

Acute nontraumatic general surgical conditions on a combat deployment

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Accepted for publication
Feb. 25, 2015

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DOI: 10.1503/cjs.013414

Background: Literature is lacking on acute surgical problems that may be encountered on military deployment; even less has been written on whether or not any of these surgical problems could have been avoided with more focused predeployment screening. We sought to determine the burden of illness attributable to acute nontraumatic general surgical problems while on deployment and to identify areas where more rigorous predeployment screening could be implemented to decrease surgical resource use for nontraumatic problems.

Methods: We studied all Canadian Armed Forces (CAF) members deployed to Afghanistan between Feb. 7, 2006, and June 30, 2011, who required treatment for a nontraumatic general surgical condition.

Results: During the study period 28 990 CAF personnel deployed to Afghanistan; 373 (1.28%) were repatriated because of disease and 100 (0.34%) developed an acute general surgical condition. Among those who developed an acute surgical illness, 42 were combat personnel (42%) and 58 were support personnel (58%). Urologic diagnoses ($n = 34$) were the most frequent acute surgical conditions, followed by acute appendicitis ($n = 18$) and hernias ($n = 12$). We identified 5 areas where intensified predeployment screening could have potentially decreased the incidence of in-theatre acute surgical illness.

Conclusion: Our findings suggest that there is a significant acute care surgery element encountered on combat deployment, and surgeons tasked with caring for this population should be prepared to treat these patients.

Contexte : Il y a un manque de données sur les problèmes chirurgicaux aigus qui peuvent survenir lors de déploiements militaires, et encore moins sur la question de savoir si on aurait pu éviter ces problèmes en faisant un dépistage plus ciblé avant le déploiement. Nous avons tenté de déterminer le fardeau de la maladie attribuable à des problèmes non traumatiques aigus de chirurgie générale pendant le déploiement, puis d'identifier les domaines où un dépistage préalable plus rigoureux pourrait être mis en œuvre pour réduire l'utilisation des ressources chirurgicales pour les problèmes non traumatiques.

Méthodes : Notre étude a porté sur tous les membres des Forces armées canadiennes (FAC) déployés en Afghanistan entre le 7 février 2006 et le 30 juin 2011 et qui ont eu besoin de traitement pour un état chirurgical général non traumatique.

Résultats : Pendant la période de l'étude, 28 990 membres des FAC ont été déployés en Afghanistan; 373 (1,28 %) ont été rapatriés en raison de maladie et 100 (0,34 %) ont développé un état chirurgical général aigu. Parmi ces derniers, 42 faisaient partie du personnel de combat (42 %) et 58 faisaient partie du personnel de soutien (58 %). Les diagnostics urologiques ($n = 34$) constituaient les états chirurgicaux aigus les plus fréquents, suivis de l'appendicite aiguë ($n = 18$) et des hernies ($n = 12$). Nous avons identifié 5 domaines où un dépistage intensifié, préalable au déploiement, aurait possiblement réduit l'incidence des états chirurgicaux aigus en théâtre d'opérations.

Conclusion : Il ressort de nos conclusions que les missions de combat comportent un important élément de soins chirurgicaux aigus et que les chirurgiens chargés de soigner cette population devraient être préparés à traiter ces patients.

The Afghan war represented the largest combat deployment of Canadian Armed Forces (CAF) personnel in a generation, with the involvement of almost 29 000 Canadian soldiers, sailors, airmen and airwomen. In order to support this operation, considerable medical resources were deployed as well. Specifically, a Canadian-led Military Field Hospital was established at Kandahar Airfield on Feb. 7, 2006. This facility was known as the Role 3 Multinational Medical Unit (R3-MMU). As a part of this field hospital, a substantial surgical presence was necessary, including general surgeons, anesthesiologists, operating room nursing staff and operating room technicians. The R3-MMU provided frontline trauma care for Canadian and allied military personnel. The success of this facility, and others like it, has been reported previously.¹⁻³

In addition to providing care for injured military members, this medical facility also provided specialist care for nontraumatic general surgical emergencies. Such emergencies included (but were not limited to) appendicitis, testicular torsion, diverticulitis, bowel obstructions and incarcerated hernias. In an attempt to mitigate the need to expend resources on illness-related issues during the mission, all CAF personnel underwent medical screening immediately before deployment. The goal of this screening was to identify any medical conditions that could potentially result in illness or medical emergency. Previous investigators have reported the relative incidence of surgical gastrointestinal illness requiring medical repatriation.⁴ Even so, there is a relative paucity of literature on the specific acute (nontraumatic) surgical problems that may be encountered on military deployment; even less has been written on whether or not any of these surgical problems could have been avoided with more focused predeployment screening.

In this study, we sought to determine the burden of illness attributable to acute nontraumatic general surgical problems while on deployment. Further, we also attempted to identify areas where more rigorous predeployment screening could be implemented to decrease surgical resource use for nontraumatic problems. These data may help to plan future deployments both in terms of the nontrauma surgical capabilities of forward deployed field hospitals as well as focusing predeployment screening to better avoid the presentation of surgical disease in theatre.

METHODS

We studied all Canadian Armed Forces (CAF) members deployed to Afghanistan between Feb. 7, 2006, and June 30, 2011, who required treatment for a nontraumatic general surgical condition. All such incidents were captured through the Director of Health Service Operations (DHSO) database.

Director of Health Service Operations database

The DHSO database was established for prospective evaluation of all CAF members who required medical evacuation or repatriation commencing in November 2006. All entries before November 2006 were captured retrospectively. Final diagnoses were coded using ICD-9-CM codes after the patient was evaluated and treated and after his/her disposition was determined. This database tracked all cases of reported injury or illness in the Afghan theatre of operations. The database included personnel requiring medical evacuation from the battlefield to a higher echelon of care (usually the R3-MMU); personnel presenting to the R3-MMU who required hospitalization but were not transported there via the normal military medical evacuation chain (e.g., soldiers who were already stationed at Kandahar Airfield base or who were transported there via means other than a formal medical evacuation); and personnel requiring outpatient care, but who subsequently required treatment not available at a military medical unit in Afghanistan or who required prolonged recovery and, as such, were repatriated back to either Landstuhl Regional Medical Center in Germany or back to Canada.

Canadian Forces Health Information System

The Canadian Forces Health Information System (CFHIS) is the electronic patient record system for the CAF. It is the main repository of medical information for the Canadian Forces Health Services. The CFHIS was accessed to obtain information on predeployment screening or previous occurrences of illness in patients with acute general surgical conditions diagnosed in theatre as well as medical sequelae of these conditions postdeployment.

Acute nontraumatic general surgical conditions

At the R3-MMU, Canada deployed a maxillofacial surgeon, a general surgeon, an orthopedic surgeon and an anesthesiologist along with a general internist. Upper and lower endoscopy was the responsibility of the general surgeon. The maxillofacial surgeon was responsible for problems related to the parotid, thyroid and salivary glands and to other related nontraumatic conditions.

We defined general surgical conditions as those involving the torso and/or skin and would include surgical problems that would have normally fallen under the care of thoracic surgery, gastroenterology, obstetrics and gynecology and urology.

Table 1 includes a list of ICD-9-CM diagnoses that were defined a priori as acute general surgical conditions and conditions that were excluded as general surgical conditions for the purposes of this study.

Statistical analysis

The DHSO database was queried for patients meeting our inclusion criteria. All diagnoses attributed to traumatic injury were excluded. Once cases meeting our criteria were identified, we reviewed the electronic health records of each patient in CFHIS to identify previous occurrences of the same illness either before the incident event or during predeployment screening. This study was approved by the Surgeon General of the CAF and the institutional research ethics board of Sunnybrook Health Sciences Centre, Toronto, Ont.

RESULTS

Demographics and acute surgical diagnoses

Over the course of the 62-month study period 28 990 CAF personnel deployed to Afghanistan as part of the combat operation. A total of 373 (1.28%) were repatriated because of disease and 100 (0.34%) developed an acute general surgical condition while in the Afghan Theatre of Operations (Table 2). The majority of these patients were men (94%) and the mean age was 29 (range 19–47) years. Among those who developed an acute surgical illness, 42 were combat personnel (42%) and 58 were support personnel (58%). With regards to the rank of these personnel, 73 were junior noncommissioned members, 20 were senior noncommissioned members, 5 were junior officers and 2 were senior officers.

There was a wide spectrum of acute surgical conditions among patients requiring repatriation. Urologic diagnoses ($n = 34$) were most frequent, including renal colic ($n = 24$), testicular tumours ($n = 4$), testicular torsion ($n = 4$) and acute epididymitis/orchitis ($n = 2$). Acute appendicitis was the next most common ($n = 18$). Seventeen of these 18 patients underwent open appendectomy with return to full duties in theatre with no need for evacuation to higher echelon care. One patient was managed nonoperatively. Hernias ($n = 12$) were the third most common diagnosis: 11 inguinal and 1 incarcerated umbilical hernia. There were a total 6 cases of acute cholecystitis, 7 cases of ischiorectal abscesses and 5 cases of inflammatory bowel disease (Table 2).

Potentially preventable acute surgical diagnoses

Given the resources required to treat acute surgical issues in theatre, we next sought to identify potentially preventable emergency surgical issues. We identified 5 areas where intensified predeployment screening could have potentially decreased the incidence of in-theatre acute surgical illness. Specifically, we examined cases of hernias, testicular masses, acute cholecystitis, renal colic and inflammatory bowel disease.

With regard to hernias, we retrospectively reviewed the electronic medical records of all 12 patients with hernias who required repatriation or acute surgical intervention. (Table 3). None of the 11 patients with groin hernias had them documented in their predeployment physical exam and only 7 of the patients (64%) had a documented groin

Table 1. ICD-9-CM general surgical diagnoses

ICD-9-CM diagnostic codes	General surgical conditions	Non-general surgical conditions
001–139		Infections and parasites
140–149, 190–94		Neoplasms of the head and neck
150–165, 170–89, 195–99, 209–239	Neoplasms of the chest and abdomen	
200–208		Neoplasms of the lymphatic system and the blood
240–519	Aneurysms (441,442) Arterial embolism (444) Empyema (510, 513) Pneumothorax (512)	Disease of the endocrine, blood, nervous, respiratory and circulatory systems. Mental disorders
520–579	Disease of the digestive system	Oral cavity and neck (520–529) Functional disorder (564) Liver disorders (570–573)
580–629	Renal calculi (592–94) Hydrocele (603) Epididymitis/orchitis (604) Testicular torsion (608) Breast problems (610–616) Female genital tract, pelvic organs (614–629)	Disease of the genitourinary system
630–679	Ectopic (630–33) Miscarriage (634–39) Antepartum hemorrhage (640–41) Peripartum complications (660–79)	Pregnancy
680–686	Infections of the skin	
690–709		Other skin disorders
710–779		Musculoskeletal, congenital, perinatal
780–799		Nonspecific symptoms

exam. In the 1 patient with an umbilical hernia, the defect was identified and documented before deployment; however, at the time there was no evidence of incarceration and the patient was asymptomatic.

We reviewed the cases of the 4 patients with testicular masses who required repatriation for further investigation and treatment (Table 4). We were able to review the pre-deployment physical examinations for 3 of these patients. All 3 had testicular exams documented as normal, although in 1 patient a self-examination was performed. The time between the last full periodic health assessment and the diagnosis was 2 years in 1 patient, 10 months in the second and 14 months in the third, who performed a self-exam. No testicular masses were identified in any of these individuals on these predeployment examinations.

There were a total of 6 patients with acute cholecystitis encountered during deployment (Table 5). All of them required repatriation for cholecystectomy, as laparoscopic instruments were not available in theatre. All 6 patients had calculous cholecystitis. A review of their electronic patient records showed that none of them had reported any previous episodes of biliary colic or cholelithiasis. Three of the 6 patients were able to return to duty in

Afghanistan after undergoing laparoscopic cholecystectomy in Canada or at Landstuhl Regional Medical Center. One patient was managed nonoperatively with a return to duty and interval cholecystectomy postdeployment. There were no clinically important sequelae associated with any of these patients.

None of the patients with renal colic had a documented history of previous episodes of renal colic. Of the 5 patients with inflammatory bowel disease, only 1 had a previous diagnosis of inflammatory bowel disease made in Canada.

DISCUSSION

We have described the acute care surgical issues encountered during a combat mission. Over the course of the 5-year combat mission in Afghanistan, the CAF deployed nearly 29 000 personnel in support of this operation. These personnel were all relatively healthy to begin with by virtue of their employment as soldiers, sailors, airmen, and airwomen in the CAF. The relative absence or low incidence of some acute surgical diagnoses is reflective of this fact. For example there were only 3 patients with adhesive small bowel obstruction, 1 with intestinal ischemia and 1 with diverticular disease. As the population we studied were predominantly young men, the observed acute care surgical issues encountered were likely a reflection of this demographic. There was no significant difference in incidence of acute surgical illness between personnel deployed in either combat or support roles, suggesting that acute care surgical issues affect personnel irrespective of their physical employment.

Table 2. Patient demographic and clinical characteristics and acute surgical diagnoses

Characteristic	No. of patients*
General surgical diagnosis	100
Age, mean (range), yr	30 (19–47)
Male sex	95
Female sex	5
Role	
Combat personnel	42
Support personnel	48
Rank	
Junior NCM (Pte–MCpl)	73
Senior NCM (Sgt–CWO)	20
Junior officer (2Lt–Capt)	5
Senior officer (Maj–Col)	2
Diagnosis	
Hernias	12
Testicular tumour	4
Cholecystitis	6
Appendicitis	18
Ischiorectal abscess	7
Bowel obstruction	3
Intestinal ischemia	1
IBD	5
Renal colic	24
Colorectal cancer	1
Diverticulitis	1
Testicular torsion	4
Epidymitis	2
Other	12
IBD = inflammatory bowel disease; NCM = noncommissioned members.	
*Unless otherwise indicated.	

Table 3. Outcomes of hernia screening and identification

Outcome	No. (%) of patients
Repatriations owing to umbilical hernias	1 (—)
Predeployment identification of umbilical hernia	1 (100)
Repatriations owing to inguinal hernia	11 (—)
Predeployment examination of groin	7 (64)
Predeployment identification of inguinal hernia	0

Table 4. Outcomes of testicular mass screening and identification

Outcome	No. (%) of patients
Repatriations owing to testicular masses	4 (—)
Predeployment testicular exam*	3 (100)
Identification of testicular masses	0
*There were no data available for 1 patient.	

Table 5. Outcomes of cholecystitis

Outcome	No. (%) of patients
Repatriations owing to calculous cholecystitis	6 (—)
Predeployment biliary colic	0
Predeployment identification of cholelithiasis	0

The most common acute surgical illness requiring in-theatre surgical consultation was renal colic, and the most common acute surgical illness that required an operation was acute appendicitis. Almost all patients with appendicitis underwent open appendectomy, and the patients recovered uneventfully with return to full duties. There were 7 patients with ischiorectal abscesses documented in theatre. All patients were men and underwent incision and drainage with eventual return to full duties. None of these cases were recurrences, and their development on deployment may have been coincidence.

One of our study objectives was to identify potentially preventable causes of acute surgical illness encountered on deployment. We postulated that hernias, testicular tumours, acute cholecystitis, renal colic and inflammatory bowel disease could be potentially preventable given the rigorous predeployment screening in this population.

In the 12 patients with hernias, 11 were inguinal hernias and 1 was an incarcerated umbilical hernia. On review of the predeployment medical examination for these 11 patients with inguinal hernias, only 7 had a groin examination for hernias documented and none had a hernia diagnosed before it became symptomatic on deployment. These findings suggest that screening for groin hernias should be emphasized in all predeployment medical examinations and that the physicians and physician assistants conducting these examinations should be appropriately trained in assessing patients for groin hernias with the patient both supine and standing and with Valsalva manoeuvres. From the data presented here, it appears that undiagnosed inguinal hernias become symptomatic on combat deployments given the rigorous physical activity involved in these operations and therefore should be screened more intensively.

As mentioned previously, there was 1 patient with an umbilical hernia that became incarcerated and necessitated repair in theatre. This hernia had been identified on a predeployment ultrasound and was documented, although the patient was not symptomatic. However, the general trend from our data on groin hernias is that they tend to become symptomatic on combat operations and therefore caution should be taken when deploying personnel with these conditions. As we do not know how many soldiers deployed with umbilical hernias and remained symptom-free, we are unable to suggest whether the predeployment identification of an umbilical hernia should preclude a CAF member from deployment. We do, however, suggest that thought be given to hernia size, previous symptoms and possible predeployment evaluation by a general surgeon.

Next we examined the 4 patients who received new diagnoses of testicular tumours during deployment. Two of these patients had benign testicular tumours and 2 had testicular cancers. Predeployment screening data were available for 3 of the 4 patients, and all 3 had documented testicular exams, though 1 was a self exam. As mentioned previously,

the time from the last health assessment and diagnosis of a testicular mass in the 3 patients for whom data were obtainable was 2 years, 10 months and 14 months. Given the tendency of many testicular tumours to grow rapidly, this screening interval may simply not have been adequate to diagnose these tumours. No studies of appropriate screening for testicular masses have been conducted; therefore, the Canadian Task Force on the Periodic Health Examination does not recommend including or excluding testicular examination as part of the routine physical examination.^{5,6} The identification of testicular masses described in this study reflect the fact that this cohort includes a large number of young men and that testicular cancer is the most common cancer in male patients aged 15–34 years.^{7,8} Given the high ratio of young men deployed on combat operations, increased vigilance may be warranted.

In the 6 patients with acute cholecystitis, individual chart review showed that none of the individuals had previously documented cases of biliary colic or cholelithiasis. Based on the data presented here, no recommendations regarding intensified predeployment screening for cholelithiasis can be made. This emphasizes the difficulty in screening for individuals who will go on to develop biliary disease and suggests that medical mission planners and surgeons on future deployments should be aware that such cases may present. If this were to occur, open cholecystectomy remains an option if laparoscopic equipment is not available and if air evacuation cannot be arranged. Based on the number of cases of acute cholecystitis and acute appendicitis combined, one could make a strong argument in favour of the deployment of a basic laparoscopic capability at Role 3 hospitals. The cost of this capability would be offset by the decreased need for AIREVAC to Role 4 facilities, such as Landstuhl Regional Medical Center.

None of the patients with renal colic previously had documented attacks in Canada. The development of renal colic on deployment may be linked to the heat, the physical exertion required of soldiers and dehydration. Only 1 of the 5 patients had previous inflammatory bowel disease documented back in Canada, but the disease activity was previously quiescent.

CONCLUSION

A wide variety of acute surgical illnesses arise while on combat operations. Some are within the scope of modern general surgical training in North America. Others may fall within another area of subspecialty expertise (e.g., renal colic, testicular torsion). Our findings reinforce the belief that deploying military surgeons require an extended scope of practice.

The nontraumatic acute care surgical issues of a deployed military population are substantially different from those found at a normal general hospital in North America. The patient population is primarily young men,

who are otherwise very healthy. The number of such diagnoses are small and may be further minimized with careful predeployment screening. Some of these conditions, such as acute appendicitis, are not preventable with screening and can be treated safely and effectively in theatre. Others, such as acute cholecystitis, require repatriation back to Canada for optimal therapy.

Our findings suggest that intensified predeployment screening for groin hernias may detect occult cases. This may be important, as some may become symptomatic during the increased physical activity involved with combat operations. Military health organizations must balance the burden of repatriating patients from theatre with the likelihood of chronic diseases flaring up while on deployment. For example, patients with inflammatory bowel disease may flare while in theatre and require repatriation back home. In most cases, however, increased predeployment screening will likely not reduce the need for surgical care and repatriation while on deployment.

Surgeons have been an essential part of forward-deployed medical care throughout the history of modern warfare. Their early involvement in the treatment of the traumatically injured is well documented in the literature. However, based on the data presented in this paper it is apparent that there is also a significant acute care surgery element that is encountered on combat deployment, and surgeons tasked with caring for this population should be prepared to treat these cases.

Acknowledgments: This work was supported in part by the Canada Research Chair Program (A. Nathens).

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Competing interests: None declared.

Contributors: All authors designed the study. D. Pannell, J. Ricard, and E. Savage acquired the data, which all authors analyzed. D. Pannell, J. Ricard and E. Savage wrote the article, which all authors reviewed and approved for publication.

References:

1. Blackburne LH, Baer, DG, Eastridge BJ. Military medical revolution: deployed hospital and en route care. *J Trauma Acute Care Surg* 2012;73:S378-87.
2. Pannell D, Brisebois R, Talbot M, et al. Causes of death in Canadian Forces members deployed to Afghanistan and implication on tactical combat casualty care provision. *J Trauma* 2011;71:S401-7.
3. Brisebois RJ, Tien HC. Surgical experience at the Canadian-led Role 3 Multinational Medical Unit in Kandahar, Afghanistan. *J Trauma* 2011;71:S397-400.
4. Cohen SP, Brown C, Kurihara C, et al. Diagnoses and factors associated with medical evacuation and return to duty for service members participating in Operation Iraqi Freedom or Operation Enduring Freedom: a prospective cohort study. *Lancet* 2010;375:301-9.
5. The Canadian guide to clinical preventive health care. Chapter 74: Screening for testicular cancer 1994. ed Elford, RW. Available: <http://canadiantaskforce.ca/guidelines/red-brick-1994-guidelines/> (accessed 2015 May 11).
6. Canadian Task Force on the Periodic Health Examination. The periodic health examination: 2. 1984 update. *Can Med Assoc J* 1984;130:1278-85.
7. McGlynn KA, Devesa SS, Sigurdson AJ, et al. Trends in the incidence of testicular germ cell tumors in the United States. *Cancer* 2003;97:63-70.
8. Garner MJ, Turner MC, Ghadirian P, et al. Epidemiology of testicular cancer: an overview. *Int J Cancer* 2005;116:331-9.