Real-time Blood Pressure Monitoring in Porcine Tibial Artery Using LC Resonant Pressure Sensor

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Abstract: We have developed an implantable wireless sensor for real time pressure monitoring of blood circulation system. MEMS (micro-electro-mechanical system) technology was adopted as a sensor development method. The sensor is composed of photolithographically patterned inductors and a distributed capacitor in gap between the inductors. A resulting LC resonant system produces its resonant frequency in range of 269 to 284 MHz at 740 mmHg. To read the resonant frequency changed by blood pressure variation, we developed a custom readout system based on a network analyzer functionality. The bench-top testing of the pressure sensors showed good mechanical and electrical functionality. A sensor was implanted into tibial artery of farm pig, and interrogated wirelessly with accurate readings of blood pressure. After 45 days, the sensor’s electrical response and histopathology were studied with good frequency reading and biocompatibility.

Keywords: Hypertension, Pressure sensor, Implantable, Wireless, MEMS

1. 서 론

고혈압은 심근 경색 (myocardial infarction), 낙증 종 (strokes), 심부전 (heart failure), 신장 부전종 (renal failure)등과 같은 심혈관 질환을 일으키는 가장 중요한 인자로 널리 인식되고 있다 [1-3]. 전 세계적인 고혈압 추세와 메이비했는데 노년층에 의해 고혈압 환자의 수는 점차 증가하여 2025년에는 그 수가 약 15억 6천명에 달할 것으로 나타보고 있다 [4]. 현존하는 혈압 측정법은 대체로 수치치로 나눌 수 있다. 전범 (auscultatory method), 활동기 혈압 측정법 (ambulatory blood pressure monitoring, ABPM), 가정 에서의 혈압측정법 (home blood pressure monitoring, HBPM) [5-7]. 이러한 방법들은 혈관과 간접적 접촉에 의해 측정하는 방식으로 피의흐름에 의한 소리 또는 혈관의 기계적 진동을 이용하여 측정한다. 일반 혈압 계의 경우 외부로 꼬리를 둘러싼 커프 (cuff)의 작용 위치, 커프에 연결된 공기주머니 (bladder) 사이즈, 잠을 기