

## *Anesthesiology's Greatest Generation?*

WORLD War II—From the images of dashing Wermacht tanks in a blitzkrieg across Poland to the devastation of Hiroshima, this conflict has been burned into the American psyche as the last just war. Over the last several years, the war has become popular on television with “specials” showing Robert Ballard finding the Bismarck and the ships of “iron bottom sound.” Scores of books have been written about the experiences of World War II, and Ian Kershaw has just finished his two-volume biography of Adolf Hitler. Tom Brokaw, a television journalist, has given us *The Greatest Generation*, a book which tells the story of the men and women of the war in their own words. In a soundly reasoned article, David Waisel, an Air Force veteran of the Gulf War era, has given us the story of anesthesiology in the European Theater of Operations in World War II.<sup>1</sup>

What makes Waisel's manuscript unique is that most of these documentaries have not studied, in any depth, the medical care of the troops in World War II. It must be remembered that the Army Table of Organization during World War II had the following units that involved the movement of casualties. In order of increasing strength, they are Company, Battalion, Regiment, Division, Corps, and Army. Three to four companies made a battalion, three to four battalions made a regiment, three to four regiments made a division, three to four divisions made a corps, and two or more corps made an army. Each of these groups had an important role to play in the medical support of a wounded soldier (fig. 1).

The evacuation of a wounded GI from the field of battle would have started with a company medic identifying and administering first aid at the site where the soldier was injured. The wounded soldier then would be picked up from the battlefield by a team from medical battalion. This battalion consisted of three collecting companies and one clearing company. It was at this level that effective triage took place. Based on his medical condition, the wounded soldier could have been sent to a special surgical unit that dealt with his particular wound, such as head and neck or cardiothoracic. The special surgical unit was located in the corps or army

area. The other alternative was for the wounded soldier to be sent to the field hospital, behind the front lines in the army area. Emergent, stabilizing surgery occurred at the field hospital or the special surgical unit. When the soldier's condition had stabilized, he would be shipped to a general hospital in a safe area, such as Great Britain, where more definitive surgical procedures could be performed.

Anesthesiologists were present in field hospitals, special surgical units, and general hospitals. Waisel rightly points out that many surgeons had not worked with physician anesthesia before, and this exposure, under very critical conditions, may have been decisive in the postwar growth of anesthesiology. But what effect did this have on the physicians who were requested to undergo hurried training and then to be thrust into the carnage that comes during and after battle? Often, the 90-day courses were not adequate for the needs of the trainee. Training stations were short staffed, and, often, these novice physicians were assigned cases that necessitated little supervision. Training would end, and the new graduate would find himself the chief of anesthesiology in a thousand-bed hospital. This should have been a recipe for disaster, but it was not—why?

Quite simply, it was the determination of these “90-day wonders” or “3-month marvels” that made the system work. Having mastered the basics and having a wealth of observational experience, they taught themselves and each other. As Waisel has so clearly illustrated, the supplemental courses that the army ran, often with faculty from our British allies, were critical in continuing this educational process. The result was that the benefits of physician anesthesia reflected in casualty rates and improved operative statistics were driven home to the young surgeons who worked side-by-side with their anesthesiologists.

The Army followed a “proposed plan for training of officers of medical corps in anesthesiology” outlined by the Subcommittee on Anesthesia by the Division of Medical Sciences of the National Research Council. The committee consisted of Drs. Lewis S. Booth, John Lundy, and Ralph Tovell, with Emery Rovenstine as secretary and Ralph Waters as chair. Their six-page outline included both clinical and didactic instruction. Perhaps even more interesting was the list of the known physician anesthetists who could teach such a course, alphabetically listed with their clinical abilities ranked on a 1-4 scale. Executive and teaching ability were separately noted. Ralph Tovell received the highest clinical ranking and was noted to have administrative and educational abilities. Henry Beecher was ranked similarly, except that his clinical skill was considered between “good” and

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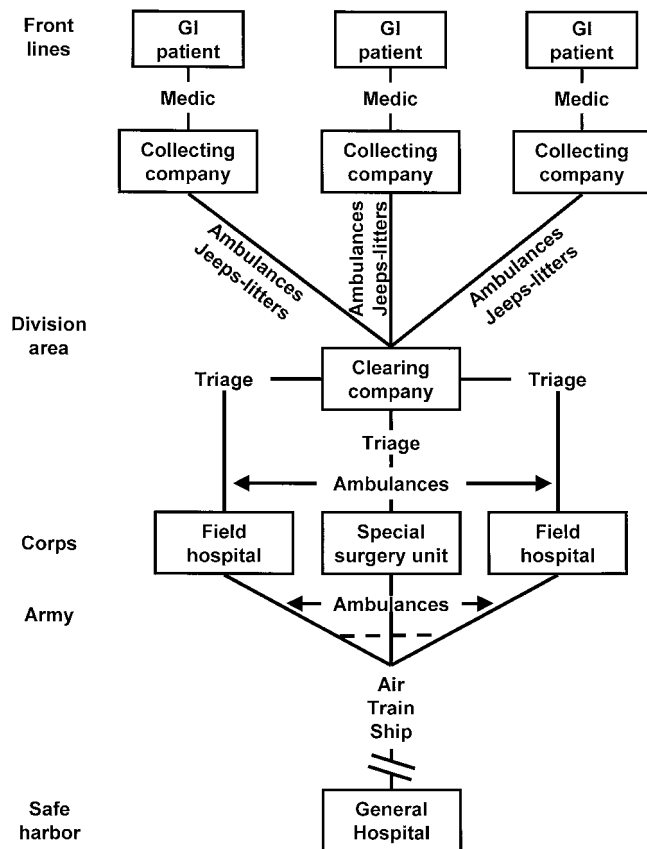


Fig. 1. Evacuation of the wounded from the battlefield in the European Theater of Operations, Allies, World War II.

“fair,” and a special notation was made concerning qualifications to teach basic science concepts as they applied to anesthesia.<sup>2</sup>

In contrast, the training program for anesthesia provided by the US Navy was neither as adequate nor as structured as that organized by the US Army under the watchful eyes of Ralph Tovell and Henry Beecher, both practicing anesthesiologists. The Navy tended to adhere to its pre-World War II organizational structure in that each naval station was an individual entity administered according to its need. The chief of surgery made all anesthesia assignments. This system had inherent disadvantages, as was demonstrated aboard one of the hospital ships in the Okinawa campaign. The chief of surgery for this ship was from the old school and believed that each surgeon should provide the anesthesia adminis-

tered to his patients. The only “trained” anesthesiologist was assigned to a minor surgical war and left without the necessary equipment to provide endotracheal anesthesia. He attempted to secure the necessary material from the US Naval Supply Depot on Guam. He was told by depot personnel that they could not help him not because they did not have the equipment but because it was going to be used on a hospital ship that was not assigned to the Fifth Fleet. Ever resourceful, he obtained the equipment through barter with an anesthesiologist assigned to the Guam Army Hospital. It later was used to save the life of a marine with grave facial injuries and in severe respiratory distress (J. W. Pender, M.D., communication *via* e-mail to D. R. Bacon, M.D., M.A., December 2000).

Waisel’s article is important to our understanding of the forces that shaped anesthesiology in a critical period of its history. With the generation of World War II veterans reaching their seventh and eighth decades, and remembering that the physicians who served as anesthesiologists were on average older than the infantrymen, first-person accounts of this time are being lost quickly. Now, anesthesiologists have trouble relating to this type of training, given our highly regulated residency programs, but each one of us owes a debt of gratitude to these “3-month marvels.” It was their determination to succeed and their devotion to anesthesiology that created a new current within the specialty. As we intubate our patients, as we construct and execute new research protocols, and even as we read the pages of ANESTHESIOLOGY, we should remember that it was these men who on a very large scale made surgeons and patients understand the need for physician specialists in our specialty.

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## Rapacuronium and Bronchospasm

THE international group of anesthesiologists who study neuromuscular blocking agents have been working for the past 30 years to develop a nondepolarizing muscle relaxant to replace succinylcholine. Their goal has been a fast-acting, short-duration drug without the side effects of succinylcholine. So far, rapacuronium (Raplon; Organon Inc., West Orange, NJ) comes closest to that goal. Its onset is approximately 20 s slower than that of succinylcholine, and recovery is 10 min longer. Nevertheless, it clearly provides adequate relaxation and intubating conditions for rapid induction.<sup>1</sup>

In this issue of the Journal, three reports describe 21 cases of bronchospasm after rapacuronium, 14 of which were "severe." The incidents involved 20 children and one adult.<sup>2-4</sup> Most frightening is the observation that some episodes were so severe that end-tidal carbon dioxide could not be detected, arterial desaturation occurred, and epinephrine was needed in addition to other bronchodilators to treat the bronchospasm. Unfortunately, such cases may be more common than these reports indicate. Three episodes of bronchospasm have occurred at my institution (out of 150 ampules of rapacuronium used), one of which led to cyanosis and bradycardia and required treatment with intravenous epinephrine. The involved anesthesiologist described the occurrence as if "somebody had put a clamp across the endotracheal tube." Fortunately, these reported events were short-lived and, because of the vigilance and skill of the anesthesiologists involved, did not result in long-lasting complications.

However, the irony remains that although we have freed ourselves of the rare occurrences of bradycardia, rhabdomyolysis, and malignant hyperthermia seen with

succinylcholine, we now need to deal with an equally serious and possibly more common problem—bronchospasm with rapacuronium.

When such a complication is brought to our attention *after* a drug has been marketed, we must ask if the medical-scientific community adequately evaluated the full range of side effects likely to be encountered. A check of the package insert provided for rapacuronium shows that its respiratory side effects are infrequent. Hypoxia and increased airway pressures are the first mentioned; a long list of other side effects of varying intensity and frequency follows. Tellingly, there is no mention of severe bronchospasm. The Consumer Information page for Raplon at the Food and Drug Administration Web site (<http://www.fda.gov/cder/consumerinfo/>) lists only "low blood pressure" as a common side effect. A Medline search of bronchospasm in the presence of rapacuronium yields no citation (obviously, this will change after the publication of this issue of ANESTHESIOLOGY). Further review of the literature is also interesting. The PubMed electronic version of the National Library of Medicine lists 23 review and 38 original articles on rapacuronium. Although 8 of the 23 reviews mention that this agent could elicit some respiratory side effects, only one comprehensively lists these, notes an overall incidence of 3.4%, and details 3 instances of severe bronchospasm out of 2,000 patients reviewed.<sup>5</sup> Of the 38 original reports, 7 mention respiratory complications in the abstract, 14 mention respiratory complications in the Result section, and 10 mention respiratory complications in the Discussion section. Adverse respiratory effects (0–16%) were noted most often when large intubating doses were used; in this situation, increased airway resistance was the most often quoted. Interestingly, in the 524 pediatric patients studied, only 5 cases of mild-moderate respiratory adverse effects were noted. Perhaps there was a tendency to underplay these side effects because they were self-limiting and a fair number occurred in patients who had predisposing conditions, such as respiratory infections, smoking, or asthma. In addition, there is the general consideration that aminosteroid relaxants do not release histamine.<sup>6</sup>

Based on these current case reports and previous published observations, it is clear that rapacuronium can induce severe and potentially life-threatening bronchospasm in certain patients. Its precise incidence is unknown, but it seems to be more frequent in patients with respiratory afflictions. Most of these respiratory adverse effects are mild and self-limiting, although they often require increased ventilatory pressure. However, in some cases (more often with children than with adults),

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the effect can be pronounced enough to necessitate aggressive treatment with bronchodilators and even, in rare cases, epinephrine.

When succinylcholine is contraindicated in a patient requiring rapid intubation, the clinician's options are limited. In my experience, anesthesiologists who have encountered rapacuronium-induced bronchospasm are usually reluctant to use the drug again. The most plausible alternative is perhaps rocuronium. It has practically the same onset time of rapacuronium but has a slightly longer duration of action. Although bronchospasm has been reported with rocuronium, it is generally rare and, based on published reports and clinical experience, seems to be less intense than that seen with rapacuronium. With very short procedures, the anesthetist may have to wait an additional 10–20 min for reversal, but this is by far a better alternative than having to treat severe bronchospasm.

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