

ESWL焦点附近声压分布的FDTD数值解析

菅喜岐
生物医学工程系

摘要: 泌尿外科结石症是一种常见多发病症。体外冲击波碎石(Extracorporeal shock wave lithotripsy:ESWL)法是应用人体外发射的高强度脉冲超声波,在人体内的焦点附近形成的冲击波破碎人体泌尿系统结石,被破碎的结石碎片随尿液排出体外的治疗泌尿外科结石症方法。由于这种治疗方法具有非创伤等优点被广泛地应用于泌尿外科结石症治疗之中。但是,ESWL治疗过程中有时会引发尿血、肾血肿等并发症,影响其法治疗效果的主要因素之一为ESWL焦点附近形成的声压分布。本研究是利用笔者等以前提出的FDTD(Finite Difference Time Domain)超声波非线性传播的仿真方法,数值仿真ESWL超声波非线性传播过程,研究ESWL焦点附近声压的分布,焦点区域(焦区)的大小、形状,高强度超声波形成的实际焦点位置。

FDTD Analysis of ESWL Focal Neighborhood Sound Pressure Distribution

Abstract: Stone diseases of the urinary and biliary tract are rather common, often very painful, and sometimes immediately life threatening. In extracorporeal shock wave lithotripsy (ESWL), high intensity ultrasonic pulse is generated outside the human body, and focused via water to human body. The kidney and ureter stones are crushed by the shock wave in focus, and discharged out of human body by the urine. The ESWL has come into wide use due to its non-invasive advantage. However, when crushing stone in human body by ESWL, it often happens to complications, such as bloody urine and a kidney hematoma. The medical treatment effect of ESWL changes by the sound pressure distribution near an ESWL focus. This study analyzes ultrasonic pulse nonlinear propagation using ultrasonic nonlinear propagation simulation FDTD (Finite Difference Time Domain) method proposed before the author, and examines the sound pressure distribution near a focus, size and form of focal region, and the focal position of the converged ultrasonic.

关键词

体外冲击波碎石(Extracorporeal shock wave lithotripsy); 超声波非线性传播(Ultrasonic pulse nonlinear propagation); FDTD解析(FDTD analysis Dynamic focus); 实际焦点位置(Factual focus location)