Sensorised “Smart” Scaffold to Monitor Cell Processes based on Impedance Characteristics

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**Abstract.** Currently, one interest in tissue engineering is realizing scaffolds which not only to direct the cell process but also to monitor them. This idea can be realised by transforming a conventional scaffold into a “smart scaffold” that acts as a sensor for cell activities. Adhesive and proliferative cells modify electrical properties of adhesion substrate. Therefore it is possible to monitor their activity by monitoring the impedance of scaffold. Furthermore, impedance techniques have been used to monitor bacterial growth and cell motility of fibroblast cells. For this scope microelectrodes were used, in order to have a stable and non-invasive interface. To investigate the feasibility of designing sensorised and biocompatible scaffolds, we have realised a polymer membrane with embedded carbon nanotubes (CNT), which present electro-conductive properties. In this work we present the cell effect of composite membrane and how it is possible to monitor cell adhesion from its change.

*Keywords*: carbon nanotubes, cell processes, impedance techniques, polymer membrane, scaffolds

# Introduction

Vascular cognitive impairment (VCI) is a cognitive disorder associated with cerebrovascular disorders. VCI is a broad concept that includes all mild cognitive disorders (MCI) to Vascular Dementia (VaD) [1]. Cognitive impairment is also a major challenge in the health sector worldwide. According to the World Health Organization (WHO) this is due to the increase in the number of people suffering from cognitive impairment by 10 million each year. VCI became a big and serious problem faced by developed countries and starting to emerge in developing countries [2]. In Indonesia, the number of people with dementia in 2013 reached 1 million people and is expected to double by 2030.

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# materials and methods

Upon to the ethical approval no 0621/UN2.F1/ETIK/2018, the donors for PRFM were screened for HIV, hepatitis B and C, and cytomegalovirus infections. All donors with no reactions were informed and the concerns were signed afterwards.

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## HSCs Isolation

Umbilical cord blood was collected from Dr. Cipto Mangunkusumo General Hospital after the participants were given informed consent. The protocols used in this study was approved by the Ethics Committee of the Faculty of Medicine, Universitas Indonesia – Dr. Cipto Mangunkusumo General Hospital. HSCs isolation was conducted as described in our previous work [9]. Briefly, HSCs were purified from umbilical cord blood by a magnetic-sorting method. Cell viability was counted by a dye exclusion method using trypan blue.

## Hydrogel Formation

### Alginate Microcapsules

Sodium alginate (Sigma-Aldrich, USA) was dissolved using phosphate-buffered saline without Ca2+ and Mg2+ (PBS w/o Ca/Mg) (Sigma-Aldrich) until a final concentration of 50 mg/ml. Alginate solution was mixed with cell suspension (5 × 106 cells/ml) in ratio 4:1. The mixture (10 μl) was dropped into 0.2 M CaCl2 solution under agitation at 230 rpm. The alginate microcapsules were subsequently washed with PBS w/o Ca/Mg.

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## Preparation of scaffold

Platelet rich plasma was isolated using RegenKit®-BCT (Regenlab) followed the manufacturer instruction. Briefly, 8 ml of peripheral blood was collected into the tube, centrifuged at 1500 g for 10 min, then the resultant of plasma supernatant and platelet sediment were inverted mixed for 10 times. Then, 7 ml of the mixture was harvested, placed in a sterile 100 ml pot (Falcon) and added with sterile CaCl2 25 mM and centrifuged for 3500 rpm 10 min. The PRFM was then collected.

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# results and discussions

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# conclussion

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