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ORIGINAL ARTICLE

Home care—a safe and attractive alternative to inpatient administration of intensive chemotherapies

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Abstract
Objective The objective of this study was to evaluate feasibility, safety, perception, and costs of home care for the administration of intensive chemotherapies.
Methods Patients receiving sequential chemotherapy in an inpatient setting, living within 30 km of the hospital, and having a relative to care for them were offered home care treatment. Chemotherapy was administered by a portable, programmable pump via an implantable catheter. The main endpoints were safety, patient's quality of life [Functional Living Index—Cancer (FLIC)], satisfaction of patients and relatives, and costs.
Results Two hundred days of home care were analysed, representing a total of 46 treatment cycles of intensive chemotherapy in 17 patients. Two cycles were complicated by technical problems that required hospitalisation for a total of 5 days. Three major medical complications (heart failure, angina pectoris, and major allergic reaction) could be managed at home. Grades 1 and 2 nausea and vomiting occurring in 36% of patients could be treated at home. FLIC scores remained constant throughout the study. All patients rated home care as very satisfactory or satisfactory. Patient benefits of home care included increased comfort and freedom. Relatives acknowledged better tolerance and less asthenia of the patient. Home care resulted in a 53% cost benefit compared to hospital treatment (€420±120/day vs. €896±165/day).
Conclusion Administration of intensive chemotherapy regimens at home was feasible and safe. Quality of life was not affected; satisfaction of patients and relatives was very high. A psychosocial benefit was observed for patients and relatives. Furthermore, a cost–benefit of home care compared to hospital treatment was demonstrated.

Keywords Home care · Quality of life · Satisfaction · Oncology · Chemotherapy

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Introduction

The main goals of home care treatment are to provide state-of-the-art patient care, improve convenience, and reduce the burden on healthcare systems.

Home care treatment has been investigated in different non-oncologic conditions and following certain medical procedures [1–6]. Studies often focused on elderly patients admitted for elective procedures or age-related diseases. Home care was associated with significantly shorter hospital stays, fewer geriatric complications, and did not increase the rate of subsequent readmissions [4, 6]. Patients and care giving relatives reported high levels of satisfaction following home care treatment [1, 4]. A meta-analysis of 22 trials revealed a decreased mortality and readmission rates in elderly patients receiving home care compared with hospital care patients [4].

In oncology, the majority of home care programs have focused on supportive care or the administration of standard chemotherapy regimens. Intensive and potentially toxic chemotherapies are still given on an inpatient basis and have never been administered at home. Home care has been successful in patients following chemotherapy and stem cell transplantation without increasing the risk of toxicity or infection [7–10]. Furthermore, in pediatric oncology, home care has been shown to be effective and safe and had additional psychosocial benefits for both children and caring parents [11–13].

Since management of chemotherapy-related side effects has improved and new, safe treatment schedules, and administration tools have been introduced [13–15], home care is becoming a valid alternative to hospital-based treatment of oncology patients.

There is evidence suggesting that home care treatment of oncology patients can reduce costs in comparison to inpatient care [16, 17]. A conclusive cost comparison depends on the way costs are calculated [4]. Nevertheless, a recent study exploring UK National Health Services and published data on home-based chemotherapy illustrated that cost-related information is often difficult to gather, incomplete (e.g., lack of indirect costs), or of poor quality [18]. Accordingly, the authors concluded that more feasibility studies are warranted.

In the current study, our objective was to evaluate the feasibility and safety of home administration of intensive chemotherapy regimens that are usually recommended to be administered in an inpatient facility. Quality of life and the satisfaction of patients and their relatives with home care were also assessed. Furthermore, the costs of home and inpatient treatment were compared in a subgroup of patients who received similar treatments in both settings.

Patients and methods

Patients

Eligible patients had to be 16 years or older, assigned to one of the intensive chemotherapy treatments listed in Table 1, and fitted with a central venous catheter to qualify for inclusion in the study. Furthermore, patients were required to live within 30 km of the hospital and with a relative who had given consent to be the named care giver during the study. Main exclusion criteria were poor performance status (ECOG≥2) and severe cardiac, lung, or renal co-morbidities.

The study protocol was approved by the ethical committee of the University Hospital, Lausanne and was carried out in compliance with good clinical practice guidelines. Written consent was obtained from patients prior to inclusion in the trial. The patients had the right to withdraw from the study at any time. In addition, patients could be withdrawn from the study upon request of the caring relative.

Treatment

The studied chemotherapy regimens were intensive treatments currently given on a hospital inpatient basis (Table 1). The treatment was administered through a portable, programmable pump with four entrance and two exit channels, allowing multiple infusion modes (Melodie®, Aguettant, Lyon, France). All chemotherapy agents used in the study were approved for the specific indication and easily administered through a programmable pump and known to be stable in syringes. Additional treatments, such as anti-emetics, anxiolytics, corticosteroids, diuretics, and methylene blue, were administered according to standard inpatient practices. Hydration was also controlled by the pump. Blood transfusions or hematopoietic stem cell reinfusion had to be administered in the hospital if needed.

A medical team consisting in a trained oncology nurse and a medical oncologist took care of the patients during the study. The nurse was responsible for standard nursing care and vital signs monitoring, preparation of chemotherapy (together with the hospital central pharmacy), and organisation of the home care and treatment administration. Patients were monitored during planned visits by the nurse (twice daily) and the medical oncologist (once daily). Patients could reach the medical team at any time via a 24 h, 7 days a week call service.

Feasibility

Mechanical and software problems relating to pump function and information on other logistical problems were recorded by the nurse.

Safety

Safety aspects were assessed and recorded by the medical oncologist [19]. Major complications during home care were defined as toxicity (WHO>2, except for gastrointestinal toxicity), uncontrolled vomiting or nausea, renal failure with oliguria, inpatient hospitalisation due to febrile episode or vital symptom modification (hemodynamic instability, cardiac pulse arrhythmia, respiratory distress, and CNS disturbances), and hospitalisation upon request of patient or relative.

Quality of life

Quality of life was assessed by the ‘Functional Living Index—Cancer’ (FLIC) questionnaire [20] that was com-

Table 1 Chemotherapy regimens and treatment cycles administered at home

Treatment	Cycles (*n*)	Treatment days (*n*)
Standard ICE[a] Ifosfamide and uromitexan (each 5 g/m^2, IV over 24 h), carboplatin (300 mg/m^2, IV on day 1), etoposide (180 mg/m^2/day, IV on days 1+2); total treatment duration: 3 days	10	30
High-dose ifosfamide-adriamycine[b] Ifosfamide (2 gm^{-2} day^{-1}, IV over 5 days), adriamycine (30 mg/m^2, IV on days 1–3), uromitexan (2 gm^{-2} day^{-1}, IV on days 1–6); total treatment duration: 7 days	8	56
BEACOPP[c] Cyclophosphamide (650 mg/m^2, IV on day 1), adriamycine (25 mg/m^2, IV on day 1), etoposide (100 mg/m^2, IV on days 1–3); total treatment duration: 3 days	7	21
Ara-C-cyclophosphamide[d] Ara-C (500 mg/m^2, IV on day 1), cyclophosphamide (1 g/m^2, PO on day 1); total treatment duration: 2 days	5	10
VAD[e] Vincristine and adriamycine (0.4 mg/day and 9 mg m^{-2} day^{-1}, IV over 4 days), dexamethasone (40 mg PO on days 1–4); total treatment duration: 5 days	4	20
Standard ifosfamide-adriamycin[f] Ifosfamide and uromitexan (5 g/m^2 and 6 g/m^2, IV over 24 h), adriamycine (75 mg/m^2, IV on day 1); total treatment duration: 3 days	3	21
MINE[g] Mitoguazone (500 mg/m^2, IV on days 1+2), ifosfamide and uromitexan (1.5 gm^{-2} day^{-1} and 1.5 g/m^2/day, IV over 5 days), etoposide (150 mg m^{-2} day^{-1}, PO on days 1–3), navelbine (15 mg m^{-2} day^{-1}, PO on days 1+2); total treatment duration: 7 days	2	14
BEAM[h] BCNU (300 mg/m^2, IV on day 1), etoposide (200 mg m^{-2} day^{-1}, IV on days 2–5), AraC (200 mg m^{-2} day^{-1}, IV on days 2–5), melphalan (140 mg/m^2, IV on day 6); total treatment duration: 7 days	2	14
High-dose ifosfamide[i] Ifosfamide (2,800 mg m^{-2} day^{-1}, IV over 5 days), uromitexan (3 gm^{-2} day^{-1}, IV over 6 days); total treatment duration: 7 days	2	14
High-dose melphalan[j] Melphalan (200 mg/m^2, PO on day 1); total treatment duration: 2 days	2	4
High-dose cyclophosphamide[k] Cyclophosphamide (2 gm^{-2} day^{-1}, on day 1+2), uromitexan (2 g/m^2, IV on days 1+2); total treatment duration: 3 days	1	3

Total treatment duration includes days for hydration and co-medication

[a] Small cell lung cancer

[b] sarcomas

[c] Hodgkin's lymphoma (vincristine, bleomycine, procarbazine and prednisone were not part of home care treatment)

[d] Lymphoma

[e] Myeloma

[f] Sarcomas

[g] Refractory lymphomas

[h] Lymphoma, conditioning regimen before hematopoietic stem cell transplantation

[i] Recurrent sarcomas

[j] Myeloma, conditioning regimen before hematopoietic stem cell transplantation

[k] Hematopoietic stem cell mobilisation

pleted by patients and relatives at the beginning and the end of treatment. FLIC is a 22-item scaled questionnaire covering seven dimensions of physical ability and the psychosocial function (health status, social role, sociability, emotional distress, pain, nausea, and suffering) Questions were answered on a visual scale from 1 to 7 (total score range, 22–154). When a question was omitted, a mean score was attributed to the question, based on the patients mean scores for the other questions. In addition, the WHO performance status was assessed at the beginning and the end of every home care treatment.

Satisfaction

A specific questionnaire on the satisfaction of patients and relatives (Table 2) was designed by the Institute of Social and Preventive Medicine of the University of Lausanne, Switzerland, since no validated questionnaire was available. The questionnaire is based on an Australian study [21, 22] and documentation from the Centre of Documentation, Research and Study in Health Economics (http://www.credes.net/). Most questions were "closed" but also "open-ended" questions were included to gather more specific information.

The questionnaires were given to the patient and his main relative for completion at the end of every treatment cycle at home. Results are shown as percentages of the different possible responses for "closed" questions and as a summary of the comments for "open-ended" questions.

Table 2 Questionnaires on satisfaction of patients and relatives

Patient questions

1. Are you satisfied with your care at home?
2. If this experience were to start again, what would you choose?
3. What were the advantages of home treatment for you?
4. What were the disadvantages of home treatment for you?
5. Did you worry during home treatment?
6. Did you fear at any time that you might not obtain rapid, appropriate care?

Relative questions

1. Are you in favor of home treatment after participation in the program?
2. If this experience were to start again, what would you choose?
3. What were the advantages of home treatment for you?
4. What were the disadvantages of home treatment for you?
5. Did you worry during the home treatment?
6. Did you fear at any time that you might not obtain rapid, appropriate care?
7. Do you have specific remarks concerning nursing care?
8. Do you have specific remarks concerning medical care?

Costs

A cost evaluation was carried out in a subgroup of patients who had received the same treatment at home and during an inpatient hospitalisation. These patients were selected after having received at least one cycle of chemotherapy in the hospital. The first cycle of hospital-based chemotherapy was not considered for cost evaluation to avoid bias related to the initial clinical work-up. Only the second or subsequent cycles, during which the patient received only the chemotherapy, were considered for cost evaluation.

The inpatient costs for nurses and administrative employees were calculated on the basis of the annual salary, work load, and number of days spent by the patient in the hospital. The physician's cost was based on the time spent for a patient (clinical examination and administrative work) and the monthly salary assuming a 60-h week schedule. Hospital catering and meal and linen charges were calculated from operating charges. Blood tests and radiological exams were valued according to the detailed account per patient and supplier. Other equipment was charged according to the official catalogue price. Structural charges including administrative hospital charges, medical logistics, and building and equipment charges were estimated as 45% of direct costs.

Costs for home care included nursing and medical staff employed at the patients' home and calculated based on the time spent with the patients and monthly salaries. Patients' expenses for meal and linen were not included. Home transportation was charged at a rate of €0.41/km, plus the salary costs for nurse and physician. Blood tests, consumables, and drugs were calculated similarly to inpatient treatment. No structural charges were considered for home treatment. The Wilcoxon signed rank test was used for comparison of means.

Results

Patient demographics

Between November 1998 and April 2001, 111 patients were eligible to receive one of the studied chemotherapy regimens (Table 1). Twenty-three patients (20.7%) fulfilled all inclusion criteria, and 17 patients (74%) were enrolled in the study. Six patients refused participation. Eight patients were female and nine were male, with a median age of 48 years (range, 20–70 years). The relatives caring for the patients were his wife (seven cases), her husband and children (three cases), her husband alone (two cases), the children and other relatives (two cases), the children and a relative with professional healthcare experience (one case),

her husband and mother-in-law (one case), or the mother (one case).

Treatments

In total, the study included 46 home-based treatments as the majority of patients received multiple cycles of chemotherapy (median, 3 cycles/patient; range, 1–10 cycles/patient; Table 1). A subgroup of seven patients, representing a total of 37 chemotherapy cycles, received the same chemotherapy regimen at home and in the inpatient setting. These patients were selected by the fact that they had already been treated in the hospital and accepted to have their next treatment at home.

Feasibility

Three planned visits/day (one by the physician and two by the nurse) accounted for 621 visits during the 46 treatment cycles representing 207 days of home care treatment. Technical problems with the pump required 32 additional home visits (median, 1 visit/cycle; range, 0–4 visits/cycle). Most of the additional visits were needed at the beginning of the study.

The main technical problem was pump failure due to air bubbles that was resolved by flushing the tube (21 cases). Partial disconnection at the exit channel occurred in nine cases, and in two cases, the needle was disconnected from the port of the catheter. These minor problems were easily solved at the patients' home. Two major pump failures were reported resulting in one overnight hospitalisation and a 4-day hospitalisation, respectively.

Safety

Medical complications occurred in three patients; one experienced a heart failure (grade 3), one an angina attack (grade 3), and one an allergic reaction to BCNU (grade 2). The complications were treated at home, and no hospitalisation was necessary. One patient was diagnosed with anemia by routine testing and received transfusions in the hospital outpatient unit. Nausea and vomiting, mainly grades 1 and 2, occurred during 36% of chemotherapy cycles and were controlled at home. No patients or relatives asked for hospitalisation during home care. Eight unplanned hospital admissions following the home care period occurred, five for febrile neutropenia, two for fever without documented infection, and one for pneumonia.

Quality of life

In total, 73 out of 92 (79%) FLIC questionnaires given to the patients were completed and returned. Mean FLIC score was 115.5±20.8 on day 1 of treatment (37 questionnaires) and remained stable until the last day of treatment 114.8± 21.1 (36 questionnaires; Table 3). FLIC scores during home care and inpatient treatment could be compared for five patients (eight questionnaires, 37 chemotherapy cycles) treated in both settings (Table 3). Neither the FLIC score nor the seven FLIC categories differed significantly between home care and inpatient treatment.

WHO performance status on day 1 was zero for 50% of patients. During chemotherapy, the score remained stable at zero in 28% of patients and increased to one or two in 65% and 27% of patients, respectively.

Satisfaction of patients and relatives

Patients returned 32 questionnaires on 46 treatment cycles (70%). They were either very satisfied with home care (31 cases) or satisfied (one case). None of them preferred the inpatient setting for the next chemotherapy cycles. Thirty-eight percent stated a preference for home care treatment, and the others had no declared preference for the setting of their next chemotherapy cycles. Patient-reported benefits of home care treatment included a higher comfort level (100%), freedom and possibility to organise their own time (94%), and the reassurance and comfort of having a relative present (88%).

Most patients were not concerned about the absence of a nurse (78%) and did not record anxiety (87%) during home care treatment. Main patient-reported disadvantages of home care were feelings of being dependent on their relatives (19%) and/or being a burden (6%). Accordingly, concerns mainly referred to the possibility that relatives might be affected or distressed by chemotherapy side effects. Other concerns included potential technical problems of the pump and side effects of chemotherapy.

The relatives returned 29 questionnaires (63%). All were in favor of home care, and most relatives (97%) preferred home care for the next treatment; one relative did not answer this specific question. Relatives stated better tolerance (i.e., fewer side effects, less distress; 90%) and less asthenia (48%) as advantages of home care. Other remarks included "being more useful to the patient," "being more autonomous," "being together," and "more freedom." The main concerns were fear due to the presence of

Table 3 Comparison of FLIC scores for home care and hospitalised patients

	Home care, mean±SD (n=17)	Inpatient, mean±SD (n=5)
Day 1	115.5±14.2	117.2±20.1
End of treatment	114.8±21.1	113.2±25.8

strangers at home (nurse, physician; 16%), request for continuous presence as patients were not allowed to be alone for more than one hour (14%), anxiety and fatigue (14%), and lack of freedom for leisure and holidays (14%). One relative did not know how to cope with patient's sadness. Twenty-one percent of relatives felt uncomfortable about the absence of professional medical staff during the treatment. Comments about the level and professionalism of nursing and medical care were all positive.

Cost evaluation

Treatment costs were evaluated in a subgroup of seven patients who received the same chemotherapy regimen at home and during an inpatient hospitalisation. The treatments were standard ICE in three patients, BEACOPP in two patients and high-dose ifosfamide or VAD in one patient each.

The mean daily difference in direct costs for home care and inpatient hospitalisation was €198±61, a 32% benefit in favor of home care (Table 4). Even if costs shifted to the patients and relatives (catering, linen) were taken into account, the balance remained beneficial. Inclusion of overhead costs in the hospital setting increased the cost–benefit of home care to 53%. The detailed evaluation of daily costs demonstrated cost reductions of 77% for nursing and 64% for paraclinical test costs if patients were treated at home (Table 4). Costs for drugs and consumables did not differ. Charges for catering in the hospital were balanced by transportation costs associated with home care.

Discussion

This study demonstrates the feasibility and safety of home care to administer intensive chemotherapies that are currently recommended to be administered in an inpatient facility. Preference of patients and caring relatives as well as cost estimations are in favor of home care. Quality of life of patients and caring relatives were not affected during the treatment cycles examined.

Our results are in line with studies in pediatric oncology patients demonstrating that home care was perceived as less stressful than hospital care, had less impact on family life, and increased parent's involvement in their child's treatment [11, 13, 23, 24]. Home care was also preferred by 73% of 40 evaluated adult oncology patients. However, as treatment in this study had to be administered by a professional, preference for treatment location was dependent on the waiting time for treatment.

Higher comfort levels and reassurance of having a relative present were major determinants for high satisfaction with home care. Concerns on the absence of knowledgeable professionals in case of side effects as reported in other studies [18] might have been overcome by the frequent, scheduled visits of health-care professionals and were mainly reported by relatives but not patients. Use of a portable, programmable pump provided complete autonomy to patients and enhanced satisfaction. Involvement of relatives improved their understanding of disease and treatment modalities and made them feel a help to the patient. Conversely, the main concern of patients with home care treatment referred to the feeling of being a burden to their relatives.

All events reported during home treatment with the exception of one blood transfusion due to anemia could be controlled at home. These findings confirm former studies reporting the safety of home care and showing reductions in the length of hospitalisation and the risk of infections compared to inpatient treatment [7, 8, 10]. Better oral nutrition and better adaptation to the bacterial flora at home are two possible explanations for lower infection frequencies observed during home care [18]. However, pooled statistics of studies comparing protective isolation (PI) with standard hospital care suggest an infection-preventive effect of PI although no benefit in mortality has been shown [25].

Cost effectiveness of home care programs is mainly dependent on the equipment required for treatment administration and the involvement of health care professionals during treatment. In our study, home care resulted in 53% lower costs compared to the costs for providing the same therapy in an inpatient setting. The main reason for the

Table 4 Cost evaluation (n=7 patients)

Cost factor	Home care (€, mean±SD)	Inpatient care (€, mean±SD)
Physicians	21±3	19±2
Nurses and other care givers	65±10	216±14
Paraclinical tests	25±10	70±35
Drugs, equipment	255±108	249±95
Catering	0	63±4
Transportation	55±34	0
Mean daily direct cost*	420±101*	618±123*
Mean daily direct cost including overheads	420±120	896±165

*p=0.009

observed cost reduction is the use of an automated pump reducing the involvement of nursing and paraclinical tests. This finding is in line with nine out of 13 published studies showing lower mean direct costs for home care compared to hospital care [16]. Detailed assessment of another randomised, controlled study also demonstrated lower total costs of home care; however, marginal costs in that study were lower in the hospital setting [17]. In order to improve our estimation of cost effectiveness, a larger patient sample size and the use of specific models would be required.

Conclusion

Following advances in prognosis and therapy of cancer, increasing emphasis is being placed on the psychosocial aspects of cancer care. This includes attempts to treat patients in their home environment.

This study, although limited by size, clearly demonstrates that home care is a valuable alternative for oncology patients, even for the administration of intensive chemotherapies. Further studies should be designed to better delineate the full potential of this kind of approach, as health care resources become increasingly limited, and new ways of taking care of patients are needed.

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