

Influence of peripheral venous cannulation on delivery of upper limb rehabilitation in Stroke patients

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Abstract

Aim

Intravenous (IV) peripheral cannulae can lead to several complications if placed in a hemiparetic limb. One significant concern is the negative effect this may have on a patient's capacity to participate in upper limb rehabilitation. The aim of this study is to examine existing practices around IV cannulation in patients with hemiparesis, evaluate the impact of peripheral cannulae on therapeutic interventions, and explore the underlying reasons for this.

Methods

A digital questionnaire was developed. All occupational therapists (OTs) and physiotherapists (PTs) who were engaged in treating stroke patients at Leeds Teaching Hospitals NHS Trust (LTHT) were invited to participate.

Results

In total 23 healthcare professionals (HCPs) responded (52.2% OTs: 47.8% PTs). 19/23 (82.6%) of respondents observed a cannula in the stroke-affected limb in their sessions. 15/23 (65.2%) of respondents reported having to postpone or reschedule their patients' therapy sessions due to the presence of an IV cannula. The primary reason for postponing sessions was dislodgement risk (11/23), followed by tissue injury and concerns of pain (7/23). 2/23 (13.3%) and 8/23 (53.3%) of therapy staff stated sessions had to be cancelled on a weekly and monthly basis respectively.

Discussion

Our findings suggest IV cannula placement on the stroke affected side can negatively interfere with therapeutic interventions and necessitate session modifications. Addressing these

concerns could lead to more effective rehabilitation and better patient experience in stroke recovery.

Introduction

Stroke patients commonly require venous access for diagnostic tests (imaging contrast agents) therapeutic interventions (such as thrombolysis and antihypertensives) and treatment of any complications (such as infection or reversal of anticoagulation). Peripheral intravenous (IV) cannulae are associated with complications including infection, thrombosis, pain migration and inadvertent removal.¹ While it is often advised against cannulating an extremity with sensorimotor deficit, there is insufficient research examining the effects of this practice, especially in relation to, therapeutic interventions, and patient recovery.² There are, however, opinion pieces in the literature advising against cannulating a hemiparetic upper limb unless in an emergency. Similarly, case report evidence advocates avoiding this practice to minimise the risk of venous thromboembolic (VTE) events.^{3,4}

This study aims to assess current practice on the stroke units at Leeds Teaching Hospitals NHS Trust (LTHT) and the impact peripheral IV cannulae have on therapeutic upper limb interventions in stroke patients with hemiparesis.

Methods

A Stroke Rehabilitation MDT, consisting of two physicians, one occupational therapist, and one physiotherapist, developed an online survey (Appendix 1). The survey enquired about the experiences of occupational therapists (OTs) and physiotherapists (PTs) regarding the impact of peripheral IV cannulation on therapy interventions. It included seven closed-ended questions and one open-ended item to promote completion. Sections included:

- Demographics and experience of respondents
- Frequency with which respondents witnessed IV peripheral cannulae in the stroke affected upper limb
- Impact of IV peripheral cannulae on therapeutic upper limb activities and the primary reasons for this.

The survey was distributed by NHS email to OTs and PTs currently involved in treating stroke patients at LTHT. It was open for 12 weeks from August to October 2024.

Data analysis was performed utilizing Microsoft Excel. All responses were anonymised. Since this study constituted a service evaluation, ethical approval was not necessary. The service evaluation was officially registered with the audit office of LTHT.

Results

There were a total of 23 respondents comprising of 11 Occupational Therapists (47.8%) and 12 Physiotherapists (52.3%). The respondents' roles ranged from rotational therapy staff to highly specialist neuro-specific therapists (Figure 1).

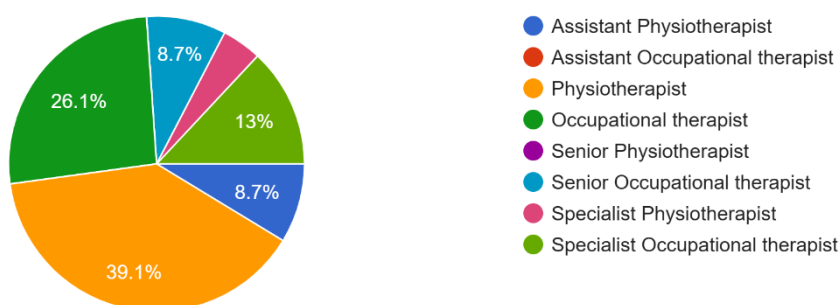


Figure 1: Job role of respondents

The majority of therapy staff (52.4%, 11/23) worked exclusively on the acute stroke unit and 65% (15/23) had worked in stroke medicine for 2 or more years.

Respondents were asked how frequently they encountered an IV cannula on the stroke affected side in their patients. 13% (3/23) answered '1-3 times a month', 8.6% (2/23) answered 'once a week' and 17.4% (4/23) answered 2-4 times weekly. No respondents had encountered an IV cannula on the affected side 'once a day' or 'more than once a day' (Figure 2).

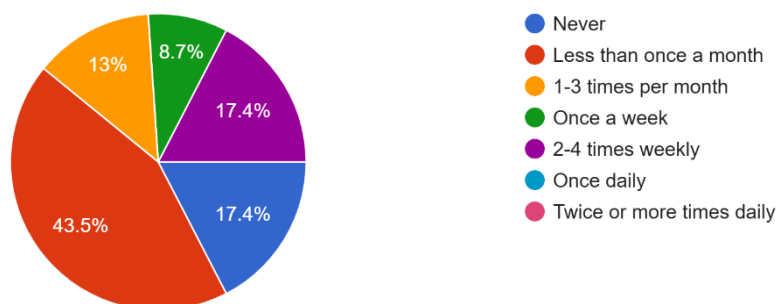


Figure 2: Frequency of encountering an IV cannula on the stroke affected side

65.2% (15/23) of respondents reported that they had experience of postponing an upper limb therapy session due to the presence of an IV cannula on the affected side. Of the 15 respondents that had to reschedule sessions, 13.3% (2/23) reported having to do so at least once a week. 26.7% (4/23) reported needing to do so 1-3 times per month (Figure 3).

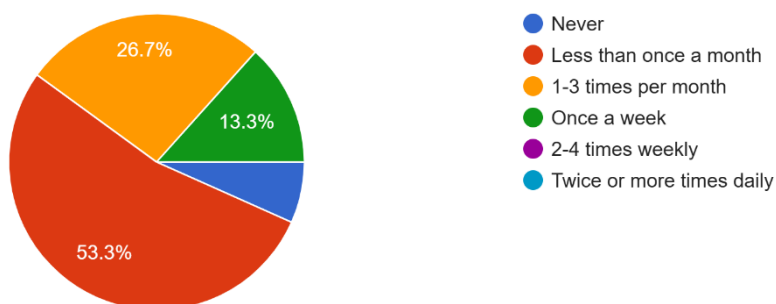


Figure 3: Frequency of postponement of upper limb therapy session due to the presence of an IV cannula on the stroke affected side

Respondents stated multiple reasons as to why therapy sessions were delayed in patients who were cannulated on the affected side. The most common of these was the 'risk of dislodgement' reported by 47.8% (11/23). The risk of tissue-related injury secondary to the cannula and pain secondary to the presence of a cannula were both reported by 30.4% of respondents (7/23). Other reasons included the administration of essential IV medications, being unable to passively move the limb, and being unable to use required equipment due to cannula positioning.

Discussion

To our knowledge this is the first study looking at the impact of IV cannulation on the delivery of upper limb stroke rehabilitation.

In this study the most common reason reported for disruption to therapy sessions was due to risk of dislodgement. Privitera et al conducted a study looking at complications from 755 IV cannulae in 269 acute stroke patients. The main complication was dislodgement occurring 236 times (31%) over 2107 study days, highlighting a dislodgement incidence rate of 112 per 1000 device days.⁵ They found that cannula calibre was the only statistically significant association with dislodgement in contrast to limb mobility, side affected by stroke or the type of deficit).⁵ In fact, complications occurred less frequently when the cannula was placed in the plegic limb, contradicting existing recommendations not to cannulate the affected limb. Whilst possible that this is due to patients independently moving their non-affected limbs, the discrepancy confirms that more research into this topic is required.⁵ It was noted by the team leading this study that therapy staff can have concerns about moving a cannulated upper limb, regardless of which side is cannulated. This becomes clinically relevant when therapy interventions involve both limbs.

In a different study, 1428 general hospitalised patients with peripheral IV cannulas were observed. The incidence of dislodgement was found to be 5.6%. This indicates that cannulation causes comparatively fewer issues for non-stroke patients than stroke patients.⁶ Patients with hemiparesis do not have a second functional arm to use for activities and therefore there could be expected to be a higher rate of dislodgement secondary to movement within the cannulated limb.

A further problem experienced by stroke patients is learned non-use of a hemiparetic limb. This has been well established as a post-stroke complication and the presence of a cannula in a stroke-affected limb may impact upon this phenomenon. Learned non-use occurs after neurological injury because of dissociation and disuse of a deafferented limb despite sufficient motor innervation.^{7,8} Cannulation in a hemiparetic limb may cause pain, anxiety and discomfort for patients. Dislodgement may result in repetitive cannulation, reinforcing negative associations with such interventions in the mind of the patient. Psychologically, a patient may limit the use of the cannulated arm in order to avoid the need for repeated cannulation attempts. If the cannula is sited in the stroke-affected arm, this negative reinforcement can contribute to learned non-use, lack of training and a progressive deterioration of the limb condition.

Learned non-use can be overcome by the applications of treatment, such as constraint-induced movement therapy, where intensive training and restraint of the unaffected arm induces increased purposeful movement of the affected arm.⁷ As per the 2023 National Clinical Guideline for Stroke for the UK and Ireland, all barriers (in this case IV cannulation in the affected arm) should be minimised to ensure patients are fully able to participate in therapy.⁹ This ensures that perceived self-efficacy, (one's own belief in capability to successfully execute actions required for a desired outcome) is maximised as this is an important driver for health behaviour improvements.^{9,10} Results obtained by Ballester et al revealed that hemiparetic stroke patients exhibit a pronounced sensitivity to success and failure when using the affected arm, strongly biasing arm use and therefore highlighting the importance of psychological factors for motor rehabilitation.¹¹

Up to 80% of stroke patients experience sensory deficits to touch, position, temperature and pain. The complications of IV cannulation, e.g. phlebitis, extravasation and cellulitis, may not be detected if the patient is unable to feel discomfort.¹² Up to 50% of stroke hemiplegic patients experience a thrombus in the leg or paretic limb.¹³ In accordance with Virchow's triad, damage to the intravascular wall from cannulation combined with venous stasis in a hemiparetic upper limb and an already hypercoagulable state increases this VTE risk further. Conversely, patients with retained sensation in the affected limb may also be adversely affected by IV cannulation. For example, pain and localised inflammation may restrict range of motion and subsequent participation in therapy sessions. In our study, 30.4% of respondents reported both pain and tissue-related injury secondary to cannulae to be the reasons for rescheduling sessions.

Given that cannulation complications are more common in stroke patients, it is important to recognise that complications have a detrimental impact on the delivery of essential therapy sessions, as demonstrated in our survey results. The 2023 National Clinical Guideline for Stroke recommends that larger doses of therapy (i.e. the number, duration and frequency of sessions) are associated with better recovery, as is early mobilisation after stroke onset.⁹ It recommends at least 3 hours of therapy on at least five days per week for those with motor recovery goals.⁹ Although the optimum dose of repetitive task practice is unclear, the literature indicates it is likely to be far higher than what is currently being delivered and likely to be in the hundreds of repetitions per day.^{14,15}

Cannulation can affect the implementation of other methods of rehabilitation therapy such as constraint-induced movement therapy, vagus and electrical nerve stimulation by reducing range of passive movement and creating challenges relating to electrode placement. Reduced time using these modalities results in risk of spasticity (and thus muscle

contractures) and reduced neuroplasticity respectively.⁹ Given the importance of repetitive task practice for rehabilitation, reducing risk of contractions and continued use of the affected limb (to avoid learned non-use), the impact of cannulas on therapy sessions could contribute to poorer rehabilitation outcomes. Avoiding cannulation of stroke affected limbs can minimise disruption to already limited therapy provision.

Mirror therapy uses a midsagittal reflection of the moving non-affected limb to give the illusion of movement in the affected limb. Unlike other rehabilitation approaches which require a degree of voluntary movements as a pre-requisite for initiating therapy, mirror therapy can be used in even completely plegic limbs.¹⁶ Pain, swelling or stiffness (provoked by, for example, the presence of a cannula) may limit this movement. Inadequate execution of movement can interfere with the neurophysiological basis of mirror therapy, thus impacting upon its efficacy.¹⁶ Similarly, cannulas may also serve as a noxious stimulus and distract the patient from focusing on the reflected limb.

Our findings demonstrate that IV cannula placement on the stroke affected side can negatively interfere with therapeutic interventions and hinder rehabilitation. This survey builds on evidence that IV cannulation should be avoided on the stroke affected side. More research into this specific topic and development of guidelines could lead to more effective rehabilitation and better patient experiences in stroke recovery.

Declarations of Conflicts of Interest:

None declared.

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Appendix 1 – Online Survey

1. Please indicate your current job title in the stroke therapy team:
2. Which unit do you predominately work on?
3. How long have you worked in the stroke department?
4. On which side do you typically find an Intravenous (IV) cannula in stroke patients?
5. When treating a stroke patient how frequently have you encountered an IV cannula on the affected side
6. Have you ever postponed or rescheduled an upper limb therapy session due to the presence of an IV cannula on the affected side?
7. If yes, how frequently?
8. If the cannula on the affected side did result in a delay to the therapy session, what was the primary reason?