

The correlation between transient blood glucose levels and alterations in cardiorespiratory output among asthma patients treated with nebulised β_2 agonists.

Background

Although β_2 agonists are effective in treating acute asthma exacerbations, the 'off-target' receptor stimulation that patients often experience can result in a complex interplay of internal and external processes. This may complicate the usual asthma pathway, leading to heightened inflammatory and compensatory responses and consequently more severe and extended exacerbations.

This study aimed to ascertain the impact of nebulised salbutamol on blood glucose levels and its correlation with the ventilation/perfusion ratio (V/Q).

Methods

A pragmatic, single-arm observational study within a single NHS ambulance Trust used both prospective and retrospective data to explore the relationship between Capillary Blood Glucose (CBG) levels and cardiorespiratory output during nebulised salbutamol administration.

Prospective data collected by paramedics at point of care and retrospective data collected from patients receiving nebulised salbutamol over the study timeframe were analysed through descriptive and inferential statistical methods to evaluate the significance of any correlations.

Results

Over a six-month timeframe the hosting ambulance Trust nebulised 7,426 patients, although just 2,412 [32%] had a known history of asthma recorded on their clinical record. When study criteria were added a 'Target Population' of 176 patients were identified, with only pre and post nebulisation heart rate (HR), respiratory rate (RR) and peripheral blood oxygenation levels (SpO2) recorded in 100 incidences.

Analysis of Retrospective Pre and Post Cardiorespiratory Data

Group	Initial HR (n=100)	Final HR (n=100)	Initial RR (n=100)	Final RR (n=100)	Initial SpO2 (n=100)	Final SpO2 (n=100)
Mean	100.79	97.44	25.03	20.07	95.44	97.71
Standard Deviation (SD)	18.14	16.78	6.86	4.83	5.43	2.67
Standard Error Mean (SEM)	1.81	1.68	0.69	0.48	0.54	0.27
The two-tailed P value (Sig.)	0.0163		less than 0.0001		less than 0.0001	
Test Static (t)	2.4441		8.6384		4.7305	
Degree of freedom (df)	99		99		99	
Mean of Initial measurement minus Final measurement	3.35		4.96		-2.27	
95% Confidence Interval of the Difference	Lower	Upper	Lower	Upper	Lower	Upper
	0.63	6.07	3.82	6.10	-3.22	-1.32
Significance	statistically significant.		extremely statistically significant.		extremely statistically significant.	

Main Trends (Retrospective Data)

- A decrease in patients' HR and RR post treatment [HR: 65%; RR: 74%], with both rates decreasing simultaneously in 48% of patients.
- SpO2 levels show a tendency to increase [59%] when either HR or RR decreases [HR: 38%; RR: 43%], but this occurs only 26% of the time when both HR and RR reduce.

Of the 100 subset, 8 patients had both pre and post CBG measurements recorded. Of these only *one patient demonstrated a reduction in CBG levels, a patient that was undergoing palliative care at the time with multimorbidity and polypharmacy.

Main Trends (Prospective Data)

- Pretreatment CBG ranged from 4.6 to 8.9 mmol/L, compared to 5.2 to 8.8 mmol/L post treatment.
- Two recruited patients were diagnosed with diabetes. These were the only patients who showed an increase in HR, decrease in RR and increase in both SpO2 and CBG levels.

Analysis of Prospective Pre and Post CBG Data

Group	Initial CBG (n=8)	Final CBG (n=8)	Initial CBG (*Outlier Removed) (n=7)	Final CBG (*Outlier Removed) (n=7)
Mean	5.988	6.363	5.571	6.243
Standard Deviation (SD)	1.611	1.141	1.188	1.177
Standard Error Mean (SEM)	0.570	0.404	0.449	0.445
The two-tailed P value (Sig.)	0.2924		0.0067	
Test Static (t)	1.1386		4.0501	
Degree of freedom (df)	7		6	
Mean of Initial measurement minus Final measurement	-0.375		-0.671	
95% Confidence Interval of the Difference	Lower	Upper	Lower	Upper
	-1.154	0.404	-1.077	-0.266
Significance	not statistically significant.		very statistically significant.	

Conclusion

A strong correlation was observed between pre and post treatment Capillary Blood Glucose levels (CBG) alongside proactive V/Q matching, reflected through changes in the Respiratory Rate, Heart Rate and Peripheral Blood Oxygen Saturation level. These changes suggest real time side effects amongst some asthma patients treated with nebulised salbutamol, which may have ramifications to their short and long term health.

Given the complexity of variables, such as anxiety, comorbidities and the intricate interplay between Respiratory Rate, Heart Rate and CBG, the critical need for monitoring all of these in acute asthma cases is highlighted, as these potential cardiorespiratory and endocrine alterations could exacerbate the condition. Further investigation is essential to understand why certain asthma patients may be more vulnerable to these drug induced side effects than others.