

Case Report

Successful Surgical Management of Acute Appendicitis in a Centenarian

Atsushi Okita^{a, b*}, Masaki Fujimura^a, Isao Sato^a, Yoshihide Chino^a,
Takafumi Yuba^{a, c}, Makoto Mizutani^a, Tomotake Tabata^a, Minoru Iida^a,
and Kimitsuka Kumano^{a, c}

^aEndoscopic Surgery Center, Daiichi Towakai Hospital, Takatsuki, Osaka 569-0081, Japan,

^bDepartment of Surgery, Okayama City Hospital, Okayama 700-8557, Japan,

^cEndoscopic Surgery Center, Kiba Hospital, Higashiosaka, Osaka 578-0941, Japan

We report an extremely rare case of a centenarian with acute appendicitis that was successfully managed via emergent surgery. A 109-year-old woman was referred to Daiichi Towakai Hospital with a high fever and nausea. She presented with peritoneal irritation, and computed tomography showed a swollen appendix with intraluminal fecolith. She was diagnosed with acute appendicitis and underwent appendectomy, which was performed via an open approach under spinal anesthesia. The patient's postoperative course was uneventful. As for treatment planning for centenarians, comprehensive and exhaustive discussions with the patient and family members should be encouraged under the principals of narrative medicine.

Key words: appendicitis, centenarian, appendectomy

Populations around the world have been aging rapidly, and Japan has become one of the world's most aged countries [1]. Therefore, the need to perform operations in elderly patients has also been increasing. The physical condition and vital organs of elderly patients deteriorate, as they often have multiple comorbidities [2,3], which can have a negative impact on their postoperative courses, especially in emergent settings [4]. Actually, one study on 12 centenarians who underwent emergent surgery in Finland reported a mortality rate of 25% [5]. In such patients, the indications for surgical interventions must be assessed carefully after considering the potential risks and benefits and the wishes of the patient and their family. Acute appendicitis is the most common abdominal emergency in the world and the most common cause of abdominal surgery in all age groups [6], but it is considered to be less common in older patients [7]. Herein, we report a rare case in which a 109-year-old woman

underwent emergency surgery for acute appendicitis.

Case

A medical practitioner visited the home of a 109-year-old woman in response to a call from her family. She had experienced a one-day history of diarrhea, fever and nausea, and presented with a high temperature of 38.5°C, tachycardia, and dehydration. She was referred to the Department of Internal Medicine at Daiichi Towakai Hospital. Her medical history included a hip fracture, and she had undergone osteosynthesis under general anesthesia at the age of 104 years. In addition, she had recently developed chronic heart failure, which was controlled with medicine. In her daily life before admission, the patient had been moved about in a wheelchair with complete assistance and had received home care. The patient was visually impaired, and it was necessary to communicate with her in a loud

Received August 31, 2020; accepted December 4, 2020.

*Corresponding author. Phone: +81-86-737-3000; Fax: +81-86-737-3019
E-mail: HZI06166@nifty.ne.jp (A. Okita)

Conflict of Interest Disclosures: No potential conflict of interest relevant to this article was reported.

voice because of presbycusis. A physical examination showed marked tenderness with positive rebound in the right lower abdomen. The patient's body weight was 35 kg, and her body mass index was 16.0 kg/m². Her vital signs showed O₂ saturation of 93%, a body temperature of 38.5°C, a blood pressure of 126/79 mmHg, and a heart rate of 113 beats/minute. Laboratory tests showed a white blood cell count of 12,400/mm³ (normal range: 3,500-9,100/mm³), a C-reactive protein level of 0.7 mg/dl (normal range: <0.3 mg/dl), an N-terminal pro-B-type natriuretic peptide level of 843 pg/ml (normal range: ≤125 pg/ml), and positivity for a hepatitis C virus. A computed tomography (CT) scan revealed a swollen appendix; a thickened wall, containing an incarcerated intraluminal fecolith; and bilateral pleural effusion with atelectasis (Fig.1). She was diagnosed with acute appendicitis and referred to our department. When seen at our clinic, she had difficulty making decisions about treatment on her own. Therefore, we fully informed the patient's family about all aspects of the possible surgery and conservative antibiotic therapy (as a palliative treatment), including their risks and benefits. After considering this information, the family decided that she should undergo surgery, and she underwent the operation urgently.

Under spinal anesthesia, laparotomy was performed in the right lower abdomen. There was a small amount of turbid ascites, and the appendix was swollen and had a white coat. Appendectomy and extensive peritoneal lavage with warm saline were conducted, and a drainage tube was inserted into the lower abdomen. The operation time was 25 min, and little intraoperative

blood loss occurred. The macroscopic specimen showed a necrotic mucosa with purulent intraluminal fluid (Fig.2), and a pathological examination revealed gangrenous appendicitis. At one postoperative day, an ultrasound cardiogram showed an ejection fraction of 64.2%, and the patient's cardiac function was maintained. The patient's postoperative course was uneventful and she was discharged on day 15 after the operation. She continued to receive care at home without any change in her activities of daily living. The patient's family members were satisfied with the successful treatment and pleased to be able to resume their normal lives. She died of natural causes at home 8 months after the operation.

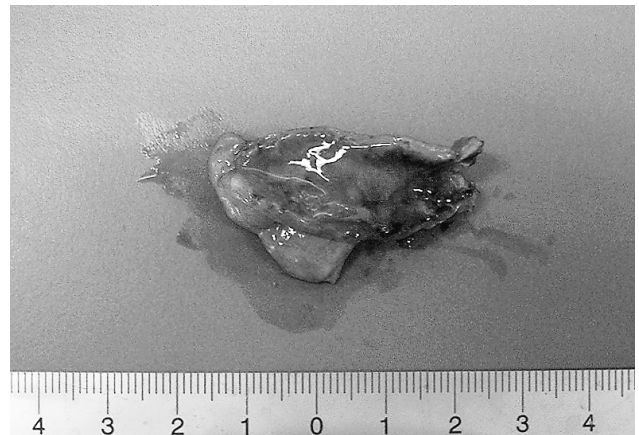


Fig. 2 Macroscopic findings. The resected specimen exhibited a necrotic mucosa with purulent intraluminal fluid.

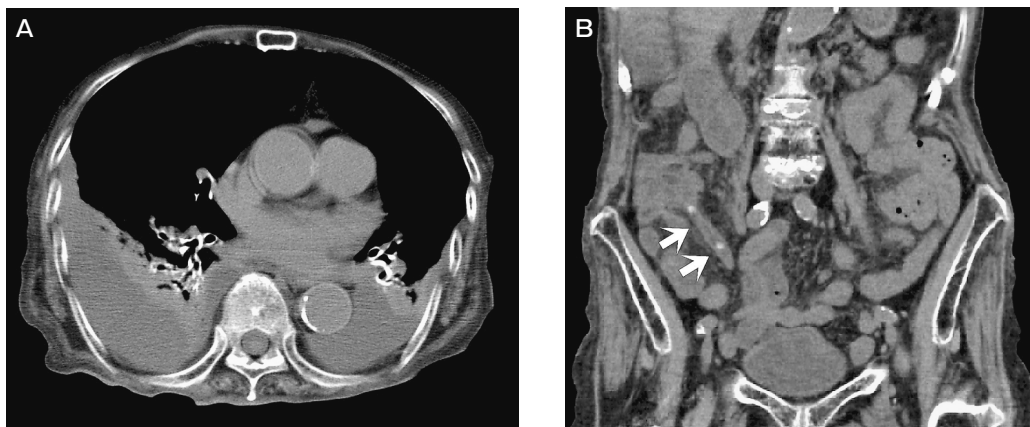


Fig. 1 Computed tomography findings. A, Bilateral pleural effusion and atelectasis; B, A swollen appendix with a thickened wall containing an appendicolith (white arrow).

Discussion

As the aging of the Japanese population has progressed, the number of centenarians in Japan has increased to approximately 71,000 <Ministry of Internal Affairs and Communications, Statistics bureau of Japan, <https://www.stat.go.jp/english/data/jinsui/index.html> (accessed June 20, 2020)>. Along with this continued increase in the number of elderly patients, surgeons are seeing an increasing number of cases with acute appendicitis involving elderly patients. These patients tend to suffer from more complicated disease and require more complex care than younger patients with acute appendicitis [8]. Indeed, elderly patients with acute appendicitis exhibit a higher mortality rate, a higher perforation rate, lower diagnostic accuracy, more atypical presentations, longer delays from symptoms onset to admission, and a higher postoperative complications rate than their younger counterparts [8, 9].

The mortality associated with appendicitis is low in all age groups, but it is higher in elderly patients [8], and previous studies demonstrated that older appendicitis patients had a 12-fold higher mortality rate than younger patients [10]. The standard surgery for acute appendicitis is fairly rapid and straightforward, but non-operative treatment has also been developed as an alternative. Non-operative management is a safe and effective treatment for adults with uncomplicated appendicitis; however, the success of this approach requires careful patient selection and the exclusion of gangrene, abscesses, diffuse peritonitis, and the presence of appendicoliths [11]. A non-operative approach can also be applied to elderly patients who exhibit evidence of uncomplicated appendicitis and do not display any clinical signs that would lead to a suspicion of complicated appendicitis [9]. In elderly patients, we often find that prolonged treatment, such as conservative antibiotic therapy with fasting, results in prolonged anorexia after the resumption of diet, extended periods of weight loss, deterioration in physical function and long periods of hospitalization that can only rarely be transferred to home care. Therefore, we speculated that surgery would result in a faster recovery compared with conservative therapy. In our case, an appendiceal fecolith was observed on a CT scan, and the patient presented with peritoneal irritation, so appendectomy was deemed preferable. Although appendicitis is a common disease, to the best of our knowledge, there is only one

set of global guidelines for elderly patients [9]. In addition, appendicitis in a centenarian is extremely rare, and the latter guidelines might not be applicable to our case. Thus, at present the choice of treatment in cases like ours depends on the experience of the surgeons.

Surgeons often face issues with patient selection and with the identification of patients likely to benefit from surgery. This is especially difficult in the elderly owing to the combination of multiple comorbidities and the general reduction in physiological reserves associated with aging [3]. Some patients with conditions that can be treated with surgery are treated conservatively instead; *i.e.*, they receive terminal care, because it is assumed that they would not survive an operation [12]. Surgeons need to make difficult decisions regarding the medical conditions of patients, but they also need to consider ethical issues involving patients and their families. Centenarians would be expected to exhibit high mortality and morbidity rates when undergoing surgery or conservative therapy in a situation that we had never been experienced before. Therefore, before selecting a particular treatment for a centenarian patient, we consider how that treatment is selected in the general population and then how it could be adapted to suit our patient. In the present case, the patient could not make a decision about which treatment she preferred. Therefore, we fully informed her family about her disease (complicated appendicitis with an appendicolith) and provided general evidence about the choice of surgery and non-operative management as an alternative (palliative care), and pointed out that this was a novel situation. When presented with all the relevant information, the patient's family decided that she should undergo surgery.

The role of interval appendectomy after successful non-operative management of complicated appendicitis remains a matter of debate, because recurrence is relatively low [13]. In our case, there was probably little chance of successful non-operative management, but if the patient could overcome this entity, we were not sure that interval appendectomy would be indicated, because the residual lifetime was limited.

In regard to anesthesia, elderly patients experience increased hemodynamic instability during spinal blockade [14]. In this case, to avoid such hemodynamic instability, a small dose of local anesthesia was used, which did not result in any hemodynamic problems. The day after the operation, echocardiography showed

that the patient's cardiac function was maintained, and no cardiac complications occurred.

Surgical treatment for appendicitis is challenging in elderly patients. In technical terms, the laparoscopic approach is superior to the open approach, as it results in a lower rate of wound infection, less pain, and shorter hospital stays, whereas open surgery is associated with a lower rate of intra-abdominal abscesses, a slightly shorter operative time and lower costs [15]. Laparoscopic appendectomy seems to be safer than the conventional open procedure due to its low invasiveness and the fact that it results in faster recovery [16]. Recently, laparoscopic appendectomy has seen increasing use worldwide, and while laparoscopy is not yet unanimously considered the gold standard, surgeons around the world tend to choose laparoscopic appendectomy over open surgery for the treatment of both simple and complicated acute appendicitis [17]. Currently, therefore, both a laparoscopic and an open approach are considered to be applicable for appendectomy and open appendectomy is actually performed more often in older than in younger patients [18]. In cases of complicated appendicitis, open appendectomy is performed, because it provides a clearer view of any abdominal adhesion and/or peritonitis; however, the diagnosis of appendicitis as non-complicated or complicated mainly depends on postoperative pathology, so the preoperative stratification of patients is not considered to be practical [16]. In a meta-analysis of laparoscopic appendectomy in elderly patients, Wang *et al.* reported that laparoscopic appendectomy was associated with lower postoperative mortality, a lower complication rate, less wound infection and shorter hospital stays than open surgery and was safe and feasible for the elderly population, but that the laparoscopic approach also significantly increased the duration of surgery [16]. Because the present case was our first experience performing appendicitis in a centenarian, the patient's perioperative course could not be predicted. Based on the patient's age, history of congestive heart failure, peritoneal irritation and weakened general condition, conventional open surgery was selected. As a result, the operation time was minimized, and the patient's postoperative course was uneventful. In such cases, the surgical approach should be selected after considering not only the experience of the surgeons, but also the disease severity and the relevant background of the patient and institution.

Cases involving emergent abdominal surgery in centenarians are rare [19-25], and in a search of the English literature we found no cases involving patients aged > 105 years. However, there have been some reports focusing on the results of operations in relatively small numbers of centenarians [26-29]. To the best of our knowledge, this 109-year-old woman is the oldest patient in the world to be diagnosed with appendicitis and undergo appendectomy. As populations age, surgeons will be increasingly confronted with clinical decisions regarding whether they should offer surgical care to very old patients, and age alone should not be the determining factor in the decision to operate. Instead, the chance of survival and expected survival time should be considered [27]. In addition, we should also encourage comprehensive discussions, under the principles of narrative medicine, with patients and their relatives when planning surgical care. According to the Japanese data of the Ministry of Health, Labour, and Welfare reported in 2019, the life expectancy of women aged 105 years or more was about eighteen months. Initially, therefore, we did not expect a long life expectancy even in the event that the treatment was successful. Instead, we focused our perioperative management on the safe discharge of the patient rather than on achieving a good prognosis, because this was an unprecedented experience and one for which we lacked data on life expectancy. Fortunately, the patient could be discharged without critical events and lived for 8 months after the operation at home. Our experience was extremely rare, but as populations age, all surgeons will eventually experience emergent surgery in centenarians.

In conclusion, we reported an extremely rare case in which a centenarian with acute appendicitis was successfully managed with an emergent appendectomy, which was performed via an open approach under spinal anesthesia.

References

1. Arai H, Ouchi Y, Toba K, Endo T, Shimokado K, Tsubota K, Matsuo S, Mori H, Yumura W, Yokode M, Rakugi H and Ohshima S: Japan as the front-runner of super-aged societies: perspectives from medicine and medical care in Japan. *Geriatr Gerontol Int* (2015) 15: 673-687.
2. Kohn RR: Human aging and diseases. *J Chronic Dis* (1963) 16: 5-21.
3. Sudlow A, Tuffaha H, Stearns AT and Shaikh IA: Outcomes of surgery in patients aged ≥ 90 years in the general surgical setting. *Ann R Coll Surg Engl* (2018) 100: 172-177.
4. Ukkonen M, Kivivuori A, Rantanen T and Paajanen H: Emergency

- abdominal operations in the elderly: a multivariate regression analysis of 430 consecutive patients with acute abdomen. *World J Surg* (2015) 39: 2854–2861.
5. Kontinen N and Rosenberg PH: Outcome after anaesthesia and emergency surgery in patients over 100 years old. *Acta Anaesthesiol Scand* (2006) 50: 283–289.
 6. Nazir A, Farooqi SA, Chaudhary NA, Bhatti HW, Waqar M and Sadiq A: Comparison of open appendectomy and laparoscopic appendectomy in perforated appendicitis. *Cureus* (2019) 11: e5105.
 7. Ilves I, Paajanen HEK, Herzog KH, Fagerström A and Miettinen PJ: Changing incidence of acute appendicitis and nonspecific abdominal pain between 1987 and 2007 in Finland. *World J Surg* (2011) 35: 731–738.
 8. Harbrecht BG, Franklin GA, Miller FB, Smith JW and Richardson JD: Acute appendicitis—not just for the young. *Am J Surg* (2011) 202: 286–290.
 9. Fugazzola P, Ceresoli M, Agnoletti V, Agresta F, Amato B, Carcoforo P, Catena F, Chiara O, Chiarugi M, Cobianchi L, Coccolini F, De Troia A, Di Saverio S, Fabbri A, Feo C, Gabrielli F, Gurrado A, Guttadauro A, Leone L, Marrelli D, Petruzzelli L, Portolani N, Prete FP, Puzziello A, Sartelli M, Soliani G, Testini M, Tolone S, Tomasoni M, Tugnoli G, Viale P, Zese M, Ishay OB, Kluger Y, Kirkpatrick A and Ansaloni L: The SIFIPAC /WSES/SICG/SIMEU guidelines for diagnosis and treatment of acute appendicitis in the elderly (2019 edition). *World J Emerg Surg* (2020) 15: 19.
 10. Kraemer M, Franke C, Ohmann C and Yang Q: Acute appendicitis in late adulthood: incidence, presentation, and outcome. Results of a prospective multicenter acute abdominal pain study and a review of the literature. *Langenbecks Arch Surg* (2000) 385: 470–481.
 11. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, Boormeester M, Sartelli M, Coccolini F, Tarasconi A, De' Angelis N, Weber DG, Tolonen M, Birindelli A, Biffi W, Moore EE, Kelly M, Soreide K, Kashuk J, Ten Broek R, Gomes CA, Sugrue M, Davies RJ, Damaskos D, Leppaniemi A, Kirkpatrick A, Peitzman AB, Fraga GP, Maier RV, Coimbra R, Chiarugi M, Sganga G, Pisanu A, De' Angelis GL, Tan E, Van Goor H, Pata F, Di Carlo I, Chiara O, Litvin A, Campanile FC, Sakakushev B, Tomadze G, Demetrashvili Z, Latifi R, Abu-Zidan F, Romeo O, Segovia-Lohse H, Baiocchi G, Costa D, Rizoli S, Balogh ZJ, Bendinelli C, Scalea T, Ivatury R, Velmahos G, Andersson R, Kluger Y, Ansaloni L and Catena F: Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. *World J Emerg Surg* (2020) 15: 27. doi: 10.1186/s13017-020-00306-3.
 12. Burns-Cox N, Campbell WB, van Nimmen BA, Vercaeren PM and Lucarotti M: Surgical care and outcome for patients in their nineties. *Br J Surg* (1997) 84: 496–498.
 13. Mima K, Miyanari N, Itoyama R, Nakao Y, Kato R, Shigaki H, Kurashige J, Inoue M, Iwagami S, Mizumoto T, Kubota T and Baba H: Interval laparoscopic appendectomy after antibiotic therapy for appendiceal abscess in elderly patients. *Asian J Endosc Surg* 2020 (13): 311–318.
 14. Tosun F, Ozen M, Tatar C and Alakus H: Unilateral spinal anesthesia experience in a supercentenarian. *AA Case Rep* (2015) 5: 117–118.
 15. Becker P, Fichtner-Feigl S and Schilling D: Clinical management of appendicitis. *Visc Med* (2018) 34: 453–458.
 16. Wang D, Dong T, Shao Y, Gu T, Xu Y and Jiang Y: Laparoscopy versus open appendectomy for elderly patients, a meta-analysis and systematic review. *BMC Surg* (2019) 19: 54.
 17. Sartelli M, Baiocchi GL, Di Saverio S, Ferrara F, Labricciosa FM, Ansaloni L, Coccolini F, Vijayan D, Abbas A, Abongwa HK, Agboola J, Ahmed A, Akhmeteli L, Akkapulu N, Akkucuk S, Altintoprak F, Andreiev AL, Anyfantakis D, Atanasov B, Bala M, Balalis D, Barakat O, Bellanova G, Beltran M, Melo RB, Bini R, Bouliaris K, Brunelli D, Castillo A, Catani M, Che Jusoh A, Chichom-Mefire A, Cocorullo G, Coimbra R, Colak E, Costa S, Das K, Delibegovic S, Demetrashvili Z, Di Carlo I, Kiseleva N, El Zalabany T, Faro M, Ferreira M, Fraga GP, Gachabayov M, Ghnnam WM, Giménez Maurel T, Gkiokas G, Gomes CA, Griffiths E, Guner A, Gupta S, Hecker A, Hirano ES, Hodonou A, Hutun M, Ioannidis O, Isik A, Ivakhov G, Jain S, Jokubauskas M, Karamarkovic A, Kauhanen S, Kaushik R, Kavalakat A, Kenig J, Khokha V, Khor D, Kim D, Kim JI, Kong V, Lasithiotakis K, Leão P, Leon M, Litvin A, Lohsiriwat V, López-Tomasetti Fernandez E, Losteridis E, Maciel J, Major P, Dimova A, Manatakis D, Marinis A, Martinez-Perez A, Marwah S, McFarlane M, Mesina C, Pędziwiatr M, Michalopoulos N, Misiakos E, Mohamedahmed A, Moldovanu R, Montori G, Mysore Narayana R, Negoi I, Nikolopoulos I, Novelli G, Novikovs V, Olaoye I, Omari A, Ordoñez CA, Ouadii M, Ozkan Z, Pal A, Palini GM, Partecq LI, Pata F, Pędziwiatr M, Pereira Júnior GA, Pintar T, Pisarska M, Ploneda-Valencia CF, Pougouras K, Prabhu V, Ramakrishnapillai P, Regimbeau JM, Reitz M, Rios-Cruz D, Saar S, Sakakushev B, Seretis C, Sazhin A, Major P, Skrovinova M, Smirnov D, Spyropoulos C, Strzalka M, Talving P, Teixeira Gonsaga RA, Theobald G, Tomadze G, Torba M, Tranà C, Ulrych J, Uzunoğlu MY, Vasilescu A, Occhionorelli S, Venara A, Vereczkei A, Vettoretto N, Vlad N, Waledziak M, Yilmaz TU, Yuan KC, Yunfeng C, Zilinskis J, Grelpois G and Catena F: Prospective observational study on acute appendicitis worldwide (POSAW). *World J Emerg Surg* (2018) 13: 19.
 18. Dowgiałto-Wnukiewicz N, Kozera P, Wójcik W, Lech P, Rymkiewicz P and Michalik M: Surgical treatment of acute appendicitis in older patients. *Pol Przegl Chir* (2019) 91: 12–15.
 19. Taha AM and Welling RE: Acute torsion of the gallbladder in a 100-year-old female patient. *J Natl Med Assoc* (1985) 77: 404–410.
 20. Fajardo R, Diaz F, Cabrera LF and Pedraza M: Acute abdomen in the centenary patient, mesh migration into the sigmoid colon after laparoscopic inguinal hernia repair (TAPP): A case report and review of literature. *Int J Surg Case Rep* (2020) 66: 334–337.
 21. Yamazaki Y, Otowa Y, Kusano S, Nakajima K, Satake S and Yamasaki Y: Incarcerated obturator hernia treated using a hybrid laparoscopic and anterior preperitoneal approach: a case report. *Asian J Endosc Surg* (2018) 11: 277–279.
 22. Nagamine Y, Godai K, Oki H and Kanmura Y: Management of a centenarian who underwent emergency laparoscopic cholecystectomy under general anesthesia with subcostal transversus abdominis plane block. *JA Clin Rep* (2016) 2: 24.
 23. Miller RL, Yeung D, McCluney S and Warren OJ: Unique case of herniated small bowel infarction within a colonic stomal prolapse. *BMJ Case Rep* (2017) bcr2017220850. doi: 10.1136/bcr-2017-220850.
 24. Tan SL: A case report on a 103 year old patient with perforated peptic ulcer. *Med J Malaysia* (1980) 35: 162–163.
 25. Melnik I, Goldstein D and Yoffe B: Use of a porcine dermal collagen implant for contaminated abdominal wall reconstruction in a 105-year-old woman: a case report and review of the literature. *J Med Case Rep* (2015) 9: 95.
 26. Katlic MR: Surgery in centenarians. *JAMA* (1985) 253: 3139–3141.
 27. McCann WJ and Smith JW: The surgical care of centenarians. *Curr Surg* (1990) 47: 2–3.
 28. Cogbill TH, Strutt PJ and Landercasper J: Surgical procedures in centenarians. *Wis Med J* (1992) 91: 527–529.
 29. Warner MA, Saletel RA, Schroeder DR, Warner DO, Offord KP and Gray DT: Outcomes of anesthesia and surgery in people 100 years of age and older. *J Am Geriatr Soc* (1998) 46: 988–993.