incontinent of urine but there was no associated back pain. He was admitted to hospital and the weakness resolved within three to four days. Several months later he woke up at 2am to find that he could not move any part of his body and could not speak. He eventually managed to move normally after 15 to 20 minutes and then went back to sleep. During this experience he said it was like there was a 'ton weight' on his body. When he woke in the morning he had the right arm and leg heaviness that he has had ever since. He has had four other episodes all arising from sleep in a similar manner over a three month period.*

### **On waking**

In thirteen other cases the symptoms were noticed on waking, often with various combinations of panic, dissociation, pain and fatigue. In this first example the patient could not remember any other symptoms at the onset.

*A 26-year-old woman noticed some problems with her right elbow 'locking'. A couple of weeks later she got out of bed in the morning and discovered that she was unable to stand on her right leg. It felt like jelly, there was no sensory disturbance and she thought it might have been due to the way she had been*

lying in bed. She also noticed that the grip of her right hand was slightly diminished. Her symptoms gradually got worse such that after a couple of months she had much worse 'achy' weakness of the right leg - with difficulty walking to the shops. She was using both hands just to lift up a glass and could not lift her right arm above 90 degrees. She also found she was becoming tired and exercise made her sweaty and out of breath. She found herself gradually feeling more frustrated with her disability and had periodic bouts of crying. Her mother advised that she should lie on the sofa for most of the day.

### **Migraine**

In eight cases there were symptoms of a migraine around the onset of the symptom, again often with a mixture of other potentially relevant factors. In this example the onset of the trouble seems to have started with a migraine with aura and a faint (or non-epileptic attack), compounded by iatrogenesis, fatigue and persistent dissociative symptoms at the onset of the weakness.

*A 37 year old woman woke up with a severe left side headache in the early hours of the morning and could not sleep. Within an hour or two she was "screaming in pain" with marked photophobia, nausea with some mild right sided tingling. The following day she went to work but vomited for most of the day and then just as she was about to go home feeling ill, she fell off her chair, lost consciousness and the next thing she knew she woke up with paramedics around her. She was admitted to hospital where a CT brain scan and lumbar puncture were normal. For the next week she had marked fatigue, a post-lumbar puncture headache and was "not quite with it". She then noticed a gradual onset of weakness in the right arm and leg and lost confidence doing things*

### **Gradual onset with fatigue and asymmetrical limb heaviness / bed rest**

In contrast to these mainly 'sudden onset' cases were patients that developed gradual onset weakness over weeks or months (39%). They often had a clinical picture typical of chronic fatigue syndrome prior to onset.

*A 58-year-old lady gave a one-year history of progressive difficulty with walking and weakness. This started as a feeling that she was generally tired and 'not herself' with a heavy feeling in her head. She gradually noticed mild weakness of the right arm and leg which spread to involve all four limbs. The symptoms were worse at night and when tired. When she walked she had to concentrate hard to put one foot in front of the other. She had also been experiencing: jumping legs, pain in her legs, pins and needles (forearms and fingers), weakness of her hands (dropping things), fingers feeling swollen and tight, intermittent blurred vision while reading, poor memory, some stuttering of speech, slight weakness of bladder with some dribbling and stress incontinence, recent reduction in appetite and weight, irritability and poor sleep for 6 months. She commented that her symptoms had taken most of the fun out of life.*

In five patients with functional weakness, there was a considerable period of bed rest prior to the onset of the symptom (e.g. case described in figure 7.3). The bed rest was normally precipitated by an injury or pain so is not necessarily an independent factor. However, the fatigue and relative 'disembodiment' of lying in bed for a long time may be relevant factors in weakness onset.

**Someone else noticed it first**

In six patients with functional weakness it was someone else and not the patient who noticed the weakness first. In three of these cases a family member noticed the problem first and in the other three, weakness was found first by a doctor or physiotherapist examining the patient. Whether this indicates that functional weakness is commonly unnoticed by patients or that doctors and relatives can 'shape' the production of a symptom by suggestion is uncertain

**References**

- (1) Stone J, Warlow C, Sharpe M. The symptom of functional weakness: a controlled study of 107 patients. *Brain* 2010.