Randomised controlled trial of intravenous antibiotic treatment for cellulitis at home compared with hospital

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Abstract

Objectives To compare the efficacy, safety, and acceptability of treatment with intravenous antibiotics for cellulitis at home and in hospital.
Design Prospective randomised controlled trial.
Setting Christchurch, New Zealand.
Participants 200 patients presenting or referred to the only emergency department in Christchurch who were thought to require intravenous antibiotic treatment for cellulitis and who did not have any contraindications to home care were randomly assigned to receive treatment either at home or in hospital.
Main outcome measures Days to no advancement of cellulitis was the primary outcome measure. Days on intravenous and oral antibiotics, days in hospital or in the home care programme, complications, degree of functioning and pain, and satisfaction with site of care were also recorded.
Results The two treatment groups did not differ significantly for the primary outcome of days to no advancement of cellulitis, with a mean of 1.5 days (SD 0.11) for the group receiving treatment at home and 1.49 days (SD 0.10) for the group receiving treatment in hospital (mean difference 0.01 days, 95% confidence interval −0.3 to 0.28). None of the other outcome measures differed significantly except for patients' satisfaction, which was greater in patients treated at home.
Conclusions Treatment of cellulitis requiring intravenous antibiotics can be safely delivered at home. Patients prefer home treatment, but in this study only about one third of patients presenting at hospital for intravenous treatment of cellulitis were considered suitable for home treatment.

Introduction

Many retrospective reports on the outcomes of intravenous antibiotic treatment for cellulitis at home indicate that this is a safe alternative to inpatient treatment in hospital.[1–5] Only one small prospective randomised trial compared treatment at home with treatment in hospital.[6] It concluded that home treatment for conditions such as cellulitis was safe and associated with fewer adverse complications in elderly patients.

In 2001 Pegasus Health, an independent practitioners' association of 230 general practitioners in Christchurch, started a community care programme that delivered medical and nursing care to patients who would otherwise require hospital admission. Its advent provided an ideal opportunity to mount a prospective, randomised trial with the objectives of comparing the safety, efficacy, and acceptability of home treatment with hospital treatment of cellulitis requiring intravenous antibiotics. Our hypothesis was that home treatment of cellulitis with intravenous antibiotics was as effective as hospital treatment and more acceptable to patients.

Methods

Our primary outcome measure was the time to when patients' cellulitis failed to advance. Other outcomes included the total numbers of days when patients received intravenous antibiotics and oral antibiotics, and calendar days in hospital or looked after by the home care team. The decision to switch patients from intravenous to oral antibiotics was left entirely to the attending doctor in the hospital or home. We recorded patients' transfers from home to hospital and the reasons for transfer. We kept a record of all serious complications. We used questionnaires to assess patients' level of functioning and pain as well as satisfaction with their care.

Protocol

We recruited participants from patients with cellulitis attending Christchurch Hospital's emergency department. Patients considered to require intravenous antibiotic treatment for cellulitis by the emergency doctor and who met the eligibility criteria were invited to take part.

Patients were eligible if they had clinical signs of cellulitis, required intravenous antibiotic treatment because of severity of cellulitis or failure of oral antibiotic treatment, were 16 years or older and mentally competent to give informed consent, had a telephone

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An appendix and table showing mean scores on the SF-36 with standard deviations for days 3 and 6 are on bmj.com

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at home and a care giver nearby, and were currently resident in the Christchurch metropolitan area.

Exclusion criteria were pregnancy; treatment with intravenous antibiotics for cellulitis of the same site in the preceding month; two or more signs of systemic sepsis; and a blood count showing a white cell count above 12×10^9/l or less than 4×10^9/l and more than 0.1×10^9/l immature neutrophils.

Other possible exclusion criteria were signs of severe cellulitis or serious comorbidities such as cellulitis of the face, hands, or over the joints; presence of tissue necrosis, severe lymphangitis, blistering, or a very large affected area; comorbidities such as immunosuppression, peripheral vascular disease, obesity, alcoholism, or severe diabetes. The more of these relative exclusion criteria that were present the more hospital admission was recommended.

The criteria for exclusion were deliberately kept flexible as ultimately the staff in the emergency department had to make a judgment about the suitability of a patient for entry into the trial independently from the trial investigators.

Assignment

Patients were randomised to home or hospital treatment in randomly allocated blocks by an off-site coordinator.

The study team collected information in the emergency department, including demographic information; details of any current or recent use of antibiotics, the location of cellulitis; and the presence of any skin necrosis, lymphangitis, blistering, or ulceration.

The researcher drew an indelible line with a marker pen around the peripheral margin of the cellulitis and dated this for comparison on following days.

Before leaving the emergency department, every participant received his or her first intravenous dose of 2 g of cephazolin (modified in renal impairment). Participants randomly allocated to hospital treatment were admitted under the care of the on-call medical team who managed the subsequent clinical treatment, including the choice of ongoing intravenous antibiotic. They were visited each day by the study team to record clinical progress.

Patients randomly allocated to community treatment continued with 2 g of intravenous cephazolin (modified in renal impairment) twice daily. Their own general practitioner or one from the community care team visited them daily for medical review, and community care nursing staff attended twice daily to monitor the cellulitis and administer intravenous antibiotics. Research staff reviewed community and hospital clinical records in all cases and recorded duration of stay, details of antibiotic treatment, and complications.

At entry into the trial and at days 3 and 6, we administered a questionnaire modified from the short form 36 (SF-36) instrument, which focused on functional and physical aspects of health.[7] At trial entry we asked patients about their health before the infection. At days 3 and 6 patients were asked about their health in the previous 24 hours. Patients completed a patient satisfaction questionnaire four weeks after entry into the trial.

Statistical methods

The study was designed to have 200 participants, 100 in each arm. With power of 80% and $\alpha_2 = 0.05$, a moderate difference of 0.40 standard deviations was detectable between the two arms for the primary outcome. The researchers thought that a difference of up to two days would be acceptable. We used survival analysis for the main clinical outcomes and, to compare the groups, χ^2 tests for contingency tables and *t* tests for continuous variables.

Results

The trial ran from July 2002 until June 2003. We randomised 200 patients to receive treatment either at home or in hospital. After exclusions, 98 patients were in the home care arm of the trial and 96 in the hospital care arm (see bmj.com).

Characteristics at baseline of the two groups were similar except that the hospital care group were younger than the home care group (48 years *v* 55 years, respectively) and had a lower proportion of users of community service cards (37% *v* 53%). (Community service cards entitle holders to subsidised general practice, and are issued on the basis of low income.) All patients treated at home received intravenous cephazolin. Fifty five per cent (53) of the hospital patients received cephazolin, 29% (28) of the hospital patients received flucloxacillin, and the remaining hospital patients had various other antibiotics (see bmj.com).

Clinical outcomes

The primary clinical outcome was days to no advancement of cellulitis. The mean was 1.50 (SD 0.11) days for the home treatment group and 1.49 (0.10) days for the hospital group (mean difference 0.01 days, 95% confidence interval −0.3 to 0.28). Because of the marked skew in all clinical outcomes we also compared the treatment arms by survival analysis, as shown in the figure and the table. We found no significant differences on any of these outcomes, either for simple comparisons of the two types of care or when controlling for age, sex, location of cellulitis, and prior use of antibiotics.

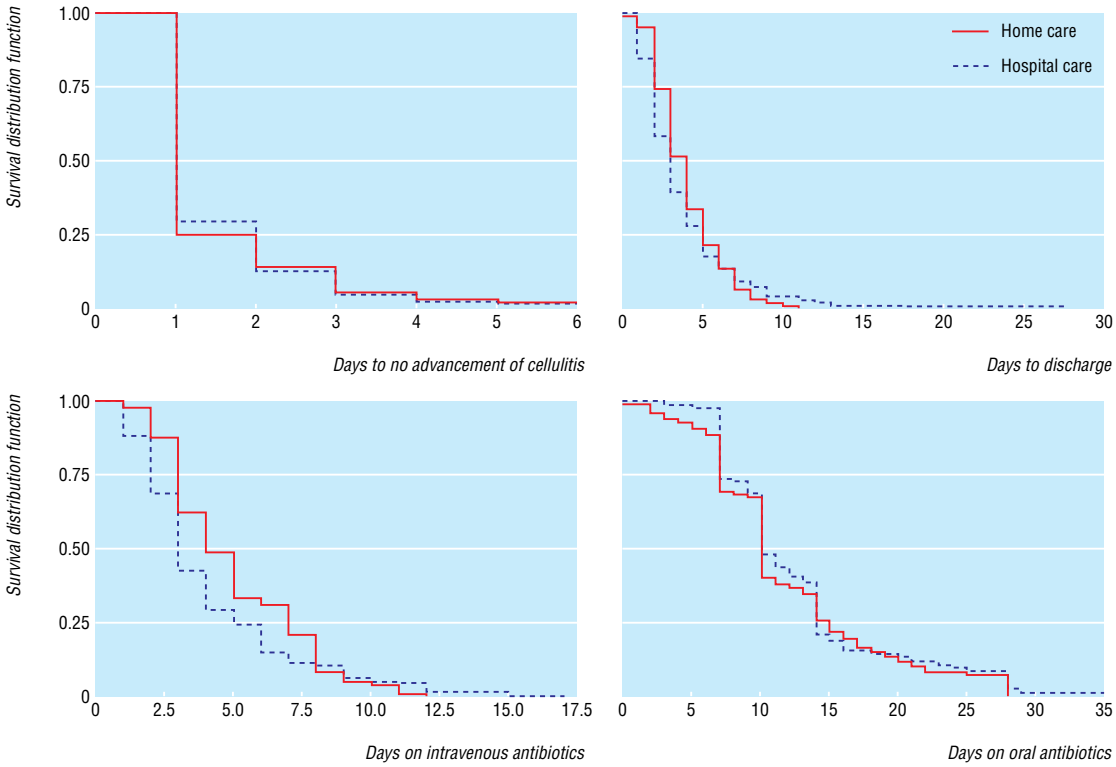
Patients' functional outcomes

We used independent *t* tests to analyse modified SF-36 questionnaires administered at baseline and at days 3 and 6 and found no significant differences in levels of

Home care versus hospital care: hazard ratios with 95% confidence intervals

	Days to no advancement of cellulitis (n=180)	Days on intravenous antibiotics (n=193)	Days to discharge (n=193)	Days on oral antibiotics (n=194)
Simple comparison				
Home care *v* hospital care	0.98 (0.73 to 1.32); P=0.90	0.84 (0.63 to 1.12); P=0.23	0.93 (0.70 to 1.23); P=0.60	1.09 (0.82 to 1.45); P=0.56
Comparison with covariates				
Home care *v* hospital care controlling for age, sex, location of cellulitis (upper *v* lower limb), and prior antibiotic treatment	0.99 (0.74 to 1.34); P=0.97	0.85 (0.64 to 1.14); P=0.29	0.95 (0.71 to 1.26); P=0.71	1.18 (0.88 to 1.59); P=0.27

Hazard ratio >1 implies home care treatment was faster; hazard ratio <1 implies home care treatment took longer.



Kaplan-Meier plots for primary and secondary outcomes

physical functioning or pain between the two treatment arms (see bmj.com).

Patients' satisfaction with site of treatment

Most patients in both treatment arms were satisfied with the care they received. However, only one in 20 of the community arm would prefer hospital treatment, whereas one in three of those receiving hospital care felt that home care was preferable. These results strongly imply that home care is the preferred treatment choice of cellulitis patients, particularly those who have experienced community care (see bmj.com).

Complications

Eleven patients (12%) randomised to home treatment required transfer to hospital and three hospital patients (3%) required readmission within one month of discharge for further treatment of their cellulitis.

Discussion

Many patients with cellulitis thought to require intravenous antibiotics can safely be treated at home under a primary care home treatment programme. The two treatment groups did not differ significantly for the primary outcome of days to no advancement of cellulitis. None of the other outcome measures differed significantly except for patients' satisfaction, which was greater in patients treated at home.

Strengths and weaknesses of this study

The clinical outcomes we have reported of failure of cellulitis margin to advance, time on intravenous antibiotics, and time spent in hospital or in home care are practical clinical outcomes that could be used in further reports of cellulitis treatment. General practitioners could not obtain home intravenous antibiotic treatment for their patients in any other way during this trial, which ensured that we had good "capture" of patients suitable for home intravenous treatment. We were not able to keep a record of cellulitis patients who declined to be randomised as emergency doctors notified trial staff only of cellulitis patients thought to be suitable and willing. Only one trial patient withdrew consent.

Comparison with other studies

A study of 100 patients being treated for a variety of conditions generally requiring hospital treatment (cellulitis, pneumonia, pyelonephritis, etc) randomised half to home treatment.[6] The outcomes for the 37 patients with cellulitis were not described separately. This study found that patients treated in hospital had higher rates of confusion and urinary and bowel complications. Overall, the patients treated at home spent 10.1 days in the programme, whereas the hospital patients stayed in hospital 7.4 days. Three other studies have described the results of intravenous treatment of cellulitis at home.[2 3 8] Patients in these studies all needed 5.5-6.5 days of intravenous treatment at home. In these studies, 5.8-7.8% of patients treated at home required transfer to hospital. These figures are broadly in keeping with our results, but patients in both of our treatment arms were kept on intravenous treatment for a shorter duration. A US based registry for outcomes of outpatient treatment with parenteral antibiotics has recorded a 12.6% rate of transfer to hospital for more than 5000 patients treated outside hospital.[9]

Other studies may have had a different threshold of severity of cellulitis in assessing the need for intravenous treatment and the point when hospital admission should be considered mandatory. Almost

What is already known on this subject

Intravenous antibiotic treatment of cellulitis can be delivered in the home

The safety, efficacy, and costs of home treatment compared with hospital treatment have not been studied extensively

What this study adds

Intravenous antibiotic treatment can be delivered safely and effectively in patients' homes

Patients prefer home treatment

This home based treatment programme was initiated and delivered from primary care rather than a hospital outreach programme

75% of our patients started receiving intravenous antibiotics after oral antibiotics had failed. This is a much higher proportion than reported in other studies and indicates that our threshold for giving intravenous antibiotics was appropriate.[1 3 6]

The high degree of satisfaction with home treatment we found has been reported from other studies of "hospital at home" programmes.[10 11]

Three studies have compared the costs of treatment for cellulitis and other acute medical conditions at home and in hospital.[1 5 12] These studies found that home treatment was about half as costly as hospital treatment.

Meaning of this study

Patients in the two treatment arms were comparable. These findings should be generalisable to other settings with comparable systems of healthcare delivery. Only about a third of patients requiring intravenous antibiotics for cellulitis were considered suitable for home treatment during the study period. Many patients with cellulitis will require admission to hospital because of their frailty, comorbidities, home situations, or the severity of their cellulitis. Patients clearly much prefer home treatment for cellulitis.

Unanswered questions and future research

Having twice daily visits from the nurse increased the costs of home treatment in this study. A report of home treatment using once daily intravenous antibiotics and nurse visits has shown that this is a safe option.[8] We considered that only about one third of patients requiring intravenous antibiotics for cellulitis were suitable for home treatment, and it is possible that a higher proportion could have been safely treated at home. This study was too small to study predictors of failure of home intravenous antibiotic treatment.

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Roots of the Atkins diet

The Atkins and similar diets have gained wide popularity and led to scientific scrutiny of low carbohydrate diets for treating obesity. However, perceptive observations on carbohydrate-rich diets and obesity can be found as far back as the start of the 19th century. In his book *Physiologie du Gout* (*Physiology of Taste*) French lawyer, politician, and lay physician Jean-Anthelme Brillat-Savarin (1755-1826) eloquently sets the grounds for gastronomy, but in several chapters he also vividly describes obesity and its causes and prevention.

In conversations with obese people Brillat-Savarin had observed their craving for flour, macaroni, rice, potatoes, bread, and sweet pastries. His idea was that the principal reason for obesity is too much starch and a flour-rich diet, especially when it is combined with sugar and fat. In accordance with his theory, neither carnivore species relying on a protein-rich diet nor vegetarians get obese unless they are fed with potatoes, grains, and flour. Furthermore, Brillat-Savarin recognises that obesity does not exist among wild tribes who need physical exercise to get their daily nutrition.

Brillat-Savarin concludes that the main reasons for obesity are too much food and drink and sets three basic rules for obesity prevention—moderation at the dining table, not too much sleep, and plenty of exercise on foot and horseback. He also instructs his readers to avoid starch, sugar, and flour based foods and to prefer light meats, greens, root vegetables, cabbage, and fruit. If you like bread, Brillat-Savarin advises that you avoid the white type and eat rye or barley instead. As a Finn who enjoys dark, fibre-rich rye bread, I appreciated this statement. For drinking, he suggests water, coffee, tea, light white wines, and even strong liquor occasionally. Those who follow his advice should feel themselves fresh, charming, agile, vigorous, and full of pep.

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