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Evaluation of fixed continuous positive airway pressure (CPAP) with C-Flex+ against fixed CPAP

Submission date	Recruitment status	[ ] Prospectively registered
07/12/2010	No longer recruiting	[ ] Protocol
Registration date	**Overall study status**	[ ] Statistical analysis plan
13/01/2011	Completed	[ ] Results
Last Edited	**Condition category**	[ ] Individual participant data
13/01/2011	Nervous System Diseases	[ ] Record updated in last year

Plain English summary of protocol
Not provided at time of registration

Contact information

Type(s)
Scientific

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Additional identifiers

Protocol serial number
EAME09PRSTS02

Study information

Scientific Title
Evaluation of fixed continuous positive airway pressure (CPAP) with C-Flex+ against fixed CPAP in patients with obstructive sleep apnoea

Acronym
C-Flex+

Study objectives
Compare the performance of a fixed continuous positive airway pressure (CPAP) device with C-Flex+ (REMstar® Pro) against fixed CPAP in patients with obstructive sleep apnoea (OSA) and validate its event detection capabilities.

Primary hypothesis and end-points:
1. Fixed CPAP with C-Flex+ delivered over one night by the REMstar® Pro, to subjects with OSA, will reduce the Apnoea-Hypopnoea Index (AHI) score to a similar level to fixed CPAP delivered by the same device over one night.

Secondary hypotheses and end-points:
1. Fixed CPAP with C-Flex+ delivered throughout the night by the REMstar® Pro, to subjects with OSA, will reduce the following variables to a similar level to fixed CPAP delivered by the same device:
1.1. SpO2 - Nocturnal oxygenation
1.1.1. Total time spent less than 90%
1.1.2. Lowest SpO2 during the night
1.1.3. Average SpO2 during the night
1.2. TST - Total sleep time
1.3. SE% Sleep efficiency
1.4. Sleep Architecture:
1.4.1. Min/% Non-REM sleep
1.4.1.1. Min/% N1
1.4.1.2. Min/% N2
1.4.1.3. Min/% N3
1.4.2. Min/% R sleep
1.4.3. Min/% Wake After Sleep Onset (WASO)
1.4.4. Arousals
1.4.4.1. # of arousals/awakenings (all cause)
1.4.4.2. Arousals due to PLMS
1.4.4.3. Arousal Index (AI)
1.4.4.4. Arousals due to Respiratory Disturbance (RDI)
2. Average Pressure Outputs will be lower on C-Flex+
3. Comfort will be rated as higher when using fixed CPAP with C-Flex+ and patients will prefer it to fixed CPAP
4. The breathing event output from the REMstar Pro will result in a number of events (AHI, flow limitation, RERAs, snore, clear airway apnoeas, obstructed airway apnoeas, hypopnoeas and periodic breathing) that is in diagnostic agreement with those obtained from a full clinical PSG over one night.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Ethikkommision, Ethikausschuss 1 am Campus Charité - Mitte approved on the 11th March 2010 (ref: EA1/036/10)

Study design

Double blind randomised controlled study

Primary study design
Interventional

Study type(s)
Treatment

Health condition(s) or problem(s) studied
Obstructive sleep apnoea

Interventions
Following the standard education and acclimatisation program of the centre, in which subjects will undergo a daytime CPAP session at a constant pressure of 5 cmH2O using several different interface models so that an appropriate interface can be selected, eligible subjects will complete a CPAP titration study under full PSG conditions. CPAP shall start with a value of 4 cmH2O and be increased in 1cmH2O increments to the point where disordered breathing, including hypopnoeas, RERAs and flow limitations, is eliminated. Respironics' Integrated heated humidifier will be used if needed and set to an initial setting of 2. During the course of the night, this setting can be changed to optimise participant comfort. This study shall be interpreted by the co-investigator to determine the optimal CPAP setting. A successful titration will be defined as an AHI less than 15.0/h under the determined optimal pressure. Subjects in whom CPAP does not adequately treat OSA during the titration will be excluded.

Following the CPAP determination study, subjects will be randomly assigned to one night of fixed CPAP with C-Flex+ and one night of fixed CPAP delivered by the REMstar Pro on consecutive nights in the Sleep Laboratory by the PSG technician under full PSG conditions.. These studies should be performed within 14 days of the CPAP determination study. Humidification will be standardised at the level from the CPAP determination study. The same interface will also be used on each occasion.

Visual Analogue Scales relating to comfort will be completed immediately upon waking after each therapy night. After the second therapy night a questionnaire asking which device they preferred will also be completed. These assessments will all be administered by the co-investigator at each site.

Intervention Type
Other

Phase
Not Applicable

Primary outcome(s)
In order to test the primary hypothesis the following PSG variables will be assessed: 1. AHI (total, REM and NREM) - total, obstructive, central, mixed and hypopnoea

Comparisons will be made using the above data. These continuous variables will be summarised using means (and standard deviations) or median (interquartile range), depending on the distribution. The within-patient differences between the modes will be presented for each of

these variables using mean differences and 95% confidence intervals. The 95% confidence bounds (one sided) will be scrutinised to determine whether or not non-inferiority of the fixed CPAP with C-Flex+ can be declared.

Key secondary outcome(s))

In order to test the secondary hypotheses the following variables will be assessed:
1. SpO2 - Nocturnal oxygenation
1.1. Total time spent less than 90%
1.2. Lowest SpO2 during the night
1.3. Average SpO2 during the night
2. TST - Total sleep time
3. SE% Sleep efficiency
4. Sleep Architecture:
4.1. Min/% Non-REM sleep
4.1.1. Min/% N1
4.1.2. Min/% N2
4.1.3. Min/% N3
4.2. Min/% R sleep
4.3. Min/% Wake After Sleep Onset (WASO)
4.4. Arousals:
4.4.1. # of arousals/awakenings (all cause)
4.4.2. Arousals due to PLMS
4.4.3. Arousal Index (AI)
4.4.4. Arousals due to Respiratory Disturbance (RDI)
Comparisons will be made using the above data. These continuous variables will be summarised using means (and standard deviations) or median (interquartile range), depending on the distribution. The within-patient differences between the modes will be presented for each of these variables using mean differences and 95% confidence intervals. The 95% confidence bounds (one sided) will be scrutinised to determine whether or not non-inferiority of fixed CPAP with C-Flex+ can be declared.

5. Average Pressure Outputs will be summarised using means (and standard deviations) or median (interquartile range), depending on the distribution. The pairwise within-patient differences between the modes will be presented as mean differences and 95% confidence intervals, and the single sample t-test will be used to assess whether the differences between the modes are statistically significant.
6. Comfort - The 10cm comfort visual analogue scale will be summarised for each of the modes from data collected on nights 1 and 2 of the study using means (and standard deviations) or median (interquartile range), depending on the distribution of the data. The pairwise within-patient differences between the modes will be presented as mean differences and 95% confidence intervals, and the single sample t-test will be used to assess whether the differences between the modes are statistically significant.
7. Preference - The number (and percentage) of patients who prefer each of the modes will be presented, along with 95% confidence intervals for these percentages and McNemar's test using a X2 test in a 2 by 2 contingency table will be used to assess whether the differences between the modes are statistically significant.
8. Breathing event output - Device reported scoring will be compared to both standard and specialised PSG scoring. The correlation coefficients will be determined. The PSG's from the study night will be considered the gold standard for identifying and quantifying apnoeas and hypopnoeas during sleep. The accuracy of the CPAP device in detecting residual events (clear airway apnoea, obstructed airway apnoea, hypopnoea, apnoea hypopnoea index, respiratory

effort related arousals and Cheyne Stokes Respiration) will be based on comparisons of the CPAP and the PSG by correlation and agreement using the method of Bland and Altman. During these analyses, a clear airway apnoea will be considered a surrogate of a central apnoea and an obstructed airway apnoea a surrogate of an obstructive apnoea. Mixed apnoeas will be classified as central on the PSG recording. For the AHI, Receiver-Operator Characteristic (ROC) curves will be constructed to determine optimal cut-off values for determining positive and negative likelihood ratios. A log transformation of the data may be performed to improve the scatter of the differences as the AHI increases. Patients with and without residual OSA on CPAP will be compared using a two sample t-test.
9. Other relevant statistical tests including multivariate analysis may be performed according to the discretion of the Principal Investigator and Statistician.

Any deviations from points 1 - 8 in this plan will be reported in the final manuscript.

Completion date
10/01/2012

Eligibility

Key inclusion criteria
1. AHI greater than 15 confirmed (greater than than 50% obstructive events) by full PSG within last 14 days
2. Age greater than or equal to 21 years of age
3. Able to provide consent
4. Able to follow the instructions given by the investigator regarding using their CPAP device and their participation in this study

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Adult

Sex
All

Key exclusion criteria
1. Inability to tolerate CPAP during the daytime CPAP session
2. Failure of CPAP to adequately treat OSA during titration (AHI greater than or equal to 15.0/h under the determined optimal pressure)
3. PAP therapy is otherwise medically contraindicated: acute upper respiratory infection, encephalitis, sinusitis or middle ear infection or surgery of the upper airway, nose, sinus, or middle ear within the previous 90 days
4. Untreated, non-OSA sleep disorders, including but not limited to; insomnia, periodic leg movements (PLM)/restless legs syndrome (RLS)
5. Treated insomnia
6. Intake of central relevant drugs, sedatives, or other drugs which impair sleep
7. Previous exposure to positive airways pressure therapy

8. Acute dermatitis or other skin lesions or trauma interfering with the application of a mask
9. Unwilling to participate in the study
10. Participation in another clinical study in the past 4 weeks
11. Shift worker

Date of first enrolment
10/01/2011

Date of final enrolment
10/01/2012

Locations

Countries of recruitment
Germany

Study participating centre
Center of Sleep Medicine
Berlin
Germany
10117

Sponsor information

Organisation
Philips Respironics (France)

ROR
https://ror.org/05jz46060

Funder(s)

Funder type
Industry

Funder Name
Philips Respironics (France)

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary

Not provided at time of registration

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Participant information sheet	Participant information sheet	11/11/2025	11/11/2025	No	Yes