

Central Venous Pressure Optical Sensing in the Internal Jugular Vein: A Case Study

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1 Abstract

1.1 Introduction

Venous pressure measurements hold significant clinical importance in intensive care units, where hemorrhagic shock is a common concern. Traditionally, assessing venous pressure has required catheterization, a risky invasive procedure. Photoplethysmography (PPG) offers a non-invasive alternative through optical sensing, where fluctuations in local blood volume modulate the light transmitted through tissue [1]. Developing a robust method to measure Internal Jugular Vein (IJV) pressure using optical techniques could provide a non-invasive alternative to traditional catheterization methods [2].

1.2 Purpose

The purpose of this case study was to use readily available PPG sensors over the IJV to evaluate the feasibility of measuring central venous pressure. The Valsalva manoeuvre, a well-known technique for modulating venous pressure, was employed to determine if a change in signal becomes observable.

1.3 Methods

A cloth PPG sensor was repurposed and placed transversely over the IJV. Red and infrared channel data were recorded and low-pass filtered to isolate the non-pulsatile PPG component. Blood pooling in the IJV, indicated by its expansion and increased light absorption, is hypothesized to produce a drop in the low-frequency signal.

1.4 Results

The repurposed PPG sensor was able to detect the IJV pulse. The low-passed output displayed a drop during Valsava.

1.5 Discussion

The ability of the repurposed sensor to detect the IJV pulse and pressure change was demonstrated. Further calibration and application exploration efforts would advance this research toward clinical applicability. This technology suffers from motion artifacts, thus requiring mitigating methodologies, technologies, and algorithms.

1.6 Conclusion

This study demonstrated the feasibility of optically sensing the jugular venous pulse and relative pressure using a common clinical cloth PPG sensor. Future work will involve a population study to validate these preliminary findings and assess the broader applicability of this approach.

References

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