Determining Surgical Method by Meniscectomy Induction on Garut sheep (Ovis aries) for early stage of Osteoarthritis

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INTRODUCTION

Osteoarthritis (OA) is the most common joint disease that cause of pain and disability by various factors such as advanced age, obesity, trauma, and arthritis disease. These factors affect by degeneration of the cartilage surface, leading to loss of matrix include proteoglycan osteophyte formation, subcondral and synovial membrane affected. In the healthy joint, meniscus, articular cartilage, subchondral bone, and synovial membrane provide support to the joint. The meniscus is an important load bearing structure and has nutritive as well as lubricating properties in the knee joint as well (Little et al. 2010).

Animal models are research materials that can be used in studying potential pathogenesis and therapy in various diseases in humans. Sheep are commonly large animal model of OA because of the availability, ease of handling, and have a similarities with humans in size and structure of joint. In the development of science, sheep can be used as an animal model in studying the pathogenesis of diseases in human orthopedics such as joints, ligaments, and bones. Garut sheep is an Indonesian germplasm indigenous that has the structure, density, and size of joint anatomy that are similar in human joints rather than other small animals. This is the basis of the utilization of Garut sheep as an animal model in human orthopaedic. (Little et al. 2010; Gregory et al. 2012).

The aim of this study was to identify and analyze the determining surgical method by meniscectomy induction on Garut sheep with 8 weeks post meniscectomy observation for early stage of OA.

MATERIALS AND METHODS

This study used 4 Garut sheep (Ovis aries) aged 4 years old, female, 35-40 kg, healthy, and has acclimatized for 2 weeks. Sheep are divided into 2 groups: the group one is unilateral meniscectomy of total lateral meniscus (n=2) and the group two is unilateral meniscectomy of total lateral meniscus and partial medial meniscus (n=2). The procedures used for this study was approved by the animal ethics committee of Bogor Agricultural University (No: 8-2016 RSHP FKH IPB).

The induction technique is accompanied by an exercise as far as ± 150 m daily for 3 weeks, followed by addition of 4 weeks observation. The parameters measured were radiological assessment of OA in femorotibial joint using Kellgren Lawrence grading score refers to Schiphof et al. (2008). A macroscopic evaluation was performed on the articular surface from lateral condyle referred to Osteoarthris Research Society International (OARSI) recommendations (Little et al., 2010). The data of radiography and macroscopic were analyzed descriptively and quantitatively on 8 weeks post meniscectomy observation.

RESULT AND DISCUSSION

The use of sheep as animal model of OA is supported by anatomical similarity of the femorotibial joint in humans, making easier to induce and observe the pathological effects of OA. Sheep presented the disadvantage of not prone to spontaneous arthritis, so induction is needed first to create the condition of OA (Gregory et al. 2012). The method of induction of femorotibial joint OA with meniscectomy in this study was chosen because it can cause femorotibial contact stress, so that the cartilage of the lateral condyle of the
tibia gains a greater proportion of the load received by the body.

Radiological result at 8 weeks post meniscectomy in both groups showed narrowing of the joint of the femorotibial lateral (Figure 1). In the medial condyle of group two there is a moderate level joint space compared to group one. In addition, severe osteophytes were found on the edges of the lateral condyle, increased density and severe sclerosis in the subchondral bone in both groups (Figure 1). The presence of osteophytes in the lateral condyle is an effort to improve joint degeneration and is a physiological response to overloaded joints by increasing of joint edges (Schiphof et al. 2008).

At 8 weeks, all sheep in group one present of yellow fibrillation in the articular surface that focused on the cranial to the caudal of the lateral condyle. Furthermore, were seen in group two, the location of fibrillation was only found in the lateral cranial condyle and in the cranial part of the medial condyle (Figure 2). In the macroscopic terms found the existence of fibrillation of development of worse OA by yellow to brown color, damage to the articular surface causes loss of matrix to subchondral bone. In addition to fibrillation, severe osteophytic formation was found in group one compared to group two. This occurs because of the increased contact stress of the lateral condyle of the tibia which results in the joints directly forming osteophytes on the edge of the lateral condyle as joint efforts of load distribution (Beveridge et al. 2011).

Based on radiological and macroscopic results on 8 weeks post meniscectomy, it was identified that unilateral induction of meniscus total lateral meniscectomy results in progressive damage focused on the lateral condyle compared to unilateral induction of meniscus lateral meniscectomy and partial medial meniscus.

According to Beveridge et al. (2011) that lateral meniscectomy can provide more progressive damage to joint cartilage compared to medial meniscectomy. According to the macroscopic results it is known that in both groups the final stage of OA event is present. This causes the animal model with 8 weeks post meniscectomy procedure is impossible to use as a model in OA therapy.

**CONCLUSION**

The results showed that induction with unilateral meniscectomy of total lateral meniscus followed by exercise is possible to produce progressive damage focused on the articular lateral condyle and it becomes the determining surgical method of meniscectomy induction on Garut sheep (*Ovis aries*). The progressive damage in 8 weeks post meniscectomy observation is impossible to used, because it is on the final stage of OA. Therefore, for the further study must decrease time of post meniscectomy observation for showed the early stage of OA.

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