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REVIEW

The Automatic Double-Chamber Vacuum Extractor: Defects and Laboratory Comparison

Hatern Tintara MD,
Thisara Panyaworachart MD.

Department of Obstetrics and Gynecology, Faculty of Medicine, Prince of Songkla University, Songkla, Thailand

ABSTRACT

An automatic double-chamber vacuum extractor (ADVE) is a new invention mainly for alarming system before cup detachment. We report early experience, defects, correction and laboratory comparison of this device with the conventional vacuum extractor. The rapid application of the ADVE can reduce the impulse to the scalp and provide sufficient traction force. The acoustic warning signal of the ADVE cannot prevent cup detachment with proper traction.

Key words: Ventous, Automatic vacuum extractor, Double-chamber vacuum cup

An automatic double-chamber vacuum extractor (ADVE)(ZEPPELIN, Surgical Instruments GmbH, Pullach, Germany) was imported to our Department in January 1994. Early experience with this device was not impressive because the extraction procedure failed frequently. Due to these results, most of our staff has elected to use the conventional manual vacuum extractor with a Malmstrom vacuum cup. The literature was reviewed using MEDSCAPE MEDLINE with keywords "double-chamber vacuum extractor" from 1994 to 1999. There is only one article which is a German publication presenting a case series of 18 patients with favorable outcome.[1] The ADVE consists of an automatic vacuum pump, a secretory bottle, a quick coupling, and a double-chamber vacuum cup (Fig. 1). The double-chamber vacuum cup has double rim to form two chambers, which are connected via a small hole, the 5-cm diameter of the cup correspond to the internal rim (Fig. 2).

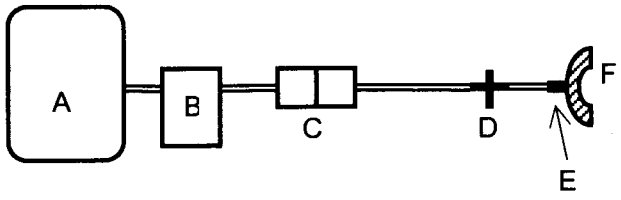


Fig. 1. Block diagram of the automatic double-chamber vacuum extractor. A, Automatic vacuum pump; B, Secretory bottle; C, Quick coupling; D, Traction handle; E, Connection nozzle of the cup; F, Double-chamber cup.

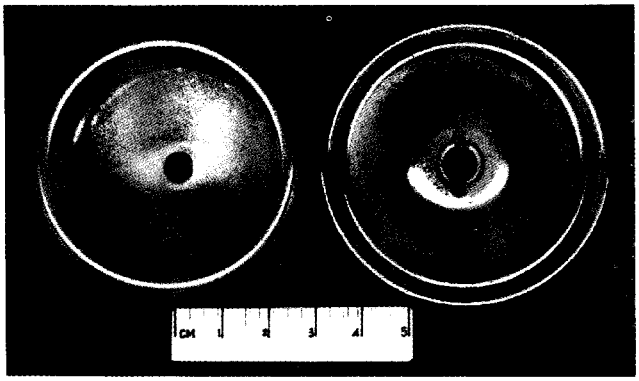


Fig. 2. The 5-cm Malmstrom cup (left) and the 5-cm double-chamber vacuum cup (right).

Technical report

The laboratory test was conducted and three defective points were identified. First, the connection nozzle of the cup was too short at only 4 mm long, so the rubber tube disconnected easily although the chain was tight. Second, the quick coupling for the vacuum hose was hard to lock, and if the connection nozzle of the coupling was incompletely locked, the coupling's valve remained close. The vacuum could not transfer to the cup, but the pressure gauge showed the vacuum pressure increase as usual. Third, the secretory bottle could easily be rotated. When the bottle was rotated over 90 degrees from vertical, the overflow plastic ball valve was engaged and blocked the system, resulting in loss of vacuum pressure at the cup. The defects were corrected by changing the cup nozzle to 15 mm in length; using a simple hose coupler instead of a quick coupler; and the bottle locking system was designed to prevent rotation of the secretory bottle.

The laboratory comparison of the ADVE using a 5-cm cup versus a conventional vacuum extractor using 5-cm Malmstrom cup (ATMOS, Germany) was conducted in two parts: 1) the impulse created to the scalp during application and 2) maximal traction force. The acoustic warning signal for cup detachment was also evaluated. We used a firm rubber ball 10-cm diameter instead of solid sphere cover with fresh canine skin as a fetal cephalic model.[2] The vacuum pressure was recorded every 10 second using a Universal Biometry DPM-III (Bio-Tek Instruments, Inc., VT, U.S.A). The maximal traction force was measured using a Universal Tensile Tester LR 30 K (LLOYD Instruments, England). The ADVE automatically increased vacuum pressure from 0 to 0.8 kg/cm^2 in 3 minutes, but the conventional method increases stepwise for 8 minutes. Statistical analysis was performed using Student's *t* - test. A $P< 0.05$ value was taken as significant. The impulse created to the scalp was 28.92 ± 0.72 kg.min by the automatic vacuum extractor and 77.37 ± 0.58 kg.min by the conventional extractor (t=250.3, df=19, P=0.000). The maximal traction force of the double-chamber vacuum extractor was 16.09 ± 0.33 kg higher than the 14.59 ± 0.26 kg from the conventional vacuum extractor (t=16.8, df=19, P=0.000). The acoustic warning signal of the ADVE could not prevent cup detachment in all 18 tests of properly applied traction.

Discussion

The automatic vacuum extractor uses rapid cup application that resuits in less chignon formation but can create high traction force. This finding supports the theory that a mechanical lock between the chignon and the solid vacuum cup is not necessary.[3] Although rapid application of the vacuum cup can decrease the impulse created to the fetal scalp and yields high traction force, but the effects of the high rate of increased vacuum pressure to the intracerebral structures needs further study. The acoustic warning signal cannot prevent cup detachment when the direction of traction is perpendicular to the cup because the entire rim of the cup separated at the same time the acoustic signal sounded. However, this may help when the direction of traction is improper because only one area will detach first. The double-chamber vacuum cup was designed to use with the acoustic warning signal, not to increase the traction force.

In conclusion, rapid application of the solid double-chamber vacuum cup can provide high traction force and reduces the impulse created to the scalp. The acoustic warning signal used with the double-

chamber cup cannot prevent detachment when the traction direction is correct. If the new medical equipment cannot be used properly, it is advisable to perform instrument testing, and defect must be corrected.

References

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