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RESEARCH

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Mobilization in the evening to prevent delirium: A pilot randomized trial

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Abstract

Background: Delirium is a common complication in patients in Intensive Care Units (ICU). Interventions such as mobilization are effective in the prevention and treatment of delirium, although this is usually completed during the daytime.

Aim: The aim of this study was to assess the feasibility of mobilization in the evening to prevent and treat ICU patients from delirium by an additional mobility team over 2 weeks.

Methods: The design was a pilot, multi-centre, randomized, controlled trial in four mixed ICUs over a period of 2 weeks. The mobility team consisted of trained nurses and physiotherapists. Patients in the intervention group were mobilized onto the edge of the bed or more between 21.00 and 23.00. Patients in the control group received usual care. The primary outcome parameter was the feasibility of the study, measured as recruitment rate, delivery rate, and safety. Secondary outcomes were duration and incidence of delirium, mortality, duration of mechanical ventilation (MV), and hospital length of stay for 28 days follow-up, and power calculation for a full trial.

Results: Out of 185 patients present in the ICUs, 28.6% (n = 53) were eligible and could be recruited, of which 24.9% (n = 46, Intervention = 26, Control = 20) were included in the final analysis. In the intervention group, mobilization could be delivered in 75% (n = 54) of 72 possible occasions; mobilization-related safety events appeared in 16.7% (n = 9) without serious consequences. Secondary parameters

Matthias Lindner and Rebecca von Haken contributed equally to this manuscript and are co-senior authors.

were similar, with less delirium in the intervention group albeit not significant. With an association of Cramer's V = 0.237, a complete study reaching statistical significance would require at least 140 patients, last 6 weeks, and cost >30 000 €.

Conclusions: In a mixed ICU population, mobilization in the evening was feasible in one-quarter of patients with a low rate of safety events. Future trials seem to be feasible and worth conducting.

KEYWORDS

delirium, early mobilization, intensive care unit, prevention, rehabilitation

1 | BACKGROUND

One of the most common complications patients experience in Intensive Care Units (ICU) is delirium[1] with incidences ranging between 20% and 89%.[2,3] Delirium is characterized by impaired attention and concentration, rapid onset and fluctuating course as well as flawed cognition, and is a direct result of one or more physical disorders, procedures, or medications.[4,5] The causes of a delirium are manifold and result from predisposing and triggering factors.[6-9] The consequences of delirium are an increased risk of prolonged duration of mechanical ventilation (MV) and length of stay, increased mortality, permanent cognitive damage, and institutionalization.[10]

For the prevention and treatment of a delirium, non-pharmacological interventions, such as early mobilization, are recommended.[2,10-13] Early mobilization is defined as interventions that support the patient through passive or active movement exercises, with the goal of maintaining or supporting patient mobility.[14] Previous studies of early mobilization during the day have been associated with a reduction in both the incidence and duration of delirium.[15-17]

In order to maintain and achieve a normal day-and-night rhythm, mobilization is recommended during the day only, allowing bed rest at night. But in more than half of patients with delirium, there is a reversal of the day-and-night rhythm with more sleep hours during the day than at night or nocturnal exacerbation of symptoms.[18,19] There are several arguments for mobilization in the evening. First, mobilization may direct agitation, as often seen in patients with hyperactive or mixed type delirium, into controlled pathways. Second, mobilization in delirious patients may promote re-orientation and potentially normalize the homeostasis of neurotransmitters through verticalization.[6,20] Third, the physical exertion of mobilization may cause natural sleep to be achieved when patients are back in bed.[10] Mobilization of patients at night is not uncommon per se; indeed about a fifth to a quarter of out-of-bed mobilizations take place in the evening or at night, albeit unsystematically and for different reasons.[21,22] Conversely, mobilization in the evening may have an overexerting effect and it is not clear if this type of intervention is suitable in ICU patients. The aim of this study was to investigate the feasibility of mobilization in the evening to prevent and treat delirium in ICU patients by an additional mobility team over 2 weeks.

What is known about the subject

- Delirium is a common complication of critically ill patients.
- Non-pharmacological interventions such as mobilization may prevent delirium.
- Mobilization is recommended during the daytime.

What this paper contributes

- In patients, who can be mobilized, mobilization in the evening can be delivered to most patients, is feasible, and safe without serious consequences.
- Mobilization in the evening may have an effect on prevention and duration of delirium.
- Future research should focus on a dose–response relationship of mobilization and delirium.

2 | METHODS

This was a pilot, multi-centre, randomized, controlled trial. The results of the study are reported in congruence with CONSORT criteria for pilot or feasibility randomized, controlled trials (Table S2).[23]

2.1 | Setting

The study was conducted in four mixed ICUs within two university hospitals in Germany. All ICUs were general ICUs with mixed adult populations, covering 32 beds in total. A third hospital in the United Kingdom was originally planned for inclusion and collected data as part of wider service evaluation. Unfortunately, because of misunderstandings between the centres, local ethical approval was not in place

at the time of data collection, and therefore this centre was excluded from the trial.

2.2 | Population

All patients treated on the participating ICUs were screened twice daily at 7.00 and 15.00 for eligibility. After assessment of each eligible patient for capacity to consent, by the treating ICU physician, patients themselves or their legal representatives gave their written informed consent. Patients were included, irrespective of their status of being on MV or not, who fulfilled all following conditions: (a) ≥18 years old, (b) Richmond Agitation Sedation Score (RASS) ≥ −3 and were responsive, (c) could be assessed for delirium, and (d) were able to being mobilized out of bed according to local policies, and (e) were expected to spend at least one night in the ICU. Patients were excluded if they had one or more of the following conditions: (a) expectation of death within the next 72 hours, (b) no informed consent for the study, (c) pre-existing immobility, (d) contraindication against mobilization, (e) delirium already present before recruitment, (f) positive pregnancy test (routinely carried out in all patients of childbearing age upon admission to ICU), (g) delirium assessment not possible (coma, foreign language, aphasia, etc.), and (h) participation in a competitive study with the outcome of delirium (Figure S1).

2.3 | Randomization

After inclusion, an independent researcher not involved in conducting this study randomized patients in a 1:1 ratio to the intervention or usual care group. Randomization was completed without blocks using a pseudo-random number generator based on a query at www.randomizer.org.

2.4 | Intervention

The early mobilization intervention was provided by an additional mobilization team. Mobilization teams have been successfully used in other studies.[16,24] The teams were made up of two people recruited from the study centres and consisted of trained intensive care nurses and/or physiotherapists and could be complemented by medical professionals. To ensure standardization of the intervention, each centre had a protocol for mobilization with similar criteria for conducting or withholding mobilization, with defined safety criteria based on the literature.[25-27] The intervention began on day 1, or after patient's consent and randomization. The time frame 21.00 to 23.00 was chosen because of the dusk at ca. 21:45 in June and practical reasons such as adaption to nurses' shift changeover and working routines in the evening. After consultation with the responsible physician and nurse, patients of the intervention group were approached between 21.00 and 23.00, informed, and mobilized after repeated verbal consent of the patients. The intervention was not delivered in cases where patients were (a) already sleeping and unresponsive to verbal questions, (b) refused the mobilization, (c) in pain, and (d) not available because of procedures. In shared rooms care was taken to ensure that fellow patients were not disturbed. The mobilization was carried out in compliance with the pre-defined safety criteria. The aim for a minimum mobility level was sitting on the edge of the bed, which, if tolerated, was progressed to standing, sitting out in a chair, or walking. Additional soothing activities such as talking, hair combing, oral care, warm foot baths, back massage, or media use were offered. The duration of the mobilization depended on the tolerance and wishes of the patient.[28] The duration of mobilization was between a minimum of 3 minutes and a maximum of 2 hours. Mobilization was stopped at 23.00 and the patient was mobilized back to bed.

The intervention was carried out for three consecutive evenings; a patient may have therefore received the maximum of three interventions. The intervention was terminated if (a) inclusion criteria were no longer met, (b) after three evenings, and (c) when the patient was discharged from the ICU. The intervention was not continued at secondary wards or units. The study was carried out in a time frame of 2 weeks from June to July to use the possible effect of dusk most efficiently.[29]

2.5 | Control group

Patients in the control group received usual care and were mobilized during the day by physiotherapists and nurses. If necessary, they received the same pharmacological treatment as patients in the intervention group, as per local policies. Patients in the control group could be mobilized during the evening, too, on the basis of nurses' clinical judgement.

2.6 | Data collection

All data were extracted prospectively from the patients' charts by the study team or assigned employees. Data included socio-demographic (age, gender, admission diagnosis, co-morbidities, frailty[30]) and care specific data (categorized admission diagnosis, ventilation device, vigilance (Richmond Agitation Sedation Score; RASS), Pain (Numeric Rating Scale, Visual Analogue Scale; NRS/VAS), Sequential Organ Failure Assessment (SOFA), according to Devlin et al.[1] Mobilizations were assessed using the ICU Mobility Scale, a valid, reliable scale ranging from 0="no mobilization" to 3="sitting on the edge of bed" to 10="independent walking."[31] Because of the obvious character of the intervention, blinding was not feasible. The data collection ended at a maximum of 28 days after admission.

2.7 | Primary and secondary outcome parameters

The primary outcome of this study was to test the feasibility of mobilization in the evening. Feasibility measures of the intervention included percentage of recruited patients (recruitment rate), the

number of patients actually receiving the intervention (delivery rate), and the number of safety events (safety rate). Potential safety events were defined as exceeding a priori defined safety limits, removal of lines or tubes, falls, Borg Rating of Perceived Exertion scale ≥7,[28] stress pain ≥5 (as measured by Numeric Rating Scale from 0 to 10, 10 indicating maximum pain), and safety events leading to consequences, e.g. withholding mobilization, re-insertion of lines or tubes, additional treatments.[32]

Secondary outcome parameters included a reduction in duration and incidence of delirium, duration of MV, length of ICU and hospital stay, mortality, and a power calculation for a full trial. Duration of delirium was assessed with the Confusion Assessment Method for the ICU (CAM-ICU) as a valid, reliable instrument for delirious detection. The duration of delirium was counted in full days; with the end of delirium defined when patients were delirium-negative for 24 hours or discharged. Patients had to be awake and delirium-assessable or were ranked as un-assessable. Other parameters such as incidence of delirium, phenotypes of delirium,[9] duration of MV, length of stay in ICU and hospital, and mortality were collected and followed-up till day 28 after ICU admission.

2.8 | Financing

Because of the pilot character of this study, we report no power calculation, but a calculation of financing the additional mobility teams. We assumed that the trial would need three mobility teams for four ICUs in two centres (in one centre, two ICU were smaller and were served by one team). Each team consisted of two clinicians, giving six clinicians per evening in total. Additionally, we recruited one clinician in each centre as reserve. Each clinician received 100€ excl. Taxes per evening, and clinicians in reserve received 50€, leading to costs of 700 € per evening. A research grant covered 10.000€, allowing us to finance three teams over the time frame of 2 weeks and additional days (in case patients were recruited at the last study day and needed another 2 days for receiving the complete, 3 days intervention), resulting in 11.200€. The costs above the grant were covered by the department.

2.9 | Statistical analysis

Categorical variables are reported in tables with absolute and relative frequencies. For all metric variables, we checked whether they follow a normal distribution on population level or not, using Shapiro–Wilk tests. In cases where normal distribution was not rejected, metrical variables are reported as means (M) and SD. In cases where normal distribution was rejected, metrical variables are reported as medians (MD) and interquartile range (IQR). Mann–Whitney *U* test, χ^2-test, Fisher's exact test, or independent t-tests were used for the analysis of outcome parameters. For measuring the strength of association between two nominal variables, giving a value between 0 und 1, we used Cramer's V and, based on that value, calculated the required number of patients in a future multi-centric trial.[33] Two-sided *P* values <.05 were regarded as

TABLE 1 Patients' characteristics

Item	All (n = 46)	Intervention group (n = 26)	Control group (n = 20)
Male (n, %)	33 (71.7)	19 (73.1)	14 (70)
Age in years (mean, SD)	62.5 (14.5)	64.4 (11.9)	60 (17.3)
Weight in kg (mean, SD)	86 (18.1)	87.7 (17.6)	83.7 (18.9)
Dementia (n, %)	0 (0)	0 (0)	0 (0)
Depression (n, %)	0 (0)	0 (0)	0 (0)
Frailty Scale (median, IQR)	4 (3-5)	4 (3-5)	4 (3-5)
Charlson Comorbidity Index (Median, IQR)	4 (3-6)	4 (2.5-6)	4 (3-6)
SOFA (median, IQR)	4 (3-6)	5 (3-7)	3 (3-6)
Highest CRP in mg/L (median, IQR)	69.6 (18.3-148)	102.5 (37.8-155)	45.3 (14.7-109)
Highest procalcitonin in µg/mL (median, IQR)	0.18 (0.06-1.34)	0.5 (0.12-5.6)	0.14 (0.05-1.42)
Highest lactate in mmol/L (median, IQR)	7.4 (1.1-11.5)	8.1 (1.3-11.2)	2.3 (1.05-15)
Highest urea in mg/dL (median, IQR)	24.5 (5.97-41)	29 (9.5-52)	16.7 (5.8-30)
Lowest GFR in mL/min (mean, SD)	74.86 (31.8)	76.29 (28.31)	72.9 (36.76)
Treatment in ICU			
Antibiotics (n, %)	41 (89.1)	24 (92.3)	17 (85)
Mechanical ventilation (n, %)	28 (60.9)	18 (69.2)	10 (50)
Continuous renal replacement therapy (n, %)	2 (4.3)	1 (3.8)	1 (5.0)
Norepinephrine, milrinone (n, %)	34 (73.9)	21 (80.8)	13 (65)
Extra corporal membrane oxygenation (n, %)	0 (0)	0 (0)	0 (0)

Abbreviations: GFR, glomerular filtration rate; ICU, intensive care unit; IQR, interquartile range; SOFA, sequential organ failure assessment.

TABLE 2 Mobilization data of the intervention group

Item	Mobilizations (n = 54)
Richmond Agitation Sedation Scale (median, IQR)	0 (0-0)
Pain (0-10) (median, IQR)	0 (0-3)
Mode of breathing	
Spontaneous breathing (n, %)	40 (74.1)
Endotracheal tube (n, %)	4 (7.4)
Tracheostomy tube (n, %)	6 (11.1)
Non-invasive ventilation/ high flow nasal oxygenation (n, %)	4 (7.4)
Mobilization level (median, IQR)	4 (3-6)
Duration (median, IQR)	20 (18.5-30)
Activities during mobilizations	
Talk (n, %)	53 (98.1)
Massage on the back (n, %)	39 (72.2)
Combing hair (n, %)	16 (29.6)
Mouth care (n, %)	12 (22.2)
Media (TV, radio, smartphone) (n, %)	2 (3.7)
Footbath (n, %)	0 (0)

Note: Data reported as number (percent) or median (Interquartile range).
Abbreviations: IQR, interquartile range.

TABLE 3 Unwanted safety events

Events	n = 54 Mobilizations
Well tolerated (n, %)	45 (83.3)
Any unwanted safety event (n, %)	9 (16.6)
Heart rate > 220—age (n, %)	0 (0)
Deviation systolic blood pressure > 20% (n, %)	4 (7.4)
Deviation oxygen saturation > 5% (n, %)	1 (1.8)
Fall (n, %)	0 (0)
Borg Scale >6 (n, %)	2 (3.7)
Pain under strain >4 (n, %)	1 (1.8)
Removal of lines or tubes (n, %)	1 (1.8)
Consequences of safety events	7 (12.9)
Stopping mobilization (n, %)	4 (7.4)
Additional drugs (n, %)	2 (3.7)
Additional fluids (n, %)	1 (1.8)
Re-/Insertion of lines or tubes (n, %)	0 (0)
Dressing change (n, %)	0 (0)
Cardiopulmonary resuscitation (n, %)	0 (0)

statistically significant. The analysis was carried out using the statistical software package SPSS (version 21, IBM, Armonk, NY, 2012).

Prior to recruitment of patients, the study was registered and ethically approved (D408/19, S-149/2019). After trial registration, one further centre withdrew data, and the design and primary outcome had to be changed from RCT to pilot, and the outcome was changed from delirium duration to feasibility.

3 | RESULTS

During a 14-day period in June and July 2019, 185 patients were screened, 71.4% (n = 132) were excluded. Most common reasons for exclusion were patients not expected to stay in the ICU overnight (27.3%, n = 36), delirium assessment not possible (20.4%, n = 27), delirium present prior to the intervention (15.9%, n = 21), and others (Figure S1). In total, 53 (28.6%) patients were eligible for inclusion and could be randomized. The intervention was rejected on all three evenings by three (5.7%) patients, and further four (7.5%) patients were lost to follow-up.

The final recruitment rate was 24.9% (n = 46) of all present patients, 56.5% (n = 26) patients in the intervention group, and 43.5% (n = 20) patients in the control group. Patient's characteristics were similar in the intervention and control group (Table 1) without significant differences. The main admission diagnoses were surgical and/or trauma (73.9%; n = 34), sepsis (13%; n = 6), or other (pulmonary, cardiology, neuro, and gastrointestinal) (13%; n = 6).

Evening mobilization could be delivered successfully in the interventions group on 75% of occasions (54 of 72 possible mobilizations). Patients' refusal (n = 7, 9.3%) and other reasons such as examinations or interventions (n = 11, 14.7%) were reasons for not carrying out the intervention. The complete intervention, including three mobilizations, was received by 53.8% (n = 14) of patients in the intervention group, the others (n = 12, 46.2%) received two or one mobilization. Notably, no patients in the usual care group were mobilized in the evening (Table 2).

During the daytime, patients were mobilized in similar patterns in both groups such as (median, IQR) 1 (0-1) times a day, in the level of "sitting on the edge of bed" (ICU Mobility Scale 3 [0-4]), for a median of 10 minutes (IQR: 0-60). In the evening, patients in the intervention group could be mobilized in 54 occasions. They had a median RASS of 0 (IQR: 0-0), and the majority were spontaneously breathing (n = 40, 74.1%; Table 2). The median level of mobilization in the evening was 4="standing in front of bed" (IQR 3 = "sitting on the edge of bed" till 6="marching on spot"). During the mobilization, 122 activities in total were delivered, mostly talks (n = 53, 98.1%) (Table 2).

In terms of safety, mobilization was well tolerated in most cases (n = 45, 83.3%). In patients with unwanted safety events, deviation of systolic blood pressure > 20% was the most common event (n = 4, 7.4%). Consequences of safety events appeared in 12.9% of mobilizations, mostly stopping mobilization (n = 4, 7.4%). No patient required re−/insertions of lines or tubes, or cardiopulmonary resuscitation (Table 3).

There were differences in the secondary outcome parameter duration of delirium (Median (IQR): intervention group: 1.5(1-2.7) vs. control group: 2(1-2) days), but not this was not significant (Mann–Whitney *U* test: *P* = .860). Incidence of delirium was lower in the

TABLE 4 Other outcome parameters

Item	All (n = 46)	Intervention group (n = 26)	Control group (n = 20)	Results[a]	*P* value
Incidence of delirium (n, %)	17 (36.9)	7 (26.9)	10 (50)	–	.133[b]
28 d free of delirium (median, IQR)	28 (26.7-28)	28 (27-28)	27.5 (26-28)	200.5	.126[c]
28 d free of mechanically ventilation (median, IQR)	27 (25-28)	26 (24.7-28)	27.5 (26-28)	179	.063[c]
28 d free of ICU (median, IQR)	23 (18.7-24.2)	23 (19.5-24)	23 (18.2-25)	242.5	.695[c]
28 d free of hospital (median, IQR)	0 (0-13.2)	1 (0-13.2)	0 (0-14)	258	.962[c]
Mortality in ICU (n, %)	2 (4.3)	1 (3.8)	1 (5)	–	.697[b]
Mortality in hospital (n, %)	1 (2.2)	0 (0%)	1 (5)	–	

Abbreviations: ICU, intensive care unit; IQR, interquartile range.
[a]Fisher's exact tests do not provide results, but *P* values.
[b]Fisher's exact test.
[c]Mann–Whitney *U* test.

Intervention group with n = 7 (26.9%) vs. n = 10 (50%), Odds Ratio was 0.37 (95%CI 0.11-1.26), albeit not significant (Fisher's exact: *P* = .133); Cramers' V was 0.237. The association between patients, who received all three interventions vs one or two interventions, was Cramer's V = 0.194 (*P* = .407). Other parameters, such as 28 days free of delirium, mechanical ventilation, ICU, hospital, and mortality, did not show any meaningful differences (Table 4). Phenotypes of delirium did not differ between both groups (Table S1).

Based on these results, we calculated in a point biserial model the required number of patients in a multi-centre trial, including 32 beds would be at least n = 140, using a power of 80% and a double-sided *P* = .05. Estimating the same recruitment and delivery rate, the duration of a RCT would last for 6 weeks with costs of at least 33 600€.

4 | DISCUSSION

This pilot, multi-centre, randomized, controlled trial including n = 46 patients on mixed ICUs demonstrated mobilization in the evening by an additional mobility team to be feasible. One-quarter of all patients could be recruited, and the intervention could be delivered to three-quarters of included patients. The incidence of safety events was low, without any serious consequences. The intervention reduced incidence and duration of delirium but did not reduce length of MV or days in ICU and hospital.

The trial was feasible in terms of recruitment, provision, and safety. Nevertheless, recruitment was not sufficient, as two-thirds of patients could not be included. We underestimated the impact of some aspects. Organizational changes increased the ratio of patients with a short stay. Some patients refused to consent, which is common in ICU rehabilitation studies.[34] The complete intervention, mobilization during three evenings in a row, could be delivered only to the half of the patients. This refusal of rehab because of fatigue, pain, or sleepiness appears in up to 70% of critical care patients, and may reduce effect size.[34] The research grant, which financed the whole trial, covered 2 weeks of extra mobility teams. Retrospectively, we probably overestimated the need for mobility teams, and found that one team of two clinicians instead of two teams with four staff members was sufficient to mobilize patients on three ICUs. Also, as a number of patients reported feeling tired or were already asleep at the time of intervention, the study may have benefitted from using different time frames, such as 7 to 10 PM, which might be as feasible. Furthermore, the preventive effect of the intervention might have led to a lower number of delirious patients in the intervention group, lowering the total number of delirious patients. Future studies might evaluate the dose–response relationship of the interval (first 3 days vs. all evenings), duration, intensity, and mobilization level on prevention and treatment of delirium in critically ill patients.

While studies including early mobilization and rehabilitation in critically ill patients achieved a reduction in delirium duration or incidence,[15-17] other studies with similar interventions did not.[35-37] A recent meta-analysis found promising data for the prevention of delirium, but not for the reduction of duration of an existing delirium.[38] Our data suggest a reduction in the duration of delirium, but this is hypothesis generating at its best: how does mobilization reduce delirium? What is the impact of verticalization, gravity, muscle activity, increased metabolism, or re-activation of cerebral locomotion-programmes on brain dysfunction?[6] Is there a dose–response relationship for delirium similar to that seen in physical rehabilitation,[39] but also in delirium? And is mobilization best used as a stand-alone intervention or as part of a care bundle? Although additional re-orientation strategies were included in our protocol, this predominantly consisted of talking with the patient (98%) or back massage (72%). Anecdotally, we observed a reduction in delirium severity by mobilizing agitated patients, but delirium severity was not systematically assessed. Specific delirium phenotypes[9] could not be identified and as such it is unclear which may benefit most from mobilization. It would also be reasonable to consider that mobilization has the potential to worsen delirium, which is caused by shock and reduced cerebral perfusion,[40] but may improve a delirium caused by sedation, hypoxia, or metabolic disturbances.[5] Mobilization in the evening may also reduce delirium contributing factors such as immobility, sleep disorders or hormonal misbalance, and others.[5] Another hypothesis is that early mobilization improves brain functionality.[41] Future trials may benefit from

providing a more structured approach to re-orientation in combination with evening mobilization and evaluate the effect of mobilization on the severity of delirium.

4.1 | Strengths and limitations

Our study had several major limitations. First, the trial had fundamental methodological changes from a RCT to a pilot study. Changing the primary outcome in RCTs after registration appears in around one-third of RCTs and may enlarge the effect sizes by 16%[42]; conversely, we reported these changes transparently, and therefore outcomes other than feasibility results should be interpreted with caution. Second, the two participating hospitals have well-established bundles for delirium prevention and mobilization, which may limit generalizability to other centres with other prevention- and treatment bundles. Third, for financial reasons, patients were only additionally mobilized on three consecutive evenings, which might be too short to show a significant effect of mobilization. Another bias is the lack of blinding of outcome assessors, statisticians, or others; however, we estimate that this factor would not have changed the main results of this study. The strengths of the study are the multi-centre design, a pre-planned analysis, a comparable mobilization protocol, and the development of future research hypotheses.

4.2 | Implications and recommendations for practice

Mobilization in the evening is feasible, can be delivered to patients, and is mainly safe. Mobilization has a potential to both prevent delirium, as well as possibly help to treat existing delirium. It can be delivered in the evening hours, depending on local structures, e.g. between 19.00 and 22.00. This activity should be adapted in its duration and intensity to the patient's specific abilities and needs. Mobilization can be combined with other nursing and therapeutic activities such as re-orientation talks, calming massage, activities of daily living such as mouth care, or communication with loved ones via smartphones, etc.

5 | CONCLUSIONS

In mixed ICU patients, a study of mobilization in the evening to prevent and treat delirium is feasible. The intervention can be delivered to three of four occasions, while exceptions happen in a few cases because of examinations, patients' refusal, or other reasons. The intervention appears to be safe. Mobilization shows signs of beneficial effects on preventing and treating delirium, but more research is needed to prove further hypotheses, such as a dose–response relationship between mobilization and delirium. We estimate that a trial reaching statistical significance would require three times the number of patients, study duration, and costs, compared with this pilot study.

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AUTHORS' CONTRIBUTIONS

P.N., D.M., N.W., N.K., and R.v.H. developed the concept and design of this study, P.N., M.K., D.M., F.H., A.B. and R.v.H. assessed the data. P.N., C.B., N.W., M.K., R.v.H. analysed and interpreted the data. P.-N. drafted the manuscript. All authors read and approved the final manuscript and are personally accountable for the accuracy and integrity of this work.

PATIENT CONSENT

All patients or their legal representatives gave written consent to use their data for research.

ETHIC APPROVAL AND REGISTRATION

The study was approved by local ethics committees and registered in the German Register for Clinical Trials (DRKS00016859) on 26 February 2019 (www.drks.de). The results of the study are reported in congruence with CONSORT criteria for pilot, randomized, controlled trials.

DATA AVAILABILITY STATEMENT

Data are available on reasonable request.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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