Short Communication

Comparative Study between Using Acetone and Absolute Alcohol for Dehydration in Plastination Procedure

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Abstract

In order to develop the most practical plastination specimens used for anatomical study, the aim of the present study was to compare between using acetone and absolute alcohol for dehydration in plastination procedure. Ten pig heart specimens were used in the present study and plastination procedure was processed by using acetone (group 1) or absolute alcohol (group 2) for dehydration. The results showed that dehydration by acetone resulted in more natural color with no shrinkage of the heart specimens while dehydration by alcohol caused darker color and more shrinkage. However, the advantage of using alcohol was that it gave the drier texture of the specimens which may be easier for maintenance of the specimens. In conclusion, the dehydration process in plastination procedure could be done by using acetone either absolute alcohol depended on the objective of each plastination procedure. In cases which high quality of natural looking specimens was needed, using acetone in dehydration process was suggested.

Keywords: *Absolute alcohol, acetone, dehydration, plastination,*

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บทคัดย่อ

การศึกษาเปรียบเทียบระหว่างการใช้อะซีโตนและแอลกอฮอล์สำหรับขั้นตอนการดึงน้ำในขบวนการกำซาบด้วยสารพลาสติก

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เพื่อประโยชน์ต่อการศึกษา และงานวิจัยทางด้านกายวิภาคศาสตร์ การศึกษาครั้งนี้ มีจุดประสงค์เพื่อพัฒนาเทคนิคการกำซาบด้วยพลาสติกโดยการเปรียบเทียบระหว่างการใช้อะซีโตนและแอลกอฮอล์สำหรับการดึงน้ำในขบวนการกำซาบด้วยพลาสติก โดยการใช้ตัวอย่างหัวใจสุกรจากโรงฆ่าสัตว์ จากนั้นดำเนินขั้นตอนกำซาบด้วยพลาสติกและเปรียบเทียบระหว่างผลของการใช้อะซีโตน (กลุ่มที่ 1) และแอลกอฮอล์ (กลุ่มที่ 2) ในการดึงน้ำ ผลการทดลองพบว่าการใช้อะซีโตนจะได้อวัยวะกำซาบด้วยพลาสติกที่ใกล้เคียงกับสีธรรมชาติและไม่มีการหดตัวของตัวอย่างหัวใจ ในขณะที่การดึงน้ำด้วยแอลกอฮอล์ในขบวนการกำซาบจะได้ตัวอย่างอวัยวะที่สีเข้มกว่าสีปกติ และเกิดการหดตัวของตัวอย่างหัวใจ อย่างไรก็ตามการใช้แอลกอฮอล์จะได้ตัวอย่างที่แห้งกว่าการใช้อะซีโตนซึ่งอาจจะเป็นข้อได้เปรียบในการเก็บรักษาตัวอย่างหลังจากการกำซาบด้วยพลาสติก จากการทดลองนี้สรุปว่าสามารถใช้อะซีโตนหรือแอลกอฮอล์ในขั้นตอนดึงน้ำของขบวนการกำซาบด้วยพลาสติกโดยขึ้นอยู่กับวัตถุประสงค์ของแต่ละขั้นตอน ในกรณีที่ต้องการตัวอย่างหลังจากการกำซาบที่มีคุณภาพสูงและเนื้อเยื่อใกล้เคียงกับตัวอย่างปกตินั้น ควรจะใช้อะซีโตนในขั้นตอนการดึงน้ำออกจากเนื้อเยื่อ

คำสำคัญ: แอลกอฮอล์ อะซีโตน การดึงน้ำ การกำซาบด้วยพลาสติก

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Introduction

Plastination is a technique used in anatomical work to preserve bodies or body parts. This technique was first invented by Gunther von Hagens in 1979 to preserve animal and vegetable tissues permanently by synthetic polymer (von Hagens et al., 1987). The principle of plastination is that water and fat will be replaced by certain plastics (Bickley et al., 1981). In veterinary anatomical teaching, practice and research, plastination helps overcoming the decay of specimen used and therefore, it was a very practical tools for preserve the specimen especially in tropical climate country such as Thailand. Plastination technique helps to reduce the number of live animals used for veterinary anatomical teaching as plastination specimens could be last for a long period with most properties of the original samples. Moreover, plastination allows veterinary students to experience the texture of specimen without exposure to toxic chemicals such as formalin. In addition to macroscopic study, plastinated specimens can be used for both light microscopy and ultrastructural studies after deplastination with sodium methoxide (Grondin et al., 1994). There are four steps in the standard process of plastination which are fixation, dehydration, forced impregnation in a vacuum, and hardening. In order to develop the most practical plastination specimens used for anatomical study, the aim of the present study was to compare between using acetone and absolute alcohol for dehydration in plastination procedure.

Materials and Methods

Total 10 pig hearts were collected from the slaughter house and divided into 2 groups which were Group 1) dehydrated with acetone and Group 2) dehydrated with absolute alcohol. The plastination procedure was done accordingly to von Hagens (1987). In brief, the heart specimens were fixed in 10% formalin after washing in order to prevent decomposition. Then, they were placed in a bath of acetone (Group 1) or absolute alcohol (Group 2) under freezing condition to draw out all the water and replaces dehydration agent inside the cells. After that, the specimens were forced impregnation by placing in a bath of liquid polymer, (Biodur® S10) mixed with curing agent (Biodur® S3) in a vacuum at -25°C. In the final step, all specimens were cured with Biodur® S6 which was used as a hardener. After plastination procedure, all specimens were evaluated qualitatively by comparing color, and elasticity of the specimens between two groups with blind evaluation by two observers. Moreover, the weight of the specimens before and after the plastination procedure were also recorded and compared.

esults and Discussion

From the present study, the mean weight of the heart specimens before plastination procedures were 484 g in group 1 (acetone) and 464 g in group 2 (absolute alcohol). After plastination procedures, the mean weight of the heart specimens declined to 211.3 g (43.66%) and 136.6 g (29.31%) for acetone and absolute alcohol groups respectively. The great advantages of plastination are that the specimens are permanent, clean, non-toxic and dry. The process of dehydration in plastination procedure is to remove the specimen fluid with either alcohol or acetone. From the result of the present study, dehydration by acetone gives more natural color with no shrinkage of the heart specimens while dehydration by alcohol gives darker color and more shrinkage (figure 1). However, the advantage of using alcohol is that it gives the drier texture of the specimens which may be easier for maintenance.

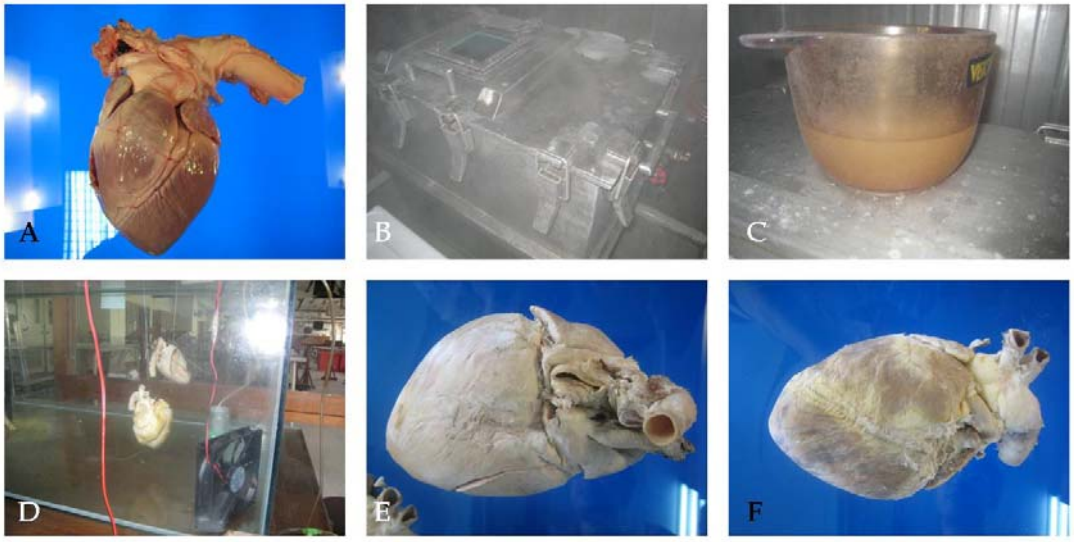

Figure 1. The figures show plastination procedure, A: heart specimen before fixation; B: forced impreganation, C: container for forced impregnation with Biodur® S10 at -25°C; D: hardening; E and F: Plastinated heart after dehydrated with acetone or absolute alcohol respectively. Noted that heart specimen in F has darker color, harder and drier texture than heart specimen in E.

In general, acetone was used in most cases because acetone also served as the intermediary solvent in forced impregnation. However, the cost of acetone was higher and it was more toxic than alcohol. From the results showed by this study, it was suggested to use alcohol for keeping the specimens for longer period especially in humidity climate and in cases with lower budget as it cost less than using a large amount of acetone for dehydration. On the other hand, using alcohol had many disadvantages regarding the morphology of the specimens as it caused more shrinkage of the specimens than using acetone. In addition, using absolute alcohol was not recommended in the plastination procedure which needed high quality of natural looking specimens i.e. visceral organs. From the present study, the pig hearts were used since they needed less dissection process after fixation and they could be good representatives of plastination specimens in animal tissues. For the plastination in larger organs, tissues or even in the whole body, the protocol for plastination needed to be adjusted since it would need a large amount of polymer and more spaces in each procedure. In addition to standard protocol of plastination, there was recent study using xylene along with silicone in the final step which caused less use of polymer or resin, and therefore making the plastination technique more cost-effective (Steinke et al., 2008). This may be the alternative protocol which could be applied to the larger piece of specimen or tissues.

Regarding the polymer for plastination, Biodur® S3, S6 and S10 are the most commonly used agents for tissue plastination though, their chemical structures are not exactly known. Recently, Chaynes and Mingotaud (2004) have studied the properties of these polymers and shown that Biodur® S10 is a polydimethylsiloxane with a molecular weight of 27,200 and silanol functionalities, Biodu®r S6 is tetraethoxysilane, and Biodur® S3 is a mixture the main component of which is dibutyltindilaurate. From this study, it was recommended that gloves and safety glass should be used for safety though there was no toxicity report for S10. Furthermore, S6 and S3 should be used under hoods since their components may cause irritation of several tissues (Holladay et al., 2001).

In conclusion, the dehydration process in plastination procedure could be done by using acetone either absolute alcohol depended on the objective of each plastination procedure. In cases which high quality of natural looking specimens was needed, using acetone in dehydration process was suggested.

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