CASE REPORT

Successful management of benign paroxysmal positional vertigo (BPPV) in a patient who was ventilated with a C3 complete spinal injury on a regional spinal unit intensive care

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SUMMARY

Benign paroxysmal positional vertigo (BPPV) occurs in 14.5% of patients with spinal cord injury (SCI) and may require intervention on intensive care unit (ICU). A 61-year-old man was admitted to a spinal injury ICU with a traumatic C3 complete SCI following a mountain bike accident. Ventilated but stable he complained of severe dizziness on rolling, during personal cares, which lasted for 40 s. Clinical examination was limited due to the injury and ventilation. Subjective questioning, visio-ocular control and a modified Dix-Hallpike and roll tests confirmed a right posterior canalithiasis BPPV. A modified right Epley was performed with assistance of four people, medical supervision, monitoring of tracheal ventilation and vital signs. No adverse reaction was observed. Resolution of dizziness on rolling was achieved with no recurrence at 1 year. BPPV can be successfully and safely managed on ICU.

BACKGROUND

Benign paroxysmal positional vertigo (BPPV) is a peripheral vestibular condition and is characterised by brief episodes of rotatory vertigo associated with head movements and a positionally induced nystagmus.¹ Reported dizziness with BPPV typically lasts less than 30 s on head movements and is latent, fatiguing and habituating.¹ It is caused by otoconia 'crystals' becoming detached from the sensory hair cells in the inner ear vestibules. The otoconia are then free to move into one or more of the semicircular canals and as the head moves, the otoconia moves around the canal-stimulating sensors. Conflicting information in the brain causes dizziness and usually a directional nystagmus.¹

Lee *et al*² identified the incidence of BPPV in patients with spinal cord injury (SCI) admitted to a regional spinal rehabilitation unit as 14.5% with the possibility of cervical SCI leading to BPPV being 2.87 times more likely compared with thoracic or lumbar SCI. BPPV has an increased occurrence of 5%–27% with traumatic brain injury/head trauma³ and 34% with whiplash injury.⁴ Cervical SCIs are frequently ventilated due to respiratory complications.⁵

Physical examination is limited in patients with SCI especially on intensive care unit (ICU) so it is fundamental that other causes are considered and

symptoms fully explored in the subjective examination as presentation can vary between, for example, BPPV and postural hypotension (box 1).^{1,6}

Patients with BPPV need not undergo further audiology and imaging investigations.¹ Questions such as: 'what kind of head movements induce the vertigo'; 'how long does the vertigo continue'; 'do you experience dizziness rolling over in bed' and 'which ear is lower most when experiencing the strongest symptoms' are (69%) accurate in identifying posterior canalithiasis BPPV.⁷

To ensure safety, during a reasoned objective assessment and treatment, Lee *et al*² made the following recommendations:

1. Obtain medical clearance regarding spinal and medical stability.
2. Obtain informed consent and insure patients able to comply.
3. Ensure neck and back are pain free in available range of movement.
4. Modify procedures and provide appropriate support throughout.
5. Prepare and modify the environment.
6. Prepare any modification for spinal stability for example, cervical collars.
7. Consider any other possible unforeseen circumstances.

Lee *et al*² validate that, following these guidelines, the Dix-Hallpike test, Roll test, Epley manoeuvre and Barbeque Roll manoeuvre are safe and efficient at assessing and treating BPPV in patients with SCI, respectively, although the speed at which the Dix-Hallpike test is performed was not discussed by Lee *et al*.^{1,2} There is conflicting evidence as to the effective speed of diagnostic and treatment manoeuvres.^{8,9} A Semont's manoeuvre is potentially more speed critical than an Epley manoeuvre.¹⁰

Lee *et al*² modified assessment and treatment techniques for people with cervical SCI and performed them on ward patients admitted for rehabilitation. A directional, rotational, latent and fatiguing nystagmus during either a Dix-Hallpike test or a Roll test is diagnostic of BPPV,¹ and the use of Frenzel or VNG goggles ruling out the inhibiting effect of eye fixation is the 'gold standard' for diagnosis.^{1,2}

Diagnosis of BPPV without nystagmus is based solely on clinical history and physical examination.¹¹

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Box 1 Clinical symptoms of benign paroxysmal positional vertigo (BPPV) and postural hypotension^{1 6}

BPPV

- ▶ Spinning vertigo, light-headed or imbalance.
- ▶ Latency of symptoms typical 0–15 s.
- ▶ Duration 15–90 s.
- ▶ Nystagmus torsional, directional.
- ▶ Canalithiasis <60 s.
- ▶ Cupulolithiasis >60 s.
- ▶ Reversal of nystagmus on sitting.
- ▶ Habituation with repeated movements.
- ▶ Related to head positions and head movements.

Postural hypotension

- ▶ Orthostatic hypotension is a fall in systolic blood pressure (BP) of at least 20 mm Hg or in diastolic BP of at least 10 mm Hg within 3 min of standing or during a head-up tilt of at least 60°.
- ▶ Dizziness ongoing.
- ▶ Slight light-headedness.
- ▶ Blurred vision ongoing.
- ▶ Fatigue.
- ▶ Palpitations.
- ▶ Neck ache.
- ▶ Syncope.
- ▶ Symptom remission on lying down.

The treatment of BPPV without nystagmus using Epley and Semont's manoeuvres is successful in 50% to 97% of patients. In patients with BPPV and a nystagmus, symptom remission ranged from 76% to 100%. These differences may not be significant, which points to the need for more studies on BPPV without nystagmus.¹¹

There is no published evidence to date of BPPV being identified and successfully and safely treated on a spinal injury ICU. Therefore, this case review aims to document the safe and effective treatment of BPPV on a regional spinal injury ICU, an area where staff may not be familiar with the presentation of BPPV and in an environment with conditions that restrict specialist assessment of possible vestibulopathy.

CASE PRESENTATION

The patient

A 61-year-old man was admitted to a regional spinal ICU following treatment at a hospital in different hospital where he had been managed following a mountain bike accident 4 months previously. The patient had initially sustained a hyperextension injury and the resulting SCI presented as a C3 complete tetraplegia for which he had an anterior discectomy and cage fixation at C3–C6. On admission to the spinal ICU, the patient required ventilatory support with a cuffed tracheostomy tube. He had bradycardia and had previously had a cardiac arrest prior to being transferred to spinal ICU. The admission to spinal ICU was to attempt ventilatory weaning. With a stable injury site and no pain during sitting out in a wheelchair (1–2 hours daily), the only other symptoms were episodes of bradycardia. He did experience a light-headed/faintingsensation on lying to sitting, which was confirmed postural hypotension on testing, but he described this as different to the 'intense spinning' he experienced on rolling during personal cares.

It was highlighted that the patient had been experiencing a sudden onset of dizziness during his daily care on quick rolls to the right and that bedside earwax removal had not resolved symptoms. Three weeks after admission, the advanced vestibular specialist physiotherapist independent prescriber was asked for an opinion regarding the dizziness.

The patient's goal

No dizziness when rolling to the right.

History of symptoms

The patient had no history of dizziness but had noticed the room spinning following quick turns to the right only; right ear lower most. He experienced nothing on quick rolls to the left. The spinning had been present for 4 months following his accident and would stop after 40 s if he were allowed to remain still. He denied any associated symptoms including tinnitus, pressure, fluctuations in hearing or hearing loss, headaches, migraines and so on. He described being worried initially but had got used to it even though it made him anxious about rolling to the right. He also experienced postural hypotension on sitting that remained unless he was able to lie down again and which he reported to be a different light-headed and woozy sensation with a slurring of his speech and some visual blurring. His blood pressure and heart rate were stable at the time of assessment and the spinal ICU consultant was happy for modified vestibular tests to be performed while his vital signs were closely monitored (blood pressure, heart rate, etc). He had cyclizine daily.

Medical history

Prior to the mountain bike accident, the patient was healthy, active and medically well. At the time of assessment, he was ventilated due to a complete C3 SCI as previously described. He had bradycardia and orthostatic blood pressure. There were no positive answers to any other special questions.

Drug history

The patient had no drug history. But his current medication are the following: zopiclone 7.5 mg; Docusate sodium 100 mg; saline nebuliser; testosterone; salbutamol 2.5 nebuliser; Traxam gel; amlodipine 5 mg; lorazepam 1 mg when necessary (PRN); cyclizine 5 mg PRN; tramadol 50 mg PRN; nifedapine 5 mg PRN; oxygen 28% PRN.

Social history

The patient was a dental surgeon, living with wife leading an active and healthy life. Enjoyed mountain bike riding.

INVESTIGATIONS

There are no investigations in line with BPPV guidelines.^{1 2}

Further investigations would be appropriate if a downbeat nystagmus was present on Dix-Hallpike as in a rarely seen anterior canal BPPV but more commonly in central pathology and also with altered visio-ocular control on bedside testing as this more commonly indicates a central cause.^{1,2} This was not observed in this case. Multicanal BPPV increases in prevalence with head injury,^{2–4} highlighting the need to test all semicircular canals if possible.

DIFFERENTIAL DIAGNOSIS

Vestibular assessment

An advanced vestibular physiotherapist independent prescriber performed a modified vestibular assessment (limited by the patient's medical condition, ICU environment

and neck range of movement) to differentiate peripheral and/or central causes of dizziness.

Objective assessment

The patient had taken cyclizine, a vestibular suppressant, earlier in the day. Cranial nerve examination was normal other than shoulder shrugging on bedside testing in 45° supine, as was visio-ocular control (gaze, tracking, saccades, convergence, divergence, skew eye deviation, etc). It was not possible to test the active vestibular-ocular reflex or perform the head impulse test due to the available range of movement in the cervical spine (limited to 5° left and right, 5° flexion and extension) and the speed at which these techniques have to be performed due to the SCI and fixation at C3.

The Dix-Hallpike^{1 2} procedure was modified using the bed tilt/recline angle to give a head-down position and patient body angle at 30°, thus altering the head position in relation to gravity and not in relation to the patient's body. It was performed at a moderate speed, comfortable for the patient. Three ICU nurses assisted with the positioning, the vestibular physiotherapist controlled the head position and the vital signs monitored by the ICU consultant. The patient was then rolled to the left. On the left Dix-Hallpike, the patient experienced a mild spinning vertigo lasting 10 s, which was latent and fatigued, but no nystagmus was observed. The patient was then brought back to sitting using the bed where the patient rested for 3 min until he felt able to continue. The procedure was repeated on the right; the right Dix-Hallpike produced a very strong spinning vertigo sensation that lasted 40 s, was latent and fatigued in a crescendo-decrescendo pattern. No nystagmus was observed; however, the symptoms did habituate with a repeated right Dix-Hallpike test. In line with the guidelines, a roll test was performed in the absence of nystagmus on Dix-Hallpike.^{1 2} The roll test was negative on the right and left.

Vital signs remained stable and within normal limits (monitored by ICU consultant) during the assessment ruling out bradycardia and postural hypotension causes. The patient described being pain free and comfortable throughout.

Clinical reasoning

The latent, fatiguing and habituating spinning dizziness lasted 40 s. This is not representative of a cupulolithiasis due to the duration of patient reported symptoms on Dix-Hallpike.¹ There was no nystagmus possibly due to cyclizine, and there were no Frenzel glasses available at the bedside to reduce fixation. The patient had no associated symptoms of nausea or headache and so on. He described it to be different to postural hypotension and symptoms occurred during quick rolling to the right and are most severe on right Dix-Hallpike/rightear lower most. It followed high velocity impact to the head and neck,^{3 4} increasing incidence and appears peripheral in origin. The most common cause is posterior canalithiasis BPPV although there is a possibility of multi-canal involvement with head trauma.^{3 4}

Impression

Right posterior canalithiasis BPPV.

Outcome measure

Dix-Hallpike test—right positive subjective symptom presentation. Rolling right in personal care.

TREATMENT

Right modified Epley manoeuvre^{1 2} one cycle with four people. The same procedure was initially used as in the right Dix-Hallpike. After 1 min, the patient was then rolled to the left keeping his head in line with his body towards a left-side lie 45° angle. After 1 min, he was rolled forward to face the floor at a 45° angle; after 1 min he was sat up, with his feet over the side of the bed, using the bed and assistance of 4 for 2 min. He was then positioned back in bed supine long sitting at a 45° angle. No adverse effects on vital sign monitoring or patient discomfort witnessed. No post-Epley advice given.^{1 2} The patient was asked to indicate when he felt comfortable to move to the next position at every stage.

A Semont's manoeuvre is as effective as an Epley^{1 2}; it was not done in this case due to the need to control the patients movements with the assistance of four people while monitoring vital signs. No trunk control makes a Semont's manoeuvre very difficult in this situation and frightening for patients with SCI. Semont's manoeuvre is also more speed dependant,¹⁰ making the Epley more suitable in this case.

OUTCOME AND FOLLOW-UP

Symptoms resolved within 24 hours post-Epley on ICU, that is, repeat modified Dix-Hallpike test—right negative (no dizziness reported by patient). The patient reported:

- No further dizziness during personal cares for example, rolling/turning by carers during his time in the regional spinal injury unit.
- No symptoms on transfer to another regional unit for rehabilitation (transfer records highlighted BPPV, the treatment received and potential recurrence rates).
- No recurrence or dizzy symptoms were reported in the 4 years following treatment.

The patient died 4 years postdischarge from the ICU regional spinal injury unit and reported no problems with positional dizziness during that time.

DISCUSSION

This case study highlights the identification and successful treatment of right posterior canalithiasis in a C3 complete patient with SCI on ICU.

Correct diagnosis and treatment depends on identifying correct symptom characteristics and requires condition recognition by carers, appropriate subjective questioning, limited objective assessment and coordinated specialist treatment closely monitoring vital signs. There is evidence of suppressed nystagmus and successful treatment of BPPV in literature¹¹ which supports this diagnosis and intervention. It highlights that it is not always necessary or possible in this environment (ICU, acute or bedside settings) to observe a nystagmus to diagnose and treat BPPV despite this being the recognised gold standard. This case demonstrates that slow-sustained Dix-Hallpike and Epley positions are effective at identifying and treating BPPV in these situations and may mean more patients could be identified for assessment, thereby achieving a meaningful diagnosis of BPPV and successful intervention impacting on quality of life.

Risk factors

Environmental constraints on ICU; wires, monitors, alarms and ventilation equipment; changes to ventilation and vital capacity; patient unable to assist with body movements; medical complications, for example, cardiac arrhythmias, postural hypotension

Patient's perspective

- ▶ 'I feel so much better rolling over, the fear has gone'.
- ▶ The patient lived for a further 4 years following his injury and did not experience dizziness on rolling again following the Epley manoeuvre. The patient's widow consented to this case publication in the hope that other patients in similar situations may benefit from this knowledge.

Learning points

- ▶ Benign paroxysmal positional vertigo (BPPV) can be successfully and safely identified and treated in patients with spinal cord injury (SCI) on intensive care unit.
- ▶ VNG/Frenzel goggles recommended for differential diagnosis.
- ▶ Recommend patients not on vestibular suppressants for assessment
- ▶ The patient no longer required vestibular suppressant medication for dizziness.
- ▶ Subjective questioning is crucial to identifying characteristic of BPPV to direct a limited objective examination.
- ▶ More research is needed into BPPV without nystagmus in patients with SCI.

and so on. Poor recognition of BPPV prolongs anxiety/fear for patients.

Benefits

Education on condition recognition will assist medical professionals and carers and improve the identification and treatment of BPPV in SCI on ICU where there is potential increased risk. Collaborative working improves patient's outcomes when managing dizziness. Improved diagnostics may be possible with Frenzel lenses (infrared, if possible).

CONCLUSION

Successful identification of BPPV in patients with spinal injuries on ICU can improve care experiences and potentially quality

of life, reduced medication and anxiety levels. Education and equipment can improve the assessment, diagnosis and treatment of patients with SCI on ICU presenting with dizziness. All levels of healthcare professionals including medics, healthcare assistants and carers benefit from training on symptom recognition to improve identification and patient management.

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