

A Field-Expedient Ohmeda Universal Portable Anesthesia Complete Draw-over Vaporizer Setup

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The Ohmeda Universal Portable Anesthesia Complete (U-PAC) draw-over anesthetic system is active in the US Army inventory. It is standard equipment for Certified Registered Nurse Anesthetists assigned to US Army Forward Surgical Teams and Joint Special Operations Command.

The purpose of this article is to describe a practical and field-expedient U-PAC draw-over vaporizer setup used during Operation Iraqi Freedom I (February 2003 to July 2003). During the deployment, general anesthesia was administered to 25 patients with penetrating trauma using the Gegel-Mercado setup without system malfunction. This setup strengthens the standard

U-PAC draw-over system delivery because it increases fractional inspired oxygen concentrations, promotes hands-free operation, enhances circuit cleanliness reducing cross contamination, and provides an alternate method for draw-over anesthesia administration in austere conditions when a ventilator may not be available or practical. It integrates and builds on the core concepts of draw-over anesthesia delivery in the literature. The Gegel-Mercado setup is combat proven.

Keywords: Draw-over anesthesia, field anesthesia, Ohmeda Universal Portable Anesthesia Complete.

The use of ambient air as a vehicle for delivering volatile anesthetic began with the introduction of general anesthesia into clinical medicine. A draw-over anesthetic system is an established technology employing this use of ambient air as the principle carrier gas. During the Falklands conflict, the British military used the Triservice Anesthesia Apparatus with success and resurfaced the interest in draw-over anesthetic systems.¹ The plenum anesthetic system, using the carrier gas pushed through the vaporizer at greater than atmospheric pressure, is the standard of care in medicine of industrialized nations.² However, a draw-over anesthetic system, when the gas is pulled through the vaporizer by a decrease in downstream pressure, offers many advantages in developing countries, natural disaster areas, wartime, and humanitarian operations.² Draw-over features include durability, compactness and portability, low capital investment, low operating expense, and no requirement for compressed gas or electricity.³

The United States military has a practical interest in and need for a simple, durable, lightweight anesthesia delivery system for use in the battlefield and humanitarian operations. A draw-over system fulfills this requirement. GE Healthcare (Fairfield, Connecticut), formerly the Datex-Ohmeda Corporation, manufactured the Universal Portable Anesthesia Complete (U-PAC) draw-over system, which is active in the US Army inventory (Figure 1). The Ohmeda U-PAC is a calibrated, temperature-compensated, flow-over, low-resistance, draw-over vaporizer designed for nonbreathing circuit systems and for use with a variety of anesthetic agents.⁴ The U-PAC weighs approximately 5 pounds and fits into a container about

the size of a briefcase.¹ Oxygen may be added to the U-PAC, but it is not required for operation. Oxygen supplementation may be provided by pipeline, compressed oxygen tanks, or an oxygen concentrator. Under austere conditions, oxygen supplies may be scarce and difficult to transport and handle. The U-PAC was specifically designed for these conditions.

An oxygen reservoir tube provides increased fraction of inspired oxygen (F_{IO_2}) when supplementary oxygen is used during draw-over anesthesia.⁵ The reservoir allows oxygen to accumulate during the expiratory phase of the respiratory cycle, which increases the F_{IO_2} delivered during the inspiratory phase. For improved patient safety, an oxygen reservoir with supplemental oxygen should always be used when available.⁶

Materials and Methods

The purpose of this article is to describe a practical and



Figure 1. Standard U-PAC Draw-over Setup Ready for Use

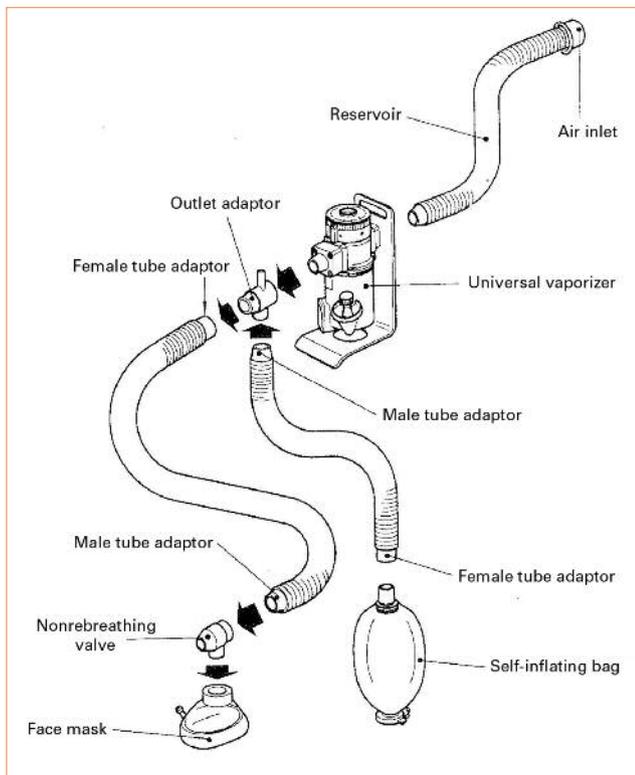


Figure 2. Breakout View of the Universal Portable Anesthesia Complete Draw-over Anesthetic System (Printed with permission of GE Healthcare, Fairfield, Connecticut.)

field-expedient U-PAC draw-over vaporizer set-up developed by Brian T. Gegel, CRNA, MSN, and Zenon Mercado III, CRNA, MSN, and used during Operation Iraqi Freedom I (February 2003 to July 2003). The essential components of the Ohmeda U-PAC can be viewed in Figure 2. The volume of the standard Ohmeda oxygen reservoir is 130 mL (18 in or 46 cm long). With the Gegel-Mercado setup (Figure 3), the oxygen reservoir tubing was crafted from 22-mm plastic tubing, typically found in any operating room, and attached to the U-PAC with a plastic 22-mm male-male adapter. The length of the reservoir was expanded to approximately 36 in or 91 cm.⁷

Another modification was that the standard oxygen reservoir was added to the self-inflating bag limb to form a foot pump. This allowed hands-free operation of the system, freeing the provider to perform other immediate tasks during anesthesia management. Under austere conditions, cleaning and drying the anesthesia circuit is impractical because of the need for immediate anesthetic response. A bacteriostatic heat and moisture exchanger, Pall filter (Pall Corporation, East Hills, New York), was added to the anesthesia circuit distal to the nonrebreathing valve to provide and maintain circuit cleanliness. A Pall filter is 99.9% bacteriostatic per package container. An oxygen concentrator supplemented the system for increased FIO_2 , which provided increased patient safety.

During Operation Iraqi Freedom I, this setup was em-

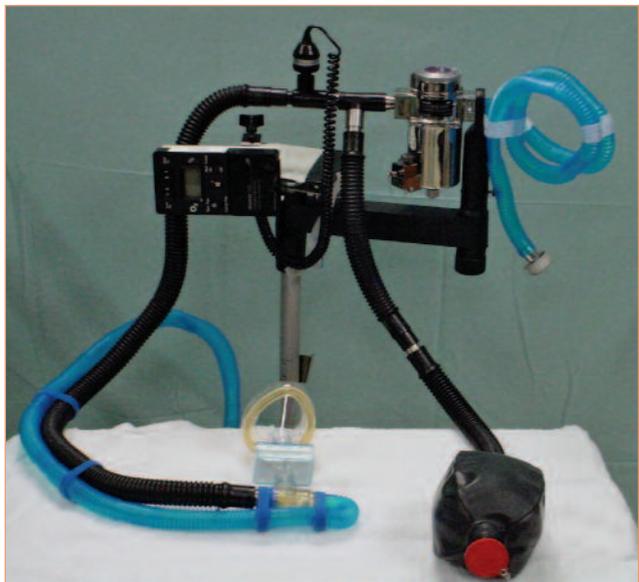


Figure 3. Gegel-Mercado Setup

ployed by the anesthesia providers of the 126th Forward Surgical Team. The 126th Forward Surgical Team was the first medical unit in Baghdad directly supporting the 1st Brigade Combat Team, 3rd Infantry Division, US Army.

Results and Discussion

Draw-over anesthesia is an uncommon practice for the modern anesthesia provider, but it offers many advantages in austere environments. A protocol exists to train and familiarize military anesthesia providers using the U-PAC draw-over system.⁸ It is standard equipment used by Certified Registered Nurse Anesthetists (CRNAs) assigned to US Army Forward Surgical Teams and the Joint Special Operations Command. Therefore, the military anesthesia provider must know how to use this system to support wartime operations and relief efforts during natural and humanitarian disasters.

Field expediency may be defined as a setup that is easily and quickly implemented. The integrity of the standard U-PAC draw-over system is maintained with parts found in any surgical environment. Replacement parts may be difficult to obtain because GE Healthcare no longer manufactures the U-PAC. This set-up is based on unpublished thesis research data, anecdotal draw-over anesthesia experience, and confirmed with a published research study.⁹ In this study, the authors recommend increasing the current reservoir volume of 130 mL to 260 mL for optimal oxygen delivery. Several investigators describe the use of a ventilator with the draw-over system.¹⁰ However, it is not approved by the US Food and Drug Administration and requires significant modifications to the draw-over system and it is not practical in many situations. The Gegel-Mercado setup integrates and builds on the core concepts of draw-over anesthesia delivery as described in the literature.

During Operation Iraqi Freedom I, this setup was employed by the anesthesia providers of the 126th Forward Surgical Team. The CRNAs provided 6 general anesthetics during convoy operations while advancing to Baghdad, where setup and operation times were brief and tactically sensitive. Nineteen general anesthetics were delivered at Baghdad International Airport, formerly known as Saddam International, and the Iraqi Olympic Stadium. During the deployment, general anesthesia was administered to 25 patients with penetrating trauma using the Gegel-Mercado setup. Notably, there were no anesthesia delivery system malfunctions.

The Gegel-Mercado setup is practical and field expedient, research based, and combat proven. It strengthens the standard U-PAC draw-over system delivery by increasing F_{IO_2} , promotes hands-free operation, enhances circuit cleanliness reducing cross-contamination, and provides an alternate method for draw-over anesthesia administration in austere conditions when a ventilator may not be available or practical. At this time, the US Army has no replacement for the U-PAC draw-over anesthetic system.

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