

# Development of equipment for tumor cauterization

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## ABSTRACT

. Equipment to cauterize tumors by an electrically heated Kanthal wire is under development. The wire(alloy of iron, chromium and Aluminum) keeps sufficient strength up to 1400 degrees in Celsius. Although AC 50Hz current source is used in the prototype experiment, RF current will be used in future. The diameter of the Kanthal wire was 0.3 mm which was connected to Kanthal wire of 0.8 mm. The thicker wire was used as a leading wire. The possibility of application of the heating wire in combination with an ultrasound endoscope was determined, where ultrasound endoscope is to be used to monitor the location on the wire and an extent of a tumor in digestive organs. This procedure requires the wire to be applied inside ultrasound transmitting media. First, the wire was applied in the degassed water in which a chicken liver sample was submerged. The wire, however, burned out in water soon after it became red-hot at 12 A. The reason is that large current is required for the wire to become red-hot due to strong convection. Starch paste of 3 weight percent was employed instead of water. This made the wire red-hot approximately at 6 A, showing the increased viscosity of the starch decreased the convection and the wire was cover by the steam. The liver sample was cauterized successively, while the location of the wire and the liver was monitored by an ultrasound diagnosis equipment outside the plastic vessel of the starch paste.

**Key words:** Cancer treatment, cauterization, heat, Kanthal wire, starch paste

## 1. INTRODUCTION

Cancer occupies large portion of cause of death. These days low aggressive treatment is extensively studied for better Quality of Life. On the other hand future of expensive treatment such as heavy charged particle treatment should be considered from the context of energy crisis that may happen in not far future. Energy-saving treatment with good Quality of Life seems to be most desirable. This may help patients in developing countries as well because the energy-saving treatment seem to be inexpensive. Abdominal operation imposes heavy burden to patients. Therefore it should be avoided if the cancer is detected in early stages. In endoscopic surgery only superficial tumor can be resected due to the fact that extension of the tumor in the tissue is not known from endoscopic observations.

Recently ultrasound endoscopes were developed which enabled the extension of the tumor in the tissue to be observed. Cauterizing apparatus is under development that may be used to remove tumor under the observation of ultrasound endoscope.

## 2. MATERIALS AND METHODS

A prototype equipment to cauterize tumors by an electrically heated Kanthal wire is shown in Fig. 1. The wire(alloy of iron, chromium and Aluminum) keeps sufficient strength up to 1400 degrees in Celsius. Although AC 50Hz current source is used in the prototype experiment, RF current will be used in future to avoid electrical shock. A slide transformer adjusted the voltage applied to the transformer. The transformer then supplied electric current to a Kanthal wire, which is to be heated up.

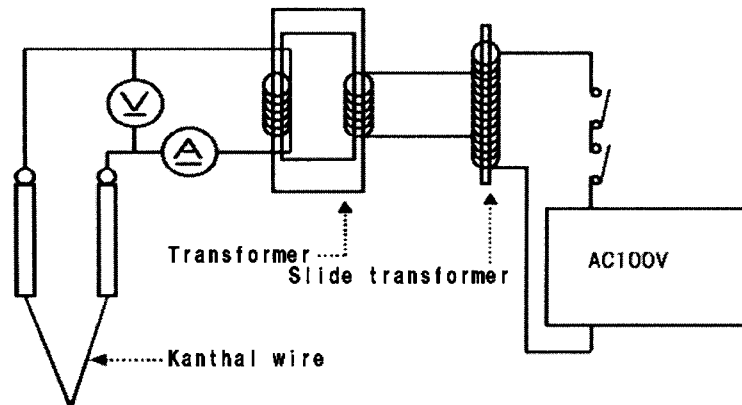


Fig. 1 Prototype circuit for cauterizing apparatus.

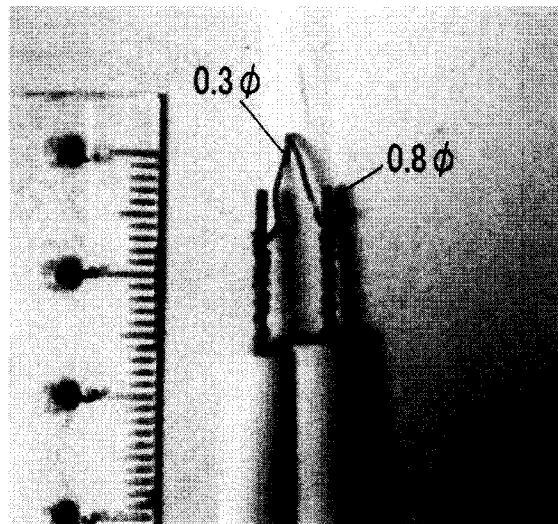


Fig. 2 Kanthal wire to be heated up by electric current..

The diameter of the Kanthal wire was 0.3 mm which was connected to Kanthal wire of 0.8 mm (Fig.2). The thicker wire was used as a leading wire. The Kanthal wire was inserted to a chicken liver sample. The liver in contact with the Kanthal wire disappeared as a smoke with carbonized surrounding tissue. The tissue around the carbon was degenerated.

The possibility of application of the heating wire in combination with an ultrasound endoscope was determined, where ultrasound endoscope is to be used to monitor the location on the wire and an extent of a tumor in digestive organs. This procedure requires the wire to be applied inside ultrasound transmitting media. First, the wire was applied in the degassed water in which a chicken liver sample was submerged. The wire, however, burned out in water soon after it became red-hot at 12 A. The reason is that large current is required for the wire to become red-hot due to strong convection.

Starch paste of 3 weight percent was employed instead of water (Fig. 3). This made the wire red-hot approximately at 6 A, showing the increased viscosity of the starch decreased the convection and the wire was cover by the steam. The liver sample was cauterized successively, while the location of the wire and the liver was monitored by an ultrasound diagnosis equipment outside the plastic vessel of the starch paste (Fig. 4).

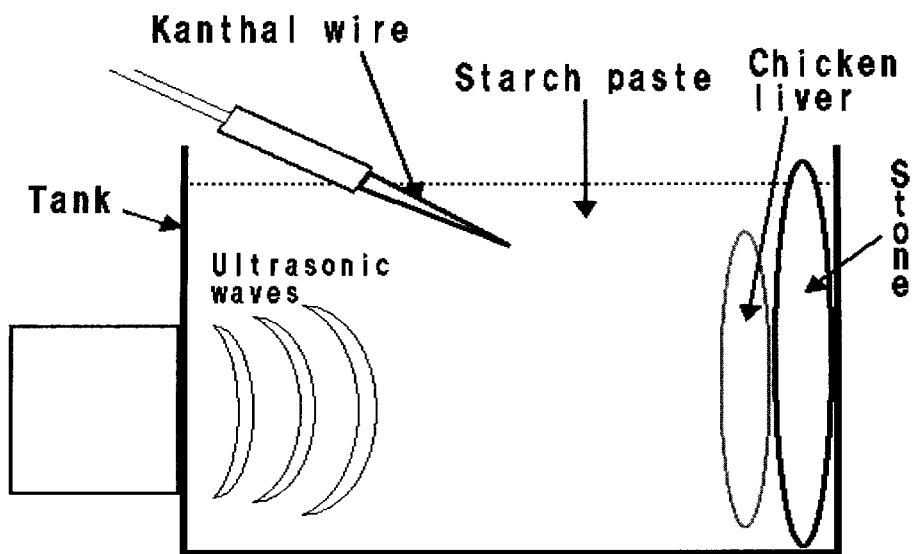
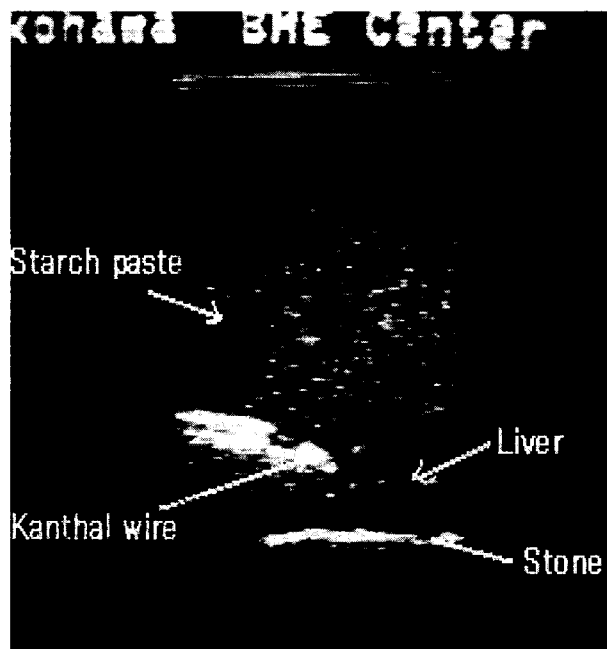
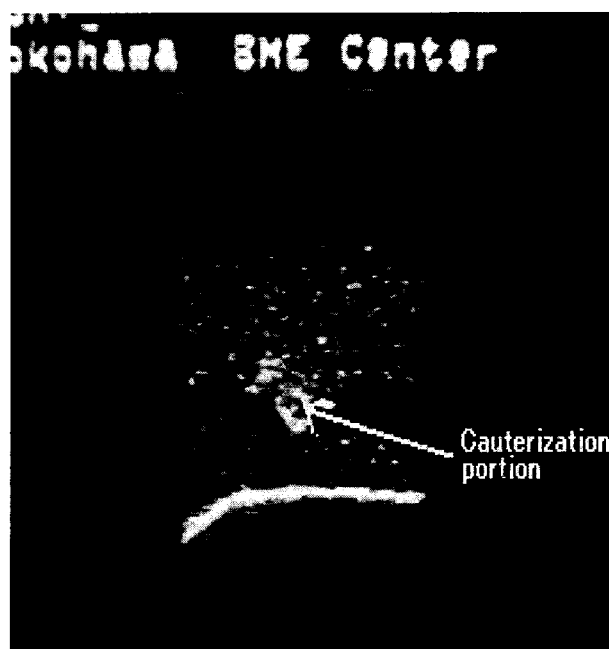


Fig. 3 Cauterizing experiment using chicken liver sample in starch paste.



(A) Before cauterization,



(B) After Cautilization.

Fig. 4 Cauterizing process in starch paste monitored by ultrasound echography (Toshiba SSA-390A 9MHz).

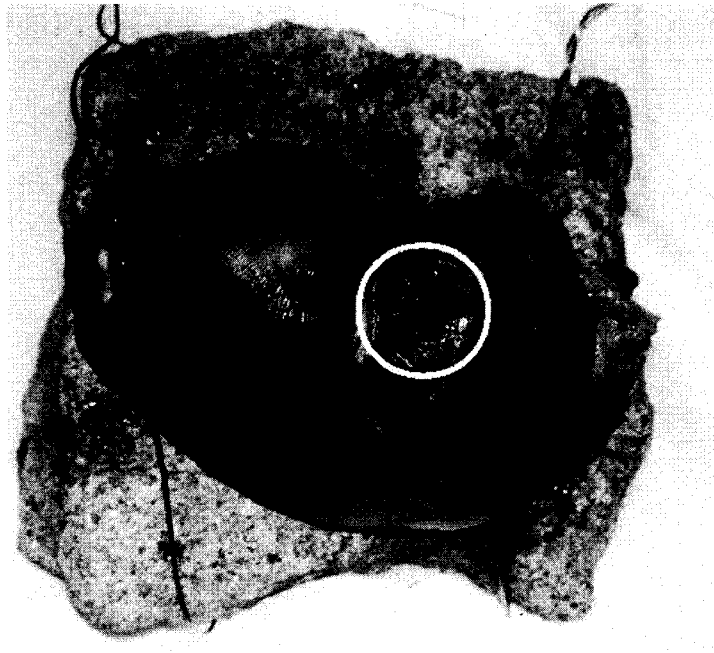


Fig. 5 Cauterized chicken liver in starch paste monitored by ultrasound echogram