

Subcutaneous fluids—a blast from the past or a rosy future?

Dehydration in frail, elderly, nursing-home residents is a common problem usually leading to hospital admission for rehydration with intravenous fluids. Such admissions increase pressure on secondary care and may cause distress to the patient. We consider the use of subcutaneous fluids in elderly patients, and its potential role as an element of care near to home.

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Dehydration is common in the elderly population, often occurring on a background of cognitive impairment, malignant disease, oral problems, and dysphagia secondary to neurological disease.¹ The exact prevalence is unknown, but dehydration is estimated to contribute to approximately 7% of hospital admissions in those aged over 65 years in the USA.² In studies of elderly residents in long-term nursing care, biochemical markers compatible with dehydration have been found in around 60% of patients³ (dependent upon specific definitions and associated acute illnesses). In addition to being a common problem, abnormal biochemical markers of dehydration are relevant both for use of health services and for associated poor clinical outcomes.⁴

A common approach to managing biochemical (and clinical) dehydration is the use of hypodermoclysis, more commonly known as subcutaneous fluid infusion. This review considers some of the clinical and practical issues associated with this method of fluid administration, and its role in contemporary health care.

Why are elderly people prone to dehydration?

There are numerous explanations for elderly individuals' increased susceptibility to dehydration. A full review of these reasons is beyond the scope of this article, but table 1 outlines some contributing factors. A comprehensive assessment of elderly patients is required to confidently identify causes of dehydration.

Efficacy of subcutaneous fluids:

Studies have shown that fluids infused subcutaneously are absorbed at similar rates as those given intravenously in elderly patients.⁵ This, and the effect on both the biochemical markers of dehydration, and the clinical effect demonstrated in patients should increase practitioner's confidence in this technique.

	Contributing factors
Physiological changes	Decreased thirst sensation Decreased renal concentrating ability
Pathological states	Infection and sepsis Diabetes Neurodegenerative conditions (eg, dementia, stroke, Parkinson's disease)
Drugs	Prescription (eg, diuretics) Recreational (eg, alcohol)
Psychosocial	Depression or poor motivation Reduced dexterity resulting in difficulties preparing drinks and meals

Table 1: Factors contributing to dehydration in elderly patients

Biochemical markers of dehydration

Commonly used biochemical markers of dehydration include elevated concentrations of serum urea and creatinine, high serum osmolality, and abnormalities of sodium concentration (either hypernatraemia or hyponatraemia). These markers have also been used to measure the efficacy of fluid replacement in dehydrated elderly patients.

Several studies have monitored alterations in urea and creatinine in patients receiving subcutaneous fluids. When compared with intravenous fluids, the subcutaneous route is non-inferior in relation to changes in urea and creatinine⁶⁻⁸ and osmolality.⁹ Studies measuring the effect of subcutaneous fluids on other metabolic and biochemical substances (including glucose, insulin, free fatty acids, and cortisol) concluded that subcutaneous fluids induced similar but smaller metabolic and hormonal changes than intravenous infusion.¹⁰

Clinical effects of subcutaneous fluids:

Although biochemical changes associated with the use of subcutaneous fluids are important, they may not translate into improved clinical outcomes. Such improvements are often difficult to identify and measure in the elderly population, in whom diseases often present non-specifically. This probably affects the nature of markers used to identify therapeutic efficacy of any given treatment. Some attempts to measure qualitative improvements associated with hypodermoclysis have been made, although the lack of robust scales and measures means that the resultant data tend to be somewhat non-specific.

Several studies refer to clinical changes associated with hypodermoclysis. Results such as similar biochemical and clinical changes in patients on intravenous or subcutaneous infusions,⁷ and return to clinical or functional baseline in 71% of patients⁸ are promising but inexact, so drawing conclusions is difficult. Arizon and colleagues¹¹ showed overall clinical improvement

in 77% of participants, with further analysis identifying general improvement in 88%, cognitive improvement in 84% and increased oral intake in 81%. This trend is further supported by a smaller study that identified clinical improvement in 57% of patients and no clinical change in 25%.¹² However, much of these data come with substantial methodological concerns.

Safety and complications

Barua¹³ argues that the relative “unpopularity” of subcutaneous fluids in clinical practice (especially in the UK) is mainly due to the publication of early case reports describing adverse events that were “ostensibly related to misuse rather than an inherently flawed technique.” As previously stated, large robust randomised trial data are lacking, although some researchers have made steps to assess issues of safety and potential complications of subcutaneous fluids. Adverse effects depend mainly on three variables: choice of solution, volume to be administered and infusion rate.¹⁴ Approximately 1500 ml of fluid can be administered, by hypodermoclysis through one site in 24 hours, and 3000 ml can be given by using two separate sites.¹⁵

Direct comparison between intravenous and subcutaneous fluids has identified no significant difference in terms of localised complications. Slesak⁷ identified potential localised complications such as phlebitis, oedema, cellulitis and pain, noting that these occurred in nine of 48 (19%) patients randomly assigned subcutaneous fluids compared with eight of 48 receiving intravenous hydration.

In a retrospective review of a series of frail patients residing

Subcutaneous	Intravenous
Cheaper	More expensive
Can be used in community	Requires admission
Low rates of complications	Higher rates of systemic infection
Easy insertion (no doctor needed)	Trained staff needed to insert cannula
Less effective in acute critical illness	Better in acute illnesses such as shock and renal failure, in which good fluid balance is essential

Table 2: Comparing subcutaneous and intravenous routes for delivering fluids

in long-term care, Arizon and coworkers¹¹ collected data for 118 episodes of hypodermoclysis in 57 patients, and found that the incidence of localised adverse reactions was around 12%. These data were analysed further showing local swelling in six patients, pain in three, and inflammation in two. This study also showed an important benefit of subcutaneous delivery in that “nobody developed signs of fluid overload.”

The rate of localised complications may be affected by the infusion fluid used. Various fluids have been used for hypodermoclysis. Most commonly, 0.9% saline is used, but 0.45% saline and 5% dextrose have been used. One study looking at more than 4000 subcutaneous infusions of either 0.9% saline or 5% dextrose in 634 elderly noted problems of fluid overload in nine patients, subcutaneous oedema in five, and localised infection in one.¹⁶ The rates of complication were too low to allow comparison between the two infusions, which itself is reassuring. A further review¹⁷ of 639 patients receiving electrolyte-free solutions, identified 16 adverse events, of which eight were severe. The addition of potassium chloride did not greatly alter the nature of adverse events.

It is possible, and indeed probable, that the rate of local complications will be affected by other variables including choice of site, skin preparation, frequency of site change, and use of hyaluronidase in the infusion. The enzyme hyaluronidase breaks down hyaluronic acid between subcutaneous cells, thus lysing the normal interstitial barrier and increasing the rate at which fluid is absorbed, and has been shown to increase the rate of diffusion of subcutaneous fluids for up to 48 hours.⁸ Other reports suggest that hyaluronidase is not necessary for prevention of oedema.⁶

Further considerations

As well as the points already raised, subcutaneous fluids may be preferable for other reasons. The rate of clinically significant infection (ie, septicaemia) with the use of subcutaneous fluids might be less than with intravenous administration.¹⁸ The overall cost in terms of cannulation is lower for hypodermoclysis⁶ than for intravenous administration. Other benefits such as positioning of cannulae away from limbs to allow movement and rehabilitation, and the fact that trained medical staff are not required for resiting or replacement have also been postulated.⁹ Several studies have also concluded that community use of subcutaneous fluids could reduce acute admissions,^{2,8,15} although personal and anecdotal experience suggests that this is often not the case in practice.

Conclusion

The number of frail elderly patients is increasing. Such patients often present with dehydration and are frequently admitted to secondary care services for rehydration. Subcutaneous administration of fluid offers a reliable and feasible way of managing such patients, and may be used effectively in the community. With pressures on hospital beds, and the drive to provide care near to home, subcutaneous fluids may be a valuable component of care that could be provided for older people. To further their use we need larger more robust research studies, especially looking at community use.

We have no conflicts of interest.

Key points

1. Frail, elderly patients are especially prone to dehydration
2. Elderly patients with dehydration account for a substantial number of acute hospital admissions
3. Subcutaneous fluids in community settings are probably underused
4. Subcutaneous fluids are a safe and economical way of administering fluid, either for rehydration or maintenance.
5. The efficacy of subcutaneous fluid infusion is probably equal to that of intravenous therapy in frail elderly patients
6. Large high quality studies looking at use of subcutaneous fluids are needed

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