

Physical exercise and therapy in terminally ill cancer patients: a retrospective feasibility analysis

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Abstract

Purpose Physical exercise (PE) and/or therapy (PT) shows beneficial effects in advanced cancer patients and is increasingly implemented in hospice and palliative care, although systematic data are rare. This retrospective study systematically evaluated the feasibility of PE/PT in terminally ill cancer patients and of different modalities in correspondence to socio-demographic and disease- and care-related aspects.

Methods All consecutive terminally ill cancer patients treated in a palliative care inpatient ward during a 3.5-year period were included. The modalities were chosen according to the therapists' and patients' appraisal of current performance status and symptoms.

Results PE/PT were offered to 572 terminally ill cancer patients, whereof 528 patients (92 %) were able to perform at least one PE/PT unit (average 4.2 units/patient). The most frequently feasible modalities were physical exercises in 50 %, relaxation therapy in 22 %, breathing training in 10 %, and positioning and lymph edema treatment in 6 % each. Physical exercise and positioning treatment were performed significantly more often in older patients ($p=0.009$ and $p=0.022$, respectively), while relaxation ($p=0.05$) and lymph edema treatment ($p=0.001$) were used more frequently

in younger. Breathing training was most frequently performed in head and neck cancer ($p=0.002$) and lung cancer ($p=0.026$), positioning treatment in brain tumor patients ($p=0.021$), and lymph edema treatment in sarcoma patients ($p=0.012$).

Conclusions PE/PT were feasible in >90 % of terminally ill cancer patients to whom PE/PT had been offered. Physical exercises, relaxation therapy, and breathing training were the most frequently applicable methods. Prospective trials are needed to evaluate the efficacy of specific PE/PT programs in terminally ill cancer patients.

Keywords Palliative care · Physical exercise · Physical therapy · Terminally ill cancer patients

Introduction

Terminally ill cancer patients usually suffer from severe and debilitating symptoms such as pain, fatigue, weakness, anorexia, dyspnea, nausea, constipation, sleeping disorders, and restlessness [1, 2]. With progressive disease and increasing symptom burden, patients present with increasing levels of functional loss, mobility dysfunction, and dependency for activities of daily living [3].

The primary aim of palliative care is to improve the quality of life of terminally ill patients and their relatives, achieved by multi-professional care to control physical and psychosocial symptoms. Several clinical studies have demonstrated that integration of early palliative care can significantly improve the quality of life and coping with symptom of terminally ill cancer patients [4–8]. Further studies indicated that patients with advanced and incurable cancer have high levels of unmet needs, not only limited to physical aspects but also in the areas of psychological and medical communication needs. The

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most prevalent seems to be physical need for assistance in dealing with a lack of energy or tiredness [9].

In recent years, physical exercise and therapy programs were increasingly used in daily practice in palliative care wards and in hospice care of terminally ill patients, but systematic data on their feasibility and specific efficacy are rare.

In patients with advanced cancer still undergoing palliative chemotherapy, clinical studies have demonstrated that adapted physical exercise programs are feasible even for incurably ill patients and have beneficial effects on their quality of life, tolerance of chemotherapy, overall symptom burden, and physical and psychosocial functioning [10–16].

In contrast, only single case reports and small studies have reported that physical exercise and therapy could also be feasible and might have beneficial effects in severely ill cancer patients after completion of causal oncologic treatment, in particular on the functional status of terminally ill cancer patients [17–23], but systematic and prospective interventional studies or treatment recommendations are completely lacking.

Traditional physical therapies used in terminally ill cancer patients are mobilization including assisted transfer, breathing training, lymph edema treatment, and massages [24, 25]. Massages are the most popular [26]; also, physical exercise interventions are a commonly used treatment in terminally ill cancer patients [18, 21–23, 27].

Therefore, this retrospective study aimed to systematically evaluate the feasibility of physical exercise and/or therapy in terminally ill cancer patients in general as well as the feasibility of different modalities in correspondence to the patient's specific socio-demographic and disease-related characteristics. In addition, the impact of structural aspects of care, e.g., from where patients were admitted to the palliative care inpatient ward and the outcome of palliative care, on the feasibility of different physical exercise and therapy modalities was evaluated.

Patients and methods

Inclusion criteria

All consecutive terminally ill cancer patients who were admitted to the specialized palliative care inpatient ward at the University Medical Center Hamburg-Eppendorf between January 1, 2009 and August 31, 2012 were screened for inclusion into this retrospective analysis. Admission to the palliative care inpatient ward was possible for patients aged over 18 years suffering from incurable and progressive cancer with presence of significant physical and/or psychosocial symptoms not allowing further care at home or in non-specialized inpatient wards. Patients with non-malignant diseases were excluded from this analysis. Physical exercise and/or therapy

(PE/PT) were offered to all patients in the inpatient palliative care ward regardless of the patient's condition.

Physical exercise and/or physical therapy procedures

After admission to the palliative care inpatient ward, PE/PT were offered to all patients within two working days and in the following on at least 4 days per week during the entire hospital stay. The procedures and modalities of PE/PT were chosen according to the treating therapists' and patients' appraisal of current performance status and symptoms prior to every new therapy unit. The PE/PT units could contain physical exercise (sitting position, standing, or walking), relaxation therapy (massage, hot roll, and smoothing), breathing therapy, positioning and lymph edema treatment, and colon massage and could be suspended due to patient's subjective appraisal or organizational reasons, but not due to objectively reduced performance status. PE/PT were always performed by the same physiotherapists specialized in palliative care and were documented routinely in the electronic patient medical record.

The number of PE/PT units performed by each patient, possible reason for non-participation, as well as the specific modalities and procedures used in each session was retrospectively analyzed. The data on PE/PT were compared with the patient's socio-demographic and disease-specific characteristics, such as gender, age, diagnosis, Karnofsky performance status (KPS), and tumor entity, which were assessed on the day of admission to the palliative care ward. In addition, we evaluated the impact of structural aspects of care, including hospitalization duration in the palliative care inpatient ward, on the feasibility of different PE/PT modalities. Subgroup analyses were performed according to the structure of care from where the patients were admitted to the palliative care inpatient ward (admission from other inpatient wards compared to admission from home care, hospices, or nursing homes), and the outcome of palliative care (patients who could be admitted to home care, hospices, or nursing homes compared to patients who died on the palliative care inpatient ward).

Statistical analysis

The data of all patients included in the underlying study entered a central EXCEL database. All statistical analyses were conducted using SPSS software version 21 (IBM, Armonk, NY, USA). Chi-square analysis was performed to examine potential associations between procedures of physical exercise and therapy and patient's socio-demographic and disease- and care-specific characteristics. Bivariate associations between variables were calculated using Pearson's product-moment or Spearman's correlation coefficient. Significance tests were conducted using a significance level of $p < 0.05$.

Results

Study recruitment and evaluation procedure

A total of 840 patients, 420 females and 420 males, were admitted to our specialized palliative care inpatient ward between January 1, 2009 and August 31, 2012. After exclusion of 62 patients due to non-malignant disease, 778 terminally ill cancer patients were eligible for this analysis, but January 1, 2009 and August 31, 2012 could not be offered to a total of 206 patients (26 %) due to a short hospital stay, including weekends (3.1 ± 1.2 day) in 188 patients (91 %) or other organizational reasons (9 %).

The remaining 572 patients were invited to perform PE/PT at least at one time point during their hospital stay, and 528 (93 %) of them participated in this program at least once. In the remaining 44 patients who did not accept the invitation to perform PE/PT, the most common reasons were “fatigue and weakness” in 43 %, “deterioration of overall well-being” in 25 %, “subjectively poor condition” in 14 %, “a combination of these reasons” in 14 %, and in 4 %, external factors were reasons for non-participation. Study recruitment and evaluation procedures are presented in detail in Fig. 1.

Patient characteristics

The 528 patients who performed PE/PT at least at one time point during their hospital stay were of a mean age of 62.2 years ($SD=13.5$). The median KPS was 40 (range, 10–70). Lung cancer was the most common tumor diagnosis in 24 % of patients, followed by gastrointestinal cancer in 15 %, and pancreatic cancer in 11 %. The average duration of hospitalization on the palliative care inpatient ward was 9.9 days ($SD=6.2$).

A total of 284 patients (54 %) were referred to the palliative care inpatient ward from other inpatient wards, while 244 patients (46 %) were referred from home care, hospices, and nursing homes. In the following, 41 % of the patients died during their stay on the palliative care inpatient ward, 37 % could be discharged to home care, and 23 % were transferred to hospices or nursing homes. Further details of patient characteristics are shown in Table 1.

In the subgroup analyses, according to structural aspects of care, the patient characteristics were imbalanced in some parameters naturally caused by the patients' specific needs: patients admitted to the palliative care ward from other inpatient wards were significantly older (63.5 years, $SD=12.3$) than the patients admitted from home care, hospices, or nursing homes (60.5 years, $SD=14.7$, $p=0.011$). In addition, patients transferred to hospices or nursing homes were significantly older (66.8 years, $SD=11.8$) than the patients who died on the palliative inpatient ward (62.8 years, $SD=12.8$) or could be discharged to home care (58.2 years, $SD=12.5$, $p<0.001$).

Average duration of hospitalization on the palliative care ward was significantly longer in patients transferred to hospices or nursing homes with 11.7 days ($SD=7.0$) compared to patients who could be discharged to home care with 10.2 days ($SD=6.1$) and patients who died during on the palliative care ward with 8.6 days ($SD=5.4$, $p<0.001$).

Modalities of physical exercise and therapy

In these 528 patients, an average number of 4.2 PE/PT units ($SD=3.1$, range 1–17) could be performed, resulting in an overall number of 4,416 units during a median hospitalization period of 8.0 days (range, 0–39). The distribution of different PE/PT modalities applied in these 4,416 units is presented in Table 2.

Most frequently, the patients were able to perform physical exercises in 54 % of all applied units. Physical exercises could be primarily conducted in a sitting position in 33 % of units and in walking in 19 %. In 67 % of physical exercise units performed in walking, patients were able to walk without any help, while walking with assistance was needed in 33 %: assisted by a high walker in 18 %, with walker frame in 13 %, and with forearm crutches in 2 %.

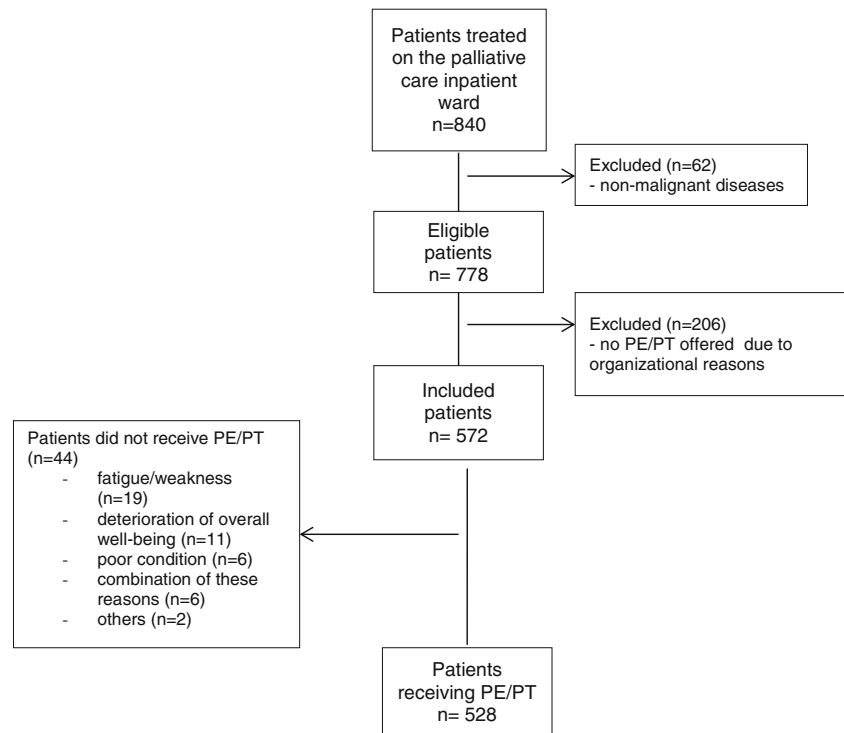
Relaxation therapy was performed in 22 % of patients, whereof massage was part of relaxation therapy in 56 % of patients. Further physical therapy procedures were breathing training which was feasible in 10 % of physical therapy units, positioning treatment in 6 %, lymph edema treatment in 6 %, and other procedures in 2 %.

Impact of socio-demographic and disease-related characteristics

Correlating feasible methods with patient socio-demographic and disease-related characteristics, physical exercise and positioning treatment were performed significantly more often in older patients ($r=0.13$, $p=0.009$ and $r=0.10$, $p=0.022$, respectively), while relaxation therapy ($r=0.10$, $p=0.05$) and lymph edema treatment ($r=0.15$, $p=0.001$) were used more frequently in younger patients. In contrast, breathing therapy showed no correlation with patients' age ($r=0.54$, $p=0.215$), and no significant correlations were determined between the patients' gender and any physical exercise or therapy modality ($r<0.01$, $p>0.05$). Positioning treatment was performed significantly more often in patients with lower KPS ($r=0.12$, $p=0.012$).

Comparing the different applied modalities with the kind of underlying tumor entity, breathing training was most frequently used in patients with head and neck cancer ($r=0.14$, $p=0.002$) and lung cancer ($r=0.10$, $p=0.026$). Positioning treatment was performed most often in patients with brain cancer ($r=0.10$, $p=0.021$), and lymph edema treatment

Fig. 1 Flow diagram on study recruitment and evaluation procedure. *n*=number of patients, PE=physical exercise, PT=physical therapy



was used most frequently in sarcoma patients ($r=0.11$, $p=0.012$).

Impact of structural aspects of care

We evaluated the impact of the care structure from which the patients were admitted to the palliative care inpatient ward on the feasibility of different PE/PT modalities. Patients admitted from home and ambulatory care received more relaxation therapy than patients previously treated on other inpatient wards ($p=0.009$). In contrast, patients admitted from inpatient wards received more positioning and lymph edema treatment than patients from home and ambulatory care ($p<0.001$). No significant differences were found for physical exercise ($p=0.496$), breathing training ($p=0.294$), and other procedures ($p=0.351$) between these subgroups. Comparison of the different PE/PT modalities with the care structures from where the patients were admitted to the palliative care inpatient ward is presented in Fig. 2.

Physical exercises (54 %), relaxation therapy (26 %), and breathing training (11 %) were most commonly used in patients who later could be discharged from the palliative care inpatient ward to home care ($p<0.001$). Patients who died in the palliative care inpatient ward had received significantly more often positioning treatment than patients who could be discharged to home care or were transferred to hospices or nursing homes ($p<0.001$). Comparison of the different physical exercise and therapy modalities with

the outcome of palliative inpatient care is presented in Fig. 3.

Discussion

The aim of this retrospective, descriptive study was to systematically evaluate the feasibility of PE/PT in a representative cohort of terminally ill cancer patients on a palliative care inpatient ward. The feasibility of the different PE/PT modalities was analyzed in correlation to the patients' specific socio-demographic and disease-related characteristics. In addition, we considered the impact of structural aspects of care on the feasibility of different PE/PT modalities.

In the underlying study, 93 % of the terminally ill cancer patients, to whom PE/PT had been offered, were able to perform PE/PT at least once during their hospitalization on the palliative care inpatient ward. An average number of 4.2 PE/PT units per patient could be performed during a median hospitalization period of 8.0 days.

Including also patients to whom PE/PT could not be offered due to organizational reasons, overall 74 % of all terminally ill cancer patients treated in our palliative care inpatient ward were able to perform PE/PT. This high rate of terminally ill patients in whom PE/PT were feasible tends to be higher than the rates reported in previous analyses. Montagnini et al. [19] and Cobbe and Kennedy [21] have also retrospectively evaluated the feasibility of physical therapy in similar study in terminally ill patients on a hospital-based palliative care unit

Table 1 Patients' characteristics

| | Patients (<i>n</i> = 528) |
|---|----------------------------|
| Gender: female/male | 270/258 |
| Age (years, AV±SD) | 62.2±13.5 |
| Female | 61.8±12.8 |
| Male | 62.5±14.2 |
| Karnofsky performance status (median, range) | 40 (range, 10–70) |
| Cancer diagnosis, <i>n</i> (%) | |
| Hematologic malignancy | 32 (6) |
| Lung cancer | 125 (23) |
| Gastrointestinal cancer | 77 (14) |
| Pancreatic cancer | 56 (11) |
| Breast cancer | 53 (10) |
| Prostate cancer | 48 (9) |
| Cancer of unknown primary | 26 (5) |
| Head and neck cancer | 27 (5) |
| Brain cancer | 28 (5) |
| Sarcomas | 28 (5) |
| Other solid tumors | 36 (7) |
| Duration of hospitalization on the PCIW (day, AV±SD) | 9.9±6.2 |
| <3 day, <i>n</i> (%) | 22 (4) |
| 3–5 days, <i>n</i> (%) | 105 (20) |
| 6–10 days, <i>n</i> (%) | 212 (40) |
| 11–20 days, <i>n</i> (%) | 153 (29) |
| >20 days, <i>n</i> (%) | 36 (7) |
| Admission from other hospital inpatient wards, <i>n</i> (%) | 284 (54) |
| Admission from home care, hospices, nursing homes, <i>n</i> (%) | 244 (46) |
| Outcome, <i>n</i> (%) | |
| Died on the PCIW | 216 (41) |
| Discharged to home care | 193 (36) |
| Transferred to hospices or nursing homes | 119 (23) |

n number of patients, *AV* average value, *SD* standard deviation, *PCIW* palliative care inpatient ward

[19] and a hospice facility [21]. In the American study, 37 % of 100 patients (71 % of their cancer patients) treated in a hospital-based palliative care unit were considered to be evaluated for a physical therapy evaluation [19]. Cobbe and Kennedy reported a rate of 65 % of 105 terminally ill patients cared in a hospice facility, who could be referred for a physiotherapy program and of 58 % of patients who were actually treated [21]. These different results might reflect the lacking data on characteristics defining terminally ill patients who could or should be considered for physical therapy. The higher results of our analysis might also represent our more offensive strategy considering PE/PT in all terminally ill cancer patients.

In our analysis, only 7 % of terminally ill cancer patients to whom PE/PT was offered did not participate in these

Table 2 Procedures of physical exercise and therapy: total number of applied units (*n* = 4,416)

| Procedures of physical exercise and therapy | Total number (%) |
|--|------------------|
| Physical exercise | 2371 (54) |
| In sitting position (exercises on edge of the bed or in wheelchair, active assisted and active resisted exercises) | 1453 (33) |
| Standing | 102 (2) |
| Walking | 817 (19) |
| Without help | 548 (67) |
| With high walker | 150 (18) |
| With walker frame | 102 (13) |
| With forearm crutches | 18 (2) |
| Relaxation therapy | 958 (22) |
| Massage | 534 (56) |
| Others (hot roll, smoothing) | 425 (44) |
| Breathing training | 450 (10) |
| Positioning treatment | 278 (6) |
| Lymph edema treatment | 269 (6) |
| Other modalities | 88 (2) |

n = numbers of physical exercise and therapy

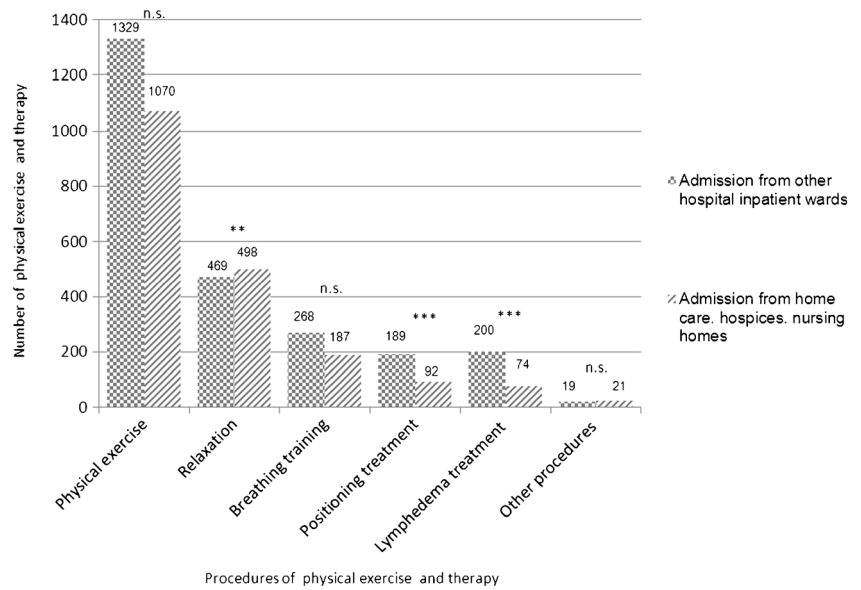
programs. The most common reasons were “fatigue and weakness,” “deterioration of overall well-being,” and “subjectively poor condition”. These reasons are similar to those reported by Montagnini et al. who have demonstrated “extreme debilitation” as the most frequent reason in 71 % of the patients why they were not appropriate for enrollment in a physical therapy program [19].

Physical exercises represented the most frequently feasible modalities which could be performed in 54 % of the terminally ill cancer patients in our analysis. The study of Cobbe and Kennedy observed a comparable rate of 57 % of patients who could be treated with physical therapy in the last week of their life [21]. These results strengthen the thesis that physical therapy is feasible in about half of all terminally cancer patients even within the last days of their life.

In our study population, physical exercises were primarily conducted in a sitting position (33 %) or in walking (19 %). In a corresponding study, Yoshioka has evaluated different types of mobility and exercise training in a single group study of 301 terminally ill cancer patients [17]. Activities of daily living, e.g., “getting in and out of chair,” “walking up or down one flight of stairs,” “gait re-education,” and “transfer training”, could be performed with assistance most frequently in 79 % of 239 patients. Further, he observed that patients who were trained in their activities of daily living presented with improved quality of life and mobility measured by the Barthel mobility index after the rehabilitation program [17].

In our analysis, relaxation therapy was performed in 22 % of all applied PE/PT units and included massage in about

Fig. 2 Correlation of the different physical exercise and therapy modalities with the care structure from which patients were admitted to the palliative care inpatient ward. n.s.=not significant, ** $p \leq 0.01$, *** $p \leq 0.001$



50 %. These results are supported by previous studies that reported that massage is the most frequently employed physical therapy modality in palliative care [18, 26].

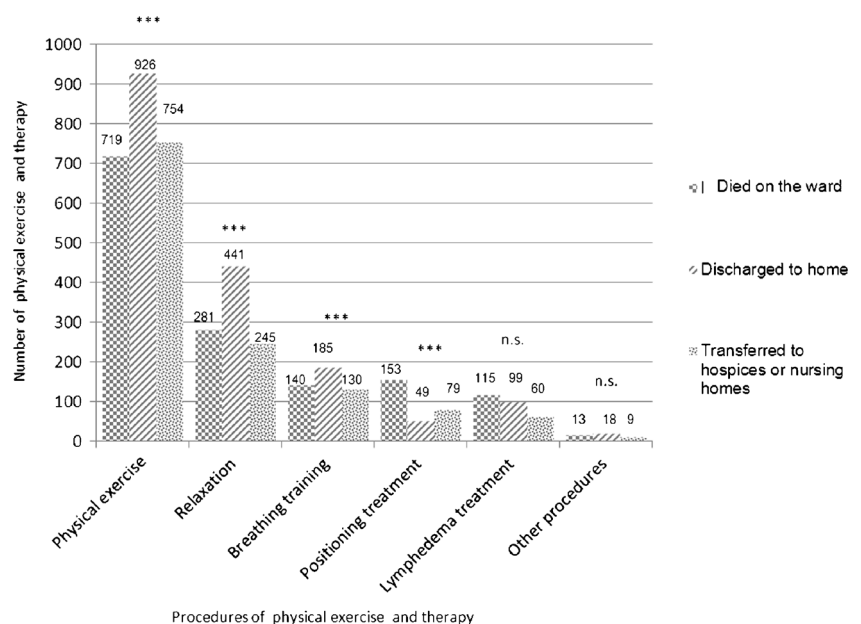
A randomized clinical pilot trial investigating physiotherapy interventions including several different therapeutic massage techniques, mobilizations, and local and global exercises in 24 terminally ill cancer patients could demonstrate that the combination of massage and exercise therapy can significantly reduce pain and improve mood in patients with terminal cancer ($p < 0.05$) [18]. Further, a review analysis has investigated beneficial effects of aromatherapy and/or massage on psychological morbidity, symptom distress, and quality of life in patients with advanced cancer. Only, 10 of 1,322 references met the methodical inclusion criteria, and 8 of them were

randomized controlled trials evaluating a total of 357 patients. Overall, short-term benefits on psychological well-being in palliative care patients by massage and aromatherapy could be concluded [27].

Breathing training and lymph edema treatment represent further modalities of physical therapy which were feasible in clinically relevant percentages of 10 and 6 % of terminally ill cancer patients, respectively. Similarly, in the study of Cobbe and Kennedy, breathing training was applicable in 15 % and lymph edema treatment in 6 % of patients during hospice care [21].

Comparing feasible PE/PT modalities with the patients' socio-demographic characteristics, positioning treatment was performed significantly more often in older patients and

Fig. 3 Correlation of different physical exercise and therapy modalities with the outcome of palliative inpatient care. n.s.=not significant, *** $p \leq 0.001$



patients with reduced performance status. This could be explained with the apparently larger subgroup of bedridden patients with older age and lower KPS receiving positioning treatment. In contrast, physical exercise could also be performed significantly more often in older than in younger patients. This might suggest that older patients preferred to actively participate in training programs, getting instructions from the physiotherapist compared to younger patients who preferred physical exercises on a self-instructed basis. Otherwise, relaxation therapy and lymph edema treatment were used more frequently in younger patients, which might be caused by the social phenomenon that younger people are more amenable to try so called “wellness modalities”.

Evaluating the impact of disease-specific characteristics, breathing training was most commonly used in patients with head and neck cancer, while positioning treatment was mostly performed in brain tumor patients and lymph edema treatment in sarcoma patients. These findings raise the thesis that different modalities PE/PT might be of specific help in patients with different tumor entities.

The specific role of rehabilitation and physical therapy in patients with head and neck cancer was evaluated in some previous studies demonstrating that rehabilitation and physical therapy could be helpful to mitigate impairments and restore function of the shoulder joint, neck, and face in these patients [28–30]. A prospective randomized trial assessed possible preventive effects of two rehabilitation programs (range-of-motion and strengthening exercises vs. thera-bite device) in patients with advanced head and neck cancer undergoing chemo-radiotherapy and could demonstrate that preventive rehabilitation is feasible in head and neck cancer patients despite of their advanced stage and burdensome treatment. Compared with data of historical controls, rehabilitation programs seem to be helpful in reducing the extent and/or severity of various functional short-term toxicities of effects of chemo-radiotherapy [30].

Subgroup analyses in our study evaluating the relation between care structures and the feasibility of PE/PT could demonstrate that physical exercises (54 %), relaxation (26 %), and breathing training (11 %) were most commonly used in patients who could be discharged from the palliative care inpatient ward into home care despite of their age or tumor disease. These results are consistent with the results of Cobbe and Kennedy who even found that more than half of the patients undergoing physical therapy could be discharged from the palliative care ward and was able to demonstrate varying degrees of functional improvement [21].

Further, our study has observed that patients admitted to the palliative care inpatient ward from ambulatory care received more relaxation therapy than patients previously also treated in other inpatient wards, while patients admitted from other inpatient wards received more positioning and lymph edema treatment than patients who have newly entered

hospitalization. This might be influenced by the significantly older age of patients admitted from other inpatient wards, but is independent from the basing tumor disease as the subgroups were well balanced in this aspect.

However, this raises the thesis that feasibility and probably also efficacy of different PE/PT modalities not only depend on the patients' socio-demographic and disease-related characteristics but also are influenced by care structures. Therefore, all three aspects have to be considered in the design of future studies prospectively evaluating specific physical exercise and/or therapy programs in terminally ill cancer patients.

The relevance of our study is limited by its retrospective and descriptive non-interventional nature and could only be hypothesis generating. Due to its descriptive character, only data on feasibility of physical exercise and therapy in routine daily practice on a specialized palliative care ward could be presented, but the efficacy of PE/PT programs on terminally ill cancer patients remains unclear and has to be evaluated in prospective controlled trials.

In particular, defining adequate endpoints for physical exercise and therapy intervention trials in terminally ill patients remains the primary task. Nevertheless, our results could demonstrate that different modalities of PE/PT should be considered in patients with different individual characteristics, different tumor entities, and being cared in different structures or with different treatment aims. Therefore, these data may represent a hypothetic basis to create specific prospective interventional trials in terminally ill cancer patients in the future.

In conclusion, in our analysis PE/PT were feasible in more than 90 % of terminally ill cancer patients cared in specialized palliative care inpatient ward. Physical exercises, relaxation therapy, and breathing training were the most commonly used modalities. Feasibility and acceptability of different PE/PT modalities seem to depend on the patients' individual and tumor-specific characteristics as well as on the structure of care and treatment aims. Specific prospective controlled trials are needed to examine the efficacy of different PE/PT programs in specific subgroups of terminally ill cancer patients respecting their individual and care-related needs.

Conflict of interest None of the authors have any conflict of interest. This study was performed without any external funding or financial sponsoring.

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