USEFULNESS OF ULTRASOUND IMAGING IN NON-INVASIVE EVALUATING OF BONE IMPLANTS IN SHEEP

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ABSTRACT

The aim of this study is to compare the imaging of conventional radiography (CR) and ultrasound (US) examination in non-invasive detecting morphological tibial bones implant of sheep. Six sheeps received bones implant at the left tibial by hydroxyapatite-tricalcium phosphate (HA-TCP) or hydoxyapatite-chitocan (HA-C) at difference group and the right tibial drilled not implanted as control. The CR and US performed before (0day), 7day, 14day, 21day and 30day after implantation. The results show that soft tissue around the implant good perform directly by US. No different gross imaging on site, implant and gross of bones on both examination of CR and US. Therefore, the highed quality of radiographic imaging to precisions evaluating in hard tissue were perform by CR. Usefulness US to gross imaging bones implant and soft tissue surrounding can perform with ionizing radiationless more safety for operator and animal. Ultrasound (US) is rapid, non-invasive, simple, effective, and presents a viable and practical alternative to conventional radiography (CR) for perform of the bones implant imaging.

Keywords: ultrasound, radiography, bones implant, sheep, hydoxyapatite, tricalcium phosphate, chitocan

INTRODUCTION

Ultrasound (US) relies on the reflection of ultrasound waves (echoes) at the interfaces of tissue that have different acoustic properties (Maylia & Nokes 1999). As compared with conventional radiographic (CR) evaluation of healing in fractured bones, US may prove to be more effective in assessing bone micro-architecture, the onset of bone formation, and the surface topography of bone (Hans et al. 1995; Hughes *et al.* 2003; Lauria *et al.* 1996). In fractured long bone, the intensity of reflected echoes during healing can identify the characteristics of bone apposition (Ricciardi et al. 1003; Thurmuller *et al.* 2002). However, CR is not a perfect diagnostic or monitoring tool, because a soft tissue healing may not be obvious and because the extent of lesion and spatial relationship to important anatomical landmarks are not easily visualized (Bender & Seltzer 1961; van der Stelt 1985). Radiographic assessment of lesion healing or expansion is usually subjective and can be impaired by the superimposition of anatomical structures (Goldman *et al.* 1972). The aim of this study is to compare the imaging of CR and US examination in non-invasive detecting morphological tibial bones implant of sheep.

MATERIAL AND METHOD

Ultrasound Examination. The US examination of bone implants were examined using a portable ultrasound machine (KX 5100, Xuzhou Kaixin Electronic Instrument Co., Ltd, China) with a multi frequency linear transducer (5-7.5 MHz) and a thermal printer to printing images of US. Ultrasound imaging for longitudinal and transverse views from the dorsal and the distal aspect of the implants were taken. Parameter of evaluation consist of size of site, implants, new bone formation, periosteal soft tissue swelling and surrounding implant site soft tissue were evaluated.

Radiographic Examination. The CR examination of bone implants were examined using a portable x-ray machine (VR-1020, MA Medical Corp.Japan). Standard radiographs of tibials bones were obtained in caudo-cranial and latero-medial. Kilo-Volt peak (kVp) and mili Ampere second (mAs) arranged that they can produce the best quality of radiographs with the focal-film distance (FFD) 80 cm for each sampling data. Film washed through in the dark room and then dried with aerated. The radiographs evaluated in front of illuminator light. Parameter of evaluation consist of margin, opacity, size of implant, shape, dimension, new bone formation, periosteal soft tissue swelling and surrounding implant site soft tissue were evaluated.

RESULT AND DISCUSSION

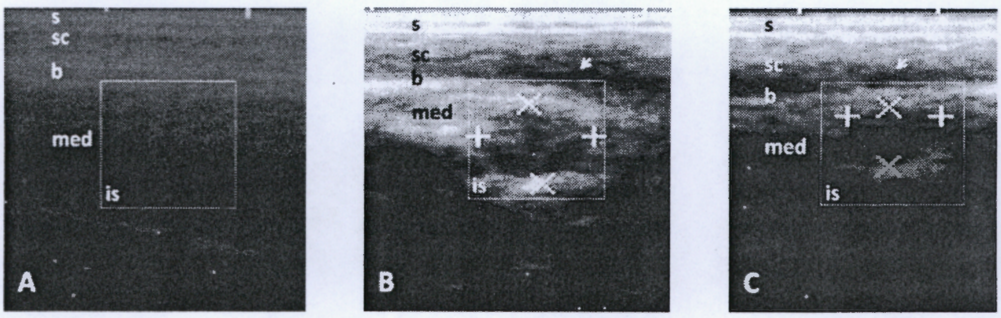

Figure 1. Ultrasound (US) images of tibial bone control group. A. Sonogram of tibial bone before drill showing that difference of echogenicity of skin, subcutan, bone and medulla of bone. B. Sonogram of 21 days tibial bone after drill. C. Sonogram of 30 days tibial bone after drill. s, skin; sc, subcutan; b, bone; med, medulla; is, implant site; arrow, anechoic image indicate that site consist of liquid. The sc area at the 21 days after implantation were higher than normal region at figure A and consist of multi echoic images, there were hyper-echoic, hypo-echoic and an-echoic. The hypo-echoic images were indicating of semi high reflective mass, like a primary callus. The hyper-echoic images were indicating of high reflective mass, like a secondary callus. The an-echoic images were indicating of un-reflective mass, like a liquid. The hole of drilled tibial visible as an-echoic image. The diameter of hole came in sight decrease after 30 days, which indicate the bone remodeling was occurred.

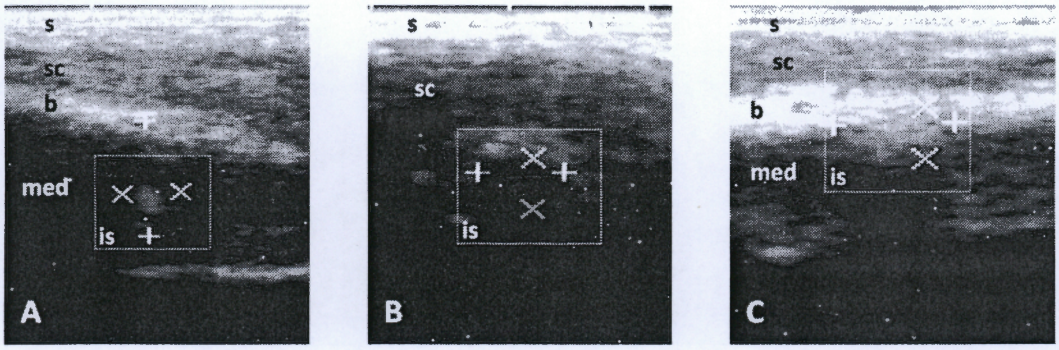

Figure 2. Ultrasound (US) image of tibial bone were implanted by Hidroxyapatite-Tricalcium Phospate (HA-TCP) group. A. Sonogram of tibial bone after 7 days implanted by HA-TCP showing the hole of implant site consists of hyper-echoic mass. B. Sonogram of tibial bone after 21 days implanted by HA-TCP. C. Sonogram of tibial bone after 30 days implanted by HA-TCP. s, skin; sc, subcutan; b, bone; med, medulla; is, implant site. The sc areas of tibial after 21 days implantation were higher than 7 days at figure A and decrease after 30 days. Inflammations and bone remodeling were occurred after implantation that visible at sc areas. The sc areas consist of multi echoic images, there were hyper-echoic, hypo-echoic and an-echoic. The hypo-echoic images were indicating of semi high reflective mass, like a primary callus. The hyper-echoic images were indicating of high reflective mass, like a secondary callus. The an-echoic images were indicating of un-reflective mass, like a liquid.

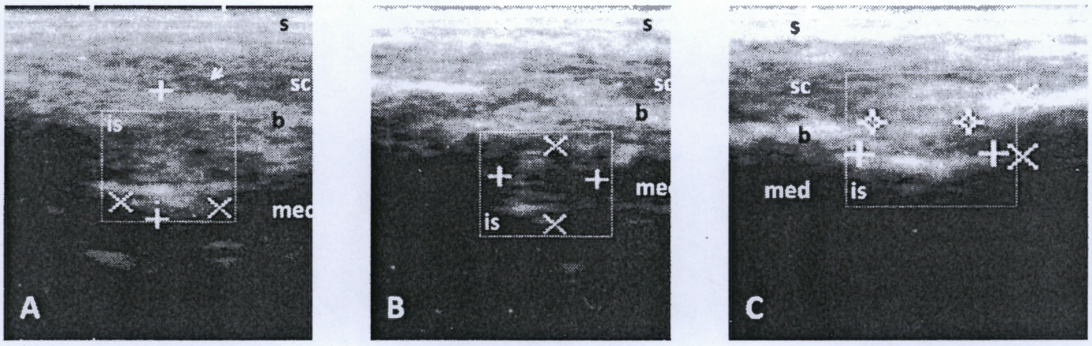

Figure 3. Ultrasound (US) image of tibial bone were implanted by Hidroxyapatite-Chitocan (HA-C) group. A. Sonogram of tibial bone after 7 days implanted by HA-C showing the hole of implant site consists of hyper-echoic mass. B. Sonogram of tibial bone after 14 days implanted by HA-C showing the implant site decreasing than 7 days before. The HA-C implant visible partial hypo-echoic that indicate of degrading implant occurred C. Sonogram of tibial bone after 30 days implanted by HA-C. s, skin; sc, subcutan; b, bone; med, medulla; is, implant site; arrow, anechoic image indicate that site consist of liquid.

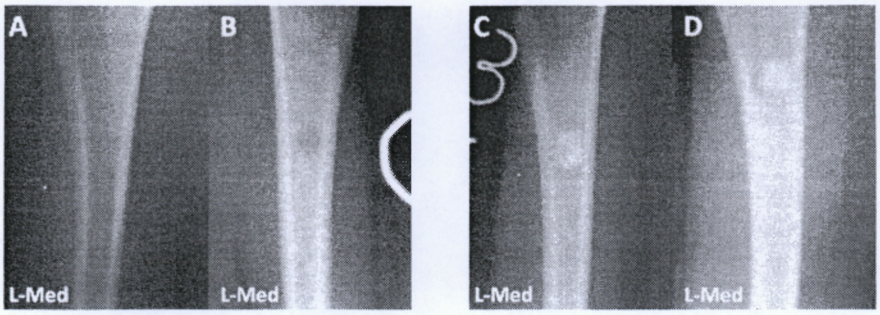

Figure 4. Conventional radiography (CR) image of tibial bones before and after implanted. A. Radiogram tibial before implantation. B. Radiogram group of Control tibial drilled without implant. The drilled bones were visible as radiolucent areas at radiogram. C. Radiogram group of HA-TCP tibial after implantation. The HA-TCP implant was visible as radiopaque areas. D. Radiogram group of HA-C tibial after implantation. L-Med, Latero-medial view of radiograph.

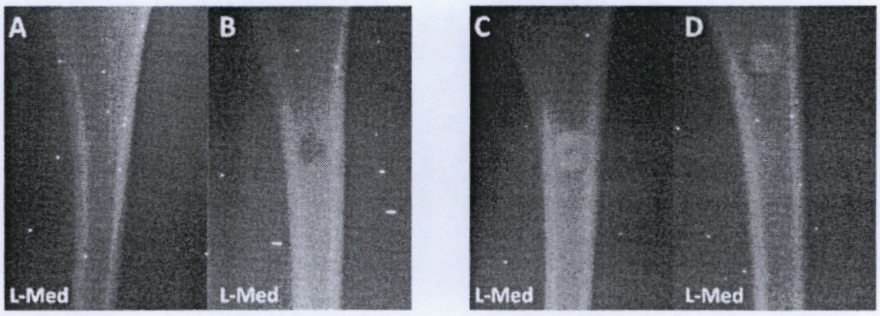

Figure 5. Conventional radiography (CR) image of tibial bones after 7 days implanted. A. Radiogram tibial before implantation. B. Radiogram group of Control tibial drilled without implant after 7 days. C. Radiogram group of HA-TCP tibial after 7 days implantation. D. Radiogram group of HA-C tibial after 7 days implantation. L-Med, Latero-medial view of radiograph. The hole of drilled bone at the control group was visible as radiolucent areas. The implants were consisting of HA-TCP and HA-C and visible as radiopaque areas.

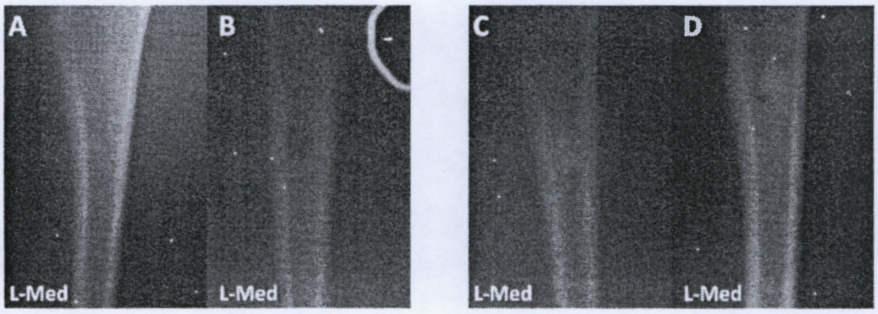

Figure 6. Conventional radiography (CR) image of tibial bones after 30 days implanted. A. Radiogram tibial before implantation. B. Radiogram group of Control tibial drilled without implant after 30 days. C. Radiogram group of HA-TCP tibial after 30 days implantation. D. Radiogram group of HA-C tibial after 30 days implantation. L-Med, Latero-medial view of radiograph. There were no differences diameter sizes of hole between 7days and 30 days after implantations. The changes of soft tissue areas around implants site were not visible at the radiograms at several day after drill and implantation until 30 days.

Soft tissue identified as hypoechoic or anechoic, which may extend around the bony contours (Pineda et al. 2009). As compared with conventional radiographic (CR) evaluation of healing in fractured bones, US may prove to be more effective in assessing bone micro-architecture, the onset of bone formation, and the surface topography of bone (Hans et al. 1995; Hughes *et al.* 2003; Lauria *et al.* 1996). Plain radiographs are the standard technique employed to document the typical bone remodeling and are, therefore, very useful (De simone *et al.* 2011). However, they are insensitive to the soft tissue changes that are the only signs of early inflammations (Siannis *et al.* 2006).

Ultrasound (US) has multiple advantages: it is readily accessible, can be performed quickly without delay and with minimal discomfort to the patient, it is useful in regions that are complicated by orthopedic instrumentation and therefore might not be well seen with CR, has a lower cost, does not use ionizing radiation, and offers real time imaging (Pineda *et al.* 2009).

CONCLUSION

Based on the result and discussion above, the usefulness US to gross imaging bones implant and soft tissue surrounding can perform with ionizing radiationless more safety for operator and animal. Ultrasound is rapid, non-invasive, simple, effective, and presents a viable and practical alternative to conventional radiography for perform of the bones implant imaging.

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