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Title

Improving Quality of Life and living independence of a Quadruple amputee with a Microclimate backrest with active airflow installed on a wheelchair

Coauthors

None

Summary

This case study shows how a microclimate backrest with active airflow can significantly improve the quality of life of a 47-year old male who is a quadruple amputee. The individual is now able to use his myoelectric prosthesis more often and live more independently.

Introduction/ Basics

A 47-year old male (Mr. O.), who is a quadruple amputee and uses a Permobil F5 electric wheelchair, with Vicair seat cushion and Permobil backrest, for 2,5 years now, presented with heat discomfort, heat rash and excessive sweat buildup. Mr. O. lives in Sydney, Australia which is considered a humid subtropical climate. The climate caused him to sweat excessively which made using his myoelectric prosthesis challenging. This caused problems for his independence and he was looking for a solution. He contacted his local wheelchair service who connected with us to find a solution for the skin rash and excessive sweat buildup, as they recognised both issues can become more severe and cause maceration of the skin, and eventually, the formation of pressure injuries or Moisture-Associated Skin Damage (MASD). Temperature and humidity affects the structure and function of the skin, increasing or lowering possible damage thresholds for the skin and underlying soft tissues (Kottner et al., 2018).

Methods/ work process

Our aim was to find an effective and convenient solution for Mr. O so that his skin conditions do not deteriorate and to improve his quality of life (QoL) by enabling the use of his prosthesis. The first step in the process was to determine the extent of the problems, to do so we used a specially developed heat & moisture scoring tool, hereafter referred to as the 'risk matrix'. The risk matrix consists of 5 rows, in each row you score the current state of your patient

from 0 to 6 (see figure 1). The total score reflects the severity of the need for better heat and/or moisture management. A questionnaire with QoL questions measuring the impact of the heat and moisture related symptoms on the QoL and measurements of the severity of these symptoms was also filled in. Finally, an evaluation of the wheelchair and what adaptations could be made, was completed. After modifying the wheelchair, the questionnaire and risk matrix will be filled in again to assess the impact of the solution.

Implementation

After initial assessment it became clear that the need for a system that could decrease the heat and moisture related symptoms would be of huge impact for Mr. O. He has a contoured backrest and seat cushion, was mostly immobile in his wheelchair and used antihistamines, all are risk factors for heat and moisture related symptoms. With regards to the severity of the symptoms did he score 9 out of 10 for the heat and moisture related complaints in the past week and 5 out of 6 for the past four weeks. As you could imagine that had a huge impact on his QoL, and on all the questions he scored 4 out of 5 points, meaning the second highest; 'Quite a lot'. The results are shown in table 1. His QoL was also reduced by the inability to use the myoelectric prosthesis due to the moisture buildup.

To alleviate the symptoms and improve QoL a microclimate system with active airflow was fitted in the Permobil backrest. A 'fanbox' blows air, with a maximum speed of 14.4m/s per fan, into two flexible channels which are integrated in the backrest. The user has full control of the system and can increase or decrease the fan speed with a remote control. To test the influence of someone's current health state, we also ask to rate their current health, both before and after using the microclimate backrest. Mr. O rated his health 10 out of 10 points, therefore the other answers weren't influenced by his current health (no bias).

Conclusion

Mr. O uses his microclimate backrest with active airflow system all day on setting 2 or 3, from the total 6 settings. Only when sitting in full sun does he turn the system up to a higher setting. The active airflow system, which uses ambient air, was effective in eliminating the skin rash and reducing excessive sweat buildup. The severity of the heat and moisture related symptoms was both rated 6/10 and with that reduced 3 points. His QoL improved in all areas; before

the 12 areas the QoL was scored on had a total score of 55/70, after this was 33/70, which is a significant improvement. With the microclimate backrest with active airflow, it was now comfortable to sit in his wheelchair and he regained more independence by being able to use his myoelectric prosthesis more often. His pain was reduced slightly and his fatigue also improved. He has not experienced any side effects of the system. Overall these are all positive effects and he summarizes it telling us: "It's great!".

References

1. Kottner, J., Black, J., Call, E., Gefen, A., Santamaria, N. Microclimate: A critical review in the context of pressure ulcer prevention. *Clinical Biomechanics*, 2018; 59, 61-70. Doi: 10.1016/j.clinbiomech.2018.09.010
2. Gauer R, Meyers BK. Heat-Related Illnesses. *Am Fam Physician*. 2019 Apr 15;99(8):482-489. PMID: 30990296.
3. Beeckman D, Schoonhoven L, Fletcher J, Furtado K, Gunningberg L, Heyman H, Lindholm C, Paquay L, Verdú J, Defloor T. EPUAP classification system for pressure ulcers: European reliability study. *J Adv Nurs*. 2007 Dec;60(6):682-91. doi: 10.1111/j.1365-2648.2007.04474.x. PMID: 18039255.
4. Parnham A, Copson D, Loban T. Moisture-associated skin damage: causes and an overview of assessment, classification and management. *Br J Nurs*. 2020 Jun 25;29(12):S30-S37. doi: 10.12968/bjon.2020.29.12.S30. PMID: 32579457.
5. Leon LR, and Bouchema A. Heat Stroke. *Compr Physiol* 5:611-647, 2015. DOI: 10.1002/cphy.c140017

Image: OTworld abstract table 1 Questionnaire answers_240.JPG

Question	Before	After
Current health	10/10	10/10
Risk matrix questions		
Heat related symptoms	2/6 Heat discomfort & rash	1/6 heat discomfort
Moisture related symptoms	3/6 Excessive sweat buildup	1/6 sweat buildup
Postural support	3/6 contoured backrest & contoured cushion	-
Mobility in wheelchair	5/6 Mostly immobile	-
Medication use	2/6 antihistamines	-
Severity of heat/moisture related complaints		
Severity heat related complaints in the past week	9/10	6/10
Severity moisture related complaints in the past week	9/10	6/10
Severity heat related symptoms in the past 4 weeks	5/6 Severe	4/6 Moderate
Severity moisture related symptoms in the past 4 weeks	5/6 Severe	4/6 Moderate
Quality of life		
Interference of heat symptoms with normal work	4/5 Quite a lot	3/5 Moderate
Interference of moisture symptoms with normal work	4/5 Quite a lot	3/5 Moderate
Interference of heat symptoms with enjoyment of life in the past 4 weeks	4/5 Quite a lot	2/5 Rarely
Interference of moisture symptoms with enjoyment of life in the past 4 weeks	4/5 Quite a lot	3/5 Sometimes
How often did heat related symptoms make simple tasks hard to complete? (past 4 weeks)	4/5 Quite a lot	2/5 Rarely
How often did moisture related symptoms make simple tasks hard to complete? (past 4 weeks)	4/5 Quite a lot	3/5 Sometimes
Leisure activities affected by heat related symptoms (past 4 weeks)	4/5 Quite a lot	2/5 Rarely
Leisure activities affected by moisture related symptoms (past 4 weeks)	4/5 Quite a lot	2/5 Rarely
How often did your heat related symptoms make you feel fed up and frustrated?	4/5 Quite a lot	2/5 Rarely
How often did your moisture related symptoms make you feel fed up and frustrated?	4/5 Quite a lot	3/5 Sometimes
How much impact do heat related issues have on your daily life?	6/10	3/10
How much impact do moisture related issues have on your daily life?	9/10	5/10
Other		
Comfort sitting in wheelchair	5/10	6/10
Extend to which you suffer from pain on an average day	4/10	3/10
Extend to which you suffer from fatigue on an average day	6/10	4/10

Table 1. The risk matrix score is calculated by combining the risk matrix questions, this makes a score of 15 before using the WheelAir, which is the 'high category'. All the measurements are improved after a test period of 2 weeks.

Image: risk matrix figure 1_241.png

Severity	0	1	2	3	4	5	6	Score
HEAT (Ref: Gauer, 2019)	No heat stress related symptoms or discomfort	Heat discomfort	Heat rash	Heat-induced muscle spasms/ heat cramps	Heat syncope (fainting, dizziness, light-headedness, brief loss of consciousness)	Heat exhaustion (headache, nausea, vomiting, exhaustion, weakness, dizziness, fainting, mental confusion etc.)	Heatstroke (body temperature > 40°C) Or Heat-induced seizures	
MOISTURE/ SKIN INTEGRITY (Ref: Beeckman, 2007 & Parnham, 2020)	Intact healthy skin without sweat buildup	Sweat buildup	Skin redness and irritation	Stage 1 pressure injury/ moisture lesion: Non-blanchable erythema of intact skin Or excessive sweat buildup	Stage 2 pressure injury/ moisture lesion: Partial-thickness skin loss with exposed dermis	Stage 3 pressure injury/ moisture lesion: Full-thickness skin loss	Stage 4 pressure injury: Full-thickness skin loss and tissue loss	
NEED FOR POSTURAL SUPPORT	Occasional wheelchair use	Standard canvas backrest & standard cushion	Contoured backrest or contoured cushion	Contoured backrest and contoured cushion	N/A	Full postural support system	Full postural support system with incontinence cover/coating	
MOBILITY IN CHAIR	No limitations in mobility	Almost no limitations in mobility	Slightly limited mobility	Moderately limited mobility	Very limited mobility	Mostly immobile	Completely immobile, sling required which remains between seat & client	
MEDICATION USE (Ref: Leon, 2015)	No relevant medication use	N/A	Antihistamine & anticholinergic drugs (impaired sweating) & spasmolytics (excessive sweating)	Antipsychotic & antidepressants (increased heat production)	Beta-blockers, calcium channel blockers (reduced blood pressure, reduced skin blood flow) & diuretics (dehydration & salt, potassium and calcium depletion)	Ephedrine & amphetamines (increased activity, heat production, impaired sweating or excess sweating, inability to regulate temperature)	N/A	

Figure 1. The risk matrix – a heat and moisture scoring tool to calculate the extent of the heat and moisture related symptoms and the need for better heat and moisture management.