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Original Article

Comparison between home and hospital set-up for unattended home-based polysomnography: a prospective randomized study

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ABSTRACT

Background: Unattended home-based polysomnography (H-PSG) is a reliable tool for the diagnosis of obstructive sleep apnoea (OSA). The quality of the recording can be influenced by several factors including the set-up location – at home versus in the sleep laboratory. Previous studies have suggested that the failure rate is higher when H-PSG is fitted in hospital. The aim of this study was to determine the influence of hook-up location on H-PSG recording quality. Feasibility and repeatability of H-PSG were also assessed.
Methods: Consecutive patients suspected of OSA were selected. Each patient underwent two H-PSGs within two weeks, one fitted at home and one fitted in the sleep laboratory. The order of H-PSG was randomly assigned.
Results: Among the 102 included patients, 95 completed the study. Ninety-three per cent of the 190 H-PSGs were satisfactory. The failure rate of H-PSG was similar for both the home set-up and the sleep laboratory set-up ($p = 0.33$). Seventy-nine per cent of patients opted to be fitted at home. OSA was diagnosed in 59%. The apnoea–hypopnoea index was similar for home and sleep laboratory set-up, resulting in a very good reproducibility (intraclass correlation coefficient of 0.85). No differences in total sleep time and sleep architecture were observed in both set-up protocols. Except for sleep duration, which was longer in the first H-PSG test, we did not observe any first-night effect during the first H-PSG.
Conclusion: The present study demonstrates that hospital hook-up is as effective as home hook-up for home-unattended polysomnography, and that feasibility and repeatability of H-PSG are very good.

1. Introduction

Polysomnography (PSG) is a comprehensive sleep assessment tool, which is reliable for the diagnosis of obstructive sleep apnoea (OSA). Unattended home-based polysomnography (H-PSG) is a valid method to establish a formal diagnosis of OSA, even in the presence of co-morbidities [1,2]. Unlike portable monitoring, the routine use of unattended PSG is not yet recommended mainly because evidence is still limited, the technique is cumbersome, and the procedure is more expensive [3,4]. Indeed, the quality of H-PSG is inferior to the quality of attended in-laboratory PSG. For example, failure rates of PSG are estimated between 4% and 20% versus 0% and 8% in the home versus laboratory environment, but it must be stressed that the quality of recordings obtained with portable monitoring devices is even worse (5–30% failed recordings) [1,5,6].

Furthermore, the quality of a recording can be influenced by several factors, including not only the experience of the sleep technician, patient behaviour, and the quality of the PSG but also the set-up location. H-PSG set-up can be performed both at home (H-PSG) and in the sleep laboratory (LH-PSG). Results from previous studies show a relatively high failure rate of H-PSG, which suggests that this might be related to hook-up within the hospital where patients have to travel with a fitted PSG [7,8], which can lead to data loss. This hypothesis is also supported by observations from other studies which used the set-up at home, and it reported a similar quality of recordings between H-PSG and attended in-laboratory PSG [9]. Hook-up at home is associated with additional costs [9]. However, there are no published data comparing the influence of the hook-up at home versus at the hospital on the quality of H-PSG recordings. With this in mind, a prospective randomized study was performed to determine the influence of set-up location on H-PSG recording quality. The feasibility and repeatability of H-PSG were also studied.

2. Materials and methods

2.1. Study design and patient selection

Patients referred to the sleep laboratory of a tertiary hospital with suspected OSA were all considered for inclusion. All patients had

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complained of snoring, excessive daytime sleepiness and/or other symptoms and signs evocative of OSA (ie, obesity, co-morbidities, and craniofacial abnormalities). They were also asked to accept set-up at home by a sleep technician. Exclusion criteria included persons under 18 years of age, anyone who had participated in a previous PSG study, restrictive respiratory disorders, and a distance between home and hospital exceeding 30 km. Written informed consent was obtained, and the local human studies committee approved the study.

2.2. Polysomnographies

All patients underwent two unattended H-PSGs, on weekdays and within 2 weeks of each other. They were performed by the same sleep technician who graduated with a master's degree in sleep medicine from the Université Libre de Bruxelles and has worked in the sleep laboratory for >10 years.

The order of recording was randomly assigned, and random allocation was made in blocks. Medical history, Epworth Sleepiness Scale (ESS), body mass index (BMI), and neck circumference were recorded. Subjective sleep quality and quantity were evaluated the morning after H-PSG using a questionnaire [4].

2.2.1. Technical aspects

Two complete H-PSGs were performed in each patient using the same technical material (electrodes, probes, nasal prongs, etc.) and methods with the exception of the set-up location. Set-up was performed once at home (HH-PSG), around 4:00 PM, and once in the sleep laboratory (LH-PSG), at the same time. The portable PSG characteristics have been described in a previous study [10]. Patients were asked to remove the device themselves, the morning after the test, and to return it to the sleep laboratory.

2.2.2. Analysis

PSG analyses were performed by a physician who was blinded to the hook-up location. Scoring was completed manually in accordance with the 2007 American Academy of Sleep Medicine scoring rules [11]. Respiratory events were expressed as an apnoea–hypopnoea index (AHI). Sleep was scored in sleep stages: stage 1, stage 2, slow-wave sleep (SWS), and rapid eye movement (REM) sleep.

OSA was defined according to the International Classification of Sleep Disorders, third edition [12].

The quality of the recordings was graded according to Redline et al. [13], and it was considered as unsatisfactory: no usable data (artefact, software dysfunction, etc.); poor: respiratory channel (airflow and bands), oximetry or electroencephalographic (EEG) channels contain <4 h of data; fair: respiratory channel (airflow or either bands), one EEG signal and oximetry good for >4 h and <5 h; good: respiratory channel (airflow or either bands), one EEG signal and oximetry good for >5 h; very good: at least one EEG channel, oximetry airflow and either band good for >5 h; and excellent: at least one EEG channel, one electrooculogram (EOG) channel, chin electromyogram (EMG), oximetry, airflow, and chest wall and abdomen good for >5 h.

PSG failure was established if the recording quality was graded as 'unsatisfactory' or 'poor'. We also calculated the percentage of interpretable data for all relevant signals: thoracic and abdominal movements, nasal airflow, pulse oximetry, two EEG channels, right and left EOGs, and submental EMG.

2.3. Statistical analysis

A power analysis conducted prior to the study predicted that a sample of 102 patients would provide an 80% power to detect a mean difference in H-PSG failure rate of 10% using a two-sided significance level of 5%.

Statistical analyses include descriptive statistics. For continuous variables, mean and standard deviation are reported if the data were symmetrically distributed; otherwise, the median (min–max) was used.

To assess the differences in continuous variables between the two hook-up conditions, unpaired *t*-test was applied; for binary variables, the likelihood ratio chi-squared test was applied.

To assess differences in continuous variables between home and sleep laboratory set-up assessment, or between night 1 and night 2 assessment in the same patient, the paired *t*-test or signed-rank test was used.

To assess differences in categorical variables between home and sleep laboratory set-up assessment, or between night 1 and night 2 assessment in the same patient, Bowker's test of symmetry was used.

The intraclass correlation was calculated using *R* version 3.0.2. All other statistical analyses were performed using the Statistical Analysis System (SAS) 9.4, SAS Institute Inc, Cary, NC, USA.

The study was registered on clinicaltrials.fgov NCT01361854.

3. Results

One hundred and two patients suspected of OSA were enrolled between August 2011 and November 2014. Seven patients delayed or refused the second H-PSG, so they could not be performed, and data analysis was then carried out on 95 patients.

In 59%, a diagnosis of OSA was established.

Complete anthropometric and demographic data are presented in Table 1.

The sleep technician encountered no problems during hook-up, at home. No car crashes, violence or other safety-related problems were reported.

3.1. Quality of sleep recordings

Of the 190 tests, 75% were excellent, 9% very good, 7% good, 2% were fair, 6% were poor and 1% were not interpretable (quality grade 'unsatisfactory'). Despite a slightly larger number of unsatisfactory and poor-quality HH-PSG recordings compared to LH-PSG (10 vs. 3%), the quality rate of H-PSG was similar in both groups ($p = 0.33$). Poor recordings resulted from ground electrode loss in six cases and from the loss of the oximeter in two cases. A mixture of problems caused poor recordings in another three cases.

Global H-PSG quality is summarized in Table 2.

A detailed analysis of individual recordings showed that we could obtain the following important percentages of good-quality data lasting for >95% of scorable time for HH-PSG and LH-PSG, respectively: 76% and 73% for thoracic band, 76% and 78% for abdominal band, 87% and 89% for oximetry, 82% and 80% for nasal pressure, 86 and 93% for EOG1, 86 and 92% for EOG2, 84% and 92% for EEG1, 84% and 92% for EEG2, and finally 89% and 96% for EMG. Detailed quality data are summarized in Table 3, and a significant difference in favour of LH-PSG was observed for EOG1 only.

Table 1
Anthropometric and demographic data of the patients.

	$n = 95$	
Age (years); mean ± SD	48 ± 12	
Gender, *N* (%)		
Female	30	32%
Male	65	68%
BMI; mean ± SD	29 ± 5	
Neck circumference (cm); mean ± SD	40 ± 4	
ESS; mean ± SD	9 ± 5	

BMI: body mass index, ESS: Epworth Sleepiness Scale score.
HH-PSG: home-unattended polysomnography (H-PSG) fitted at home.
LH-PSG: H-PSG fitted in the sleep laboratory.

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