# Watchful Waiting vs Repair of Inguinal Hernia in Minimally Symptomatic Men

## A Randomized Clinical Trial

Robert J. Fitzgibbons, Jr, MD
Anita Giobbie-Hurder, MS
James O. Gibbs, PhD
Dorothy D. Dunlop, PhD
Domenic J. Reda, PhD
Martin McCarthy, Jr, PhD
Leigh A. Neumayer, MD
Jeffrey S. T. Barkun, MD
James L. Hoehn, MD
Joseph T. Murphy, MD
George A. Sarosi, Jr, MD
William C. Syme, MD
Jon S. Thompson, MD
Jia Wang, MS
Olga Jonasson, MD

**Context** Many men with inguinal hernia have minimal symptoms. Whether deferring surgical repair is a safe and acceptable option has not been assessed.

**Objective** To compare pain and the physical component score (PCS) of the Short Form-36 Version 2 survey at 2 years in men with minimally symptomatic inguinal hernias treated with watchful waiting or surgical repair.

**Design, Setting, and Participants** Randomized trial conducted January 1, 1999, through December 31, 2004, at 5 North American centers and enrolling 720 men (364 watchful waiting, 356 surgical repair) followed up for 2 to 4.5 years.

**Interventions** Watchful-waiting patients were followed up at 6 months and annually and watched for hernia symptoms; repair patients received standard open tension-free repair and were followed up at 3 and 6 months and annually.

**Main Outcome Measures** Pain and discomfort interfering with usual activities at 2 years and change in PCS from baseline to 2 years. Secondary outcomes were complications, patient-reported pain, functional status, activity levels, and satisfaction with care.

**Results** Primary intention-to-treat outcomes were similar at 2 years for watchful waiting vs surgical repair: pain limiting activities (5.1% vs 2.2%, respectively; $P=.52$); PCS (improvement over baseline, 0.29 points vs 0.13 points; $P=.79$). Twenty-three percent of patients assigned to watchful waiting crossed over to receive surgical repair (increase in hernia-related pain was the most common reason offered); 17% assigned to receive repair crossed over to watchful waiting. Self-reported pain in watchful-waiting patients crossing over improved after repair. Occurrence of postoperative hernia-related complications was similar in patients who received repair as assigned and in watchful-waiting patients who crossed over. One watchful-waiting patient (0.3%) experienced acute hernia incarceration without strangulation within 2 years; a second had acute incarceration with bowel obstruction at 4 years, with a frequency of 1.8/1000 patient-years inclusive of patients followed up for as long as 4.5 years.

**Conclusions** Watchful waiting is an acceptable option for men with minimally symptomatic inguinal hernias. Delaying surgical repair until symptoms increase is safe because acute hernia incarcerations occur rarely.

**Clinical Trials Registration** ClinicalTrials.gov Identifier: NCT00263250

*JAMA. 2006;295:285-292* www.jama.com

MANY MEN WITH AN INGUINAL hernia are asymptomatic or minimally symptomatic. They and their physicians sometimes delay hernia repair until emergence of pain or discomfort. Surgical repair, while generally safe and effective, carries long-term risks of hernia recurrence, pain, and discomfort.[1-4]

The natural history of an untreated inguinal hernia is not known. For minimally symptomatic men, the usual basis for recommending surgical repair is to prevent a hernia accident (ie, acute hernia incarceration with bowel obstruction, strangulation of intra-abdominal contents, or both), but this is a rare event. Only an 1896 report from Berger's Paris truss clinic[5] and a 1981 report from Colombia[6] are avail-

**For editorial comment see p 328.**

**Author Affiliations** are listed at the end of this article.
**Corresponding Author:** Olga Jonasson, MD, Department of Surgery, University of Illinois, 1514 W Jackson Blvd, Chicago, IL 60607 (ojonasson@ameritech.net).

able to assess this risk. Both estimated the annual risk of a hernia accident to be approximately 3 per thousand patients. Whether watchful waiting is a good option has not been critically tested.

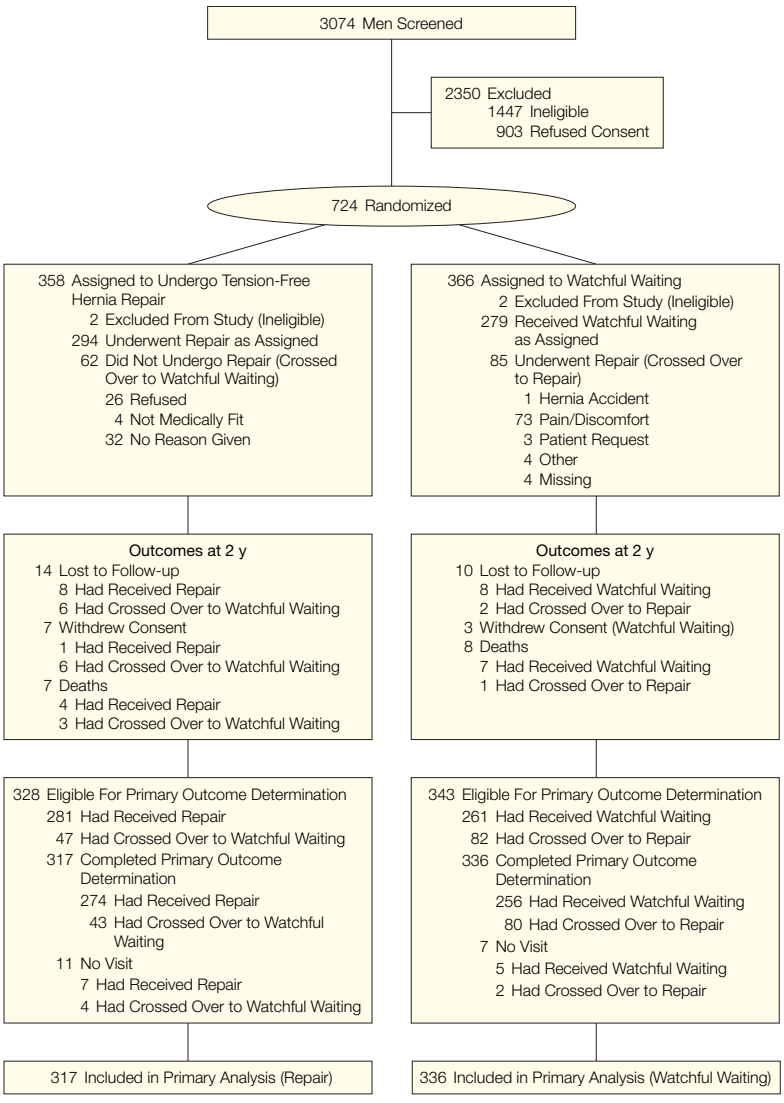
We conducted a multicenter clinical trial to compare pain, physical function, and other outcomes in men with asymptomatic or minimally symptomatic inguinal hernias randomly assigned to a strategy of watchful waiting or to receive standard open tension-free repair with mesh. We also sought to assess the safety of watchful waiting with regard to the natural history of minimally symptomatic untreated hernias and the risk of hernia accidents.[7]

## METHODS

### Study Population

Participants were men aged 18 years or older and presenting with asymptomatic or minimally symptomatic inguinal hernia (ie, the absence of hernia-related pain or discomfort limiting usual activities or difficulty in reducing the hernia within 6 weeks of screening). Excluded were those with undetectable hernias, local or systemic infection, American Society of Anesthesiologists physical status[8] greater than 3, or participation in another clinical trial. Men with minimally symptomatic chronically incarcerated hernias were not excluded. Participants were recruited from 5 community and academic centers (Creighton University, Omaha VA Medical Center, University of Nebraska, Omaha; McGill University, Montreal, Quebec; Marshfield Clinic, Marshfield, Wis; University of Texas Southwestern Medical Center, Dallas VA Medical Center, Dallas; and Lovelace Clinic, Albuquerque, NM). Enrollment of eligible patients began on January 1, 1999, and took place over 2.5 years; patients were followed up for a minimum of 2 years. The trial ended on December 31, 2004. The study was designed to assess primary outcomes at 2 years. Patients enrolled early in the trial were followed up for as long as 4.5 years (median, 3.2 years).

**Figure 1.** Screened and Enrolled Patients




### Recruitment

Men were referred by primary care physicians or other surgeons or were self-referred in response to public advertising. Approximately half of the men screened were not eligible for the trial, and 55% of eligible patients declined to give consent to be randomized (FIGURE 1). Information on race/ethnicity was gathered to ensure that a spectrum of individuals was represented in this trial. Race/ethnicity were indicated by the patient on a standard form with choices as defined by the US Census Bureau: Hispanic/Latino or non-Hispanic, white, black or African-American, Asian, native Hawaiian or Pacific Islander, or American Indian or native Alaskan.

### Study Interventions

Participants were randomly assigned to watchful waiting or to receive standard Lichtenstein open tension-free repair.[9] Details of the watchful-waiting protocols and the surgical repair are described in a previous report.[7]

### Follow-up

Patients assigned to watchful waiting were given written instructions to watch

for hernia symptoms and contact their physician if problems developed; in addition, they were examined at 6 months and yearly after enrollment. While this trial was designed primarily to compare watchful waiting with surgical repair 2 years after randomization, 367 patients were followed up for 3 years and 156 for 4 years; mean and median time of follow-up was 3.2 years.

### Randomization, Allocation Concealment, and Implementation of Randomization Scheme

Randomization was stratified by the presence of primary or recurrent hernia, unilateral or bilateral hernia, and study site. The randomization scheme was developed by the study biostatistician and allocated treatments in random block sizes of 2, 4, or 6. Randomization was accomplished by a computer-generated permuted random sequence and assigned by the Veterans Administration (VA) Cooperative Studies Program Coordinating Center, Hines, Ill. After the patient satisfied all inclusion criteria and provided written informed consent, the site coordinator telephoned the VA coordinating center to request that the patient be assigned. Patients were assigned to either watchful waiting or surgical repair in equal proportions. Because of the obvious identity of the study groups, treatment allocation was not blinded to patients or surgeons. Interim unblinded reports were provided to the data and safety monitoring board (DSMB) for safety monitoring, but all site investigators were blinded to interim outcome comparisons until all patients had undergone their final evaluation. Protocol and consent forms were approved by the Hines VA/North Chicago VA Human Studies Subcommittee and by each site's institutional review board.

### Determination of Outcomes

The primary outcomes were pain and discomfort interfering with usual activities 2 years after enrollment and change from baseline to 2 years in the physical component score (PCS) of the Short Form-36 Version 2 health-related quality-of-life survey.[10] Pain interfering with activities was defined as the selection of a level 3 or 4 response to questions with 4 choices: (1) no pain or discomfort due to the hernia or hernia operation; (2) mild pain that does not interfere with activities; (3) moderate or (4) severe levels of pain that interfere with usual activities. These patient-reported variables were measured at baseline and at the 6-month and annual visits.

Postoperative complications of surgical repair were assessed at the 2-week visit and as needed for 3 months. Long-term complications, including hernia recurrence, were assessed at the 6-month and annual visits.[7] Life-threatening complications were defined prior to the start of the study and were assessed for up to 30 days after surgical repair.

Secondary outcomes included complications, as well as patient-reported outcomes of pain (assessed using four 150-mm visual analog surgical pain scales to measure sensory and emotional aspects of hernia-related pain[11]), functional status (using the Short Form-36 Version 2 questionnaire[12]), activity levels (using the Activities Assessment Scale[13]), and satisfaction with care (using a 5-point Likert scale). These were measured at baseline, 6 months, and annually. Pain was also assessed at the time of crossover in patients assigned to watchful waiting who ultimately received surgical repair.

### Statistical Analysis

The sample size of 720 randomly assigned patients had more than 91% power for each of the primary outcomes at 2 years to detect a 10% difference in the proportion of patients with pain interfering with activities and an 8-point difference in the PCS change from baseline levels, allowing an overall 2-sided type I error rate of 5% and 4 interim analyses of the primary end points. All final analyses and associated confidence intervals for primary and secondary outcomes were adjusted for interim monitoring.[14]

Baseline characteristics were compared across groups using a $\chi^2$ test or the Fisher exact test for categorical variables and *t* test or analysis of variance for continuous variables.

Primary analyses comparing watchful waiting with surgical repair for 2-year outcomes were performed on an intention-to-treat basis. Rates for pain interfering with activities at 2 years were compared using O'Brien-Fleming sequential proportion tests. Changes in PCS were compared using O'Brien-Fleming sequential *z* tests.[14]

Some patients assigned to watchful waiting requested and received surgical repair, and some patients assigned to receive surgical repair refused surgery and were treated with watchful waiting. Therefore, as an exploratory analysis, primary and secondary outcomes were also examined to account for the intervention received (as-treated analyses). Time-to-crossover estimates were computed using life-table methods.[15] Observations were censored at termination of study participation or at completion of follow-up. Statistical testing of 2-year primary and secondary outcomes used the Dunnett t test to account for multiple comparisons of the reference group receiving surgical repair as assigned with the other as-treated groups.[16] Statistical tests were not adjusted for comparisons related to multiple secondary end points. Analyses were performed using SAS version 8.0 (SAS Institute Inc, Cary, NC).

### Organization and Monitoring

The principal investigator (R.J.F.) visited each site within the first few months to ensure compliance with study protocols. An executive committee, independent DSMB, and the Hines VA/North Chicago VA Human Studies Subcommittee provided oversight of the study. Site institutional review boards reviewed the study annually. Patient follow-up was deficient in 1 of the original sites, prompting an independent audit of all sites. All data from the single deficient site were purged, the site was dropped from the study, and an alternate site activated.[7]

**Table 1.** Baseline Demographic Characteristics

| Characteristic | Tension-Free Repair (n = 356) | Watchful Waiting (n = 364) | *P* Value |
|---|---|---|---|
| Age, mean (SD), y | 57.5 (13.9) | 57.5 (14.1) | .99 |
| Age group, y, No. (%) | | | |
| <40 | 42 (11.8) | 41 (11.3) | |
| 40-65 | 200 (56.2) | 198 (54.4) | |
| >65 | 114 (32.0) | 125 (34.3) | |
| Race, No. (%) | | | |
| White | 311 (87.4) | 311 (85.4) | .47 |
| Black | 17 (4.8) | 16 (4.4) | |
| Asian | 3 (0.8) | 3 (0.8) | |
| Multiracial | 12 (3.4) | 23 (6.3) | |
| No response | 13 (3.7) | 11 (3.0) | |
| Education, mean (SD), y | 13.9 (2.7) | 14.2 (2.7) | .09 |
| Private health insurance, No. (%) | 279 (78.3) | 285 (78.3) | .99 |
| Employment, No. (%) | | | |
| Employed | 221 (62.0) | 213 (58.5) | .61 |
| Disabled/unemployed | 18 (5.1) | 22 (6.0) | |
| Retired | 117 (32.9) | 129 (35.5) | |

## RESULTS

### Baseline Patient Characteristics

Between January 1999 and December 2002, 3074 men were screened and 1627 initially met the eligibility criteria. Of these, 724 provided informed consent and were randomly assigned to watchful waiting (366) or surgical repair (358). Two patients were excluded from analysis from each group because it was later determined by the DSMB that eligibility criteria were not met. The 2-year follow-up period ended in December 2004. Eighty-five (23%) of 364 patients assigned to watchful waiting had received surgical repair within 2 years, and 62 (17%) of 356 patients assigned to receive surgical repair did not undergo repair (Figure 1).

Baseline characteristics of the patients are given in TABLE 1 and TABLE 2 for intention-to-treat groups. The mean age of the population was 57.5 years (SD, 14), and demographic characteristics, coexisting conditions, and American Society of Anesthesiologists classifications[8] were similar between groups. Exceptions were greater body mass index and less sedentary and ambulatory activities in patients assigned to receive surgical repair; more patients were assigned to watchful waiting whose hernias had enlarged within the previous 6 weeks. Most patients (86%) were white; 5% were black; and 9% were Asian, mixed race, or gave no response.

### Operative Findings

In patients receiving surgical repair and those assigned to watchful waiting who crossed over to receive surgical repair, hernia types were determined at time of repair using the Nyhus classification.[17] Among patients undergoing repair, indirect inguinal hernias comprised 53% of hernias (type 1 = 12%, type 2 = 29%, type 3b = 12%); direct inguinal hernias (type 3a), 41%; and recurrent hernias, 6%. General anesthesia was used in 51%, spinal anesthesia in 10%, and local anesthesia in 37%. Fourteen percent of patients receiving surgical repair had bilateral repair. Seven patients had missing operative data.

### Complications and Deaths

The rate of complications was similar among those who were assigned to and received surgical repair (21.7%) and those assigned to watchful waiting who crossed over to receive surgical repair (27.9%) ($P = .30$). Three intraoperative complications (a wound hematoma requiring return to the operating room, postanesthetic hypertension, and an ilioinguinal nerve injury) were reported in all patients who received surgical repair (0.8%). Postoperative complications (90 events) reported in 85 patients (22.3%) included wound hematomas (23 [6.1%]), scrotal hematomas (17 [4.5%]), urinary tract infections (8 [2.1%]), wound infections (7 [1.8%]), orchitis (6 [1.6%]), seromas (6 [1.6%]), urinary retention (1 [0.3%]), and other minor complications (22 [5.8%]). One life-threatening complication occurred in each of 3 patients receiving surgical repair: postoperative bradycardia, deep venous thrombosis, and postoperative hypertension requiring hospitalization. By 2 years, recurrence of the hernia had occurred in 3 patients (1.0%) assigned to receive surgical repair and in 2 patients (2.3%) assigned to watchful waiting who crossed over to receive surgical repair ($P = .31$). When assessed at 3 months postoperatively, 13 patients (3.4%) receiving surgical repair experienced groin pain and 2 patients (0.5%) experienced leg pain.

One acute hernia incarceration without strangulation occurred in a watchful-waiting patient 4 months after enrollment; emergency surgical repair was complicated by a wound hematoma. There were 22 deaths among enrolled patients (10 among surgical repair and 12 among watchful-waiting patients, $P = .70$), with 15 occurring within 2 years (7 among surgical repair and 8 among watchful-waiting patients, $P = .83$); none of the deaths were attributed to the study.

### Outcomes at 2 Years

Of the original 364 watchful-waiting and 356 surgical repair patients, 21 and 28 died or withdrew consent within 2 years, respectively, leaving 94.2% and 92.1% who could have been evaluated at 2 years. Of these, 7 and 11 in the watchful-waiting and surgical repair groups, respectively, were lost to follow-up, leaving 92.3% and 89.0% who completed 2-year follow-up and who were included in analyses of the primary and secondary outcomes.

**Primary Outcomes.** At 2 years, intention-to-treat analyses showed that

pain interfering with activities developed in similar proportions in both groups (5.1% for watchful waiting vs 2.2% for surgical repair; difference 2.86%; 95% confidence interval, –0.04% to 5.77%; $P = .52$) (FIGURE 2). Mean 2-year PCS change from baseline was not significantly different: watchful-waiting patients improved by 0.29 points (of 100) and surgical repair patients improved by 0.13 points (difference, 0.16; 95% confidence interval, –1.2 to 1.5) (FIGURE 3). A sensitivity analysis adjusting for stratification factors and imbalance in baseline characteristics (ie, body mass index, Activities Assessment Scale, and recent hernia enlargement) yielded almost identical results.

In the as-treated analyses, 47.1% of patients assigned to watchful waiting who crossed over to receive surgical repair had developed pain that interfered with their activities at the time of crossover. Eighty-six percent reported some degree of pain and discomfort as their reason for requesting repair. By the time of the 2-year interview, however, the percentage of patients who had pain interfering with activity was not significantly greater in the patients who had crossed over (8.6% in the crossover group vs 1.5% in the group receiving surgical repair as assigned; difference, 7.1%; 95% confidence interval, –0.63% to 14.99%) (Figure 2). Patients assigned to watchful waiting who crossed over to receive surgical repair reported significantly larger improvement from baseline in PCS relative to patients receiving surgical repair as assigned (difference, 2.50; 95% confidence interval, 0.01 to 5.0; $P = .01$) (Figure 3).

**Secondary Outcomes at 2 Years.** Both groups had less pain at 2 years than at baseline. The amount of change from baseline in pain while at rest, during normal activities, and during work or exercise did not differ between the intention-to-treat groups. The reduction in perception of pain unpleasantness was significantly greater for patients receiving surgical repair than for those receiving watchful waiting (surgical repair, –6.2 mm vs watchful waiting, –2.3 mm; difference, 3.9 mm; 95% confidence interval, 0.8 to 7.0 mm; $P = .01$). As-treated analyses yielded similar results.

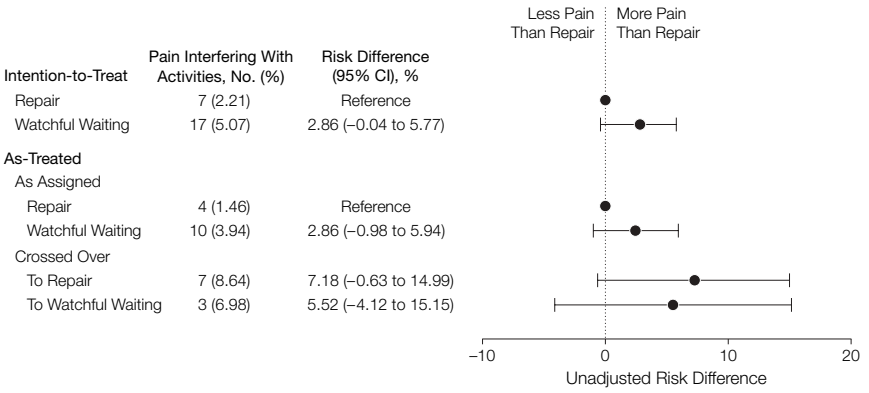
At the time of crossover from watchful waiting to surgical repair, large increases since the last visit in pain unpleasantness and pain during normal

**Table 2.** Baseline Health Status Characteristics

| Characteristic | Tension-Free Repair (n = 356) | Watchful Waiting (n = 364) | *P* Value |
|---|---|---|---|
| BMI, mean (SD)* | 26.6 (3.8) | 25.8 (3.4) | .004 |
| Coexisting conditions, No. (%) | | | |
| CHF | 2 (0.6) | 1 (0.3) | .62 |
| Prior MI | 1 (0.3) | 1 (0.3) | .99 |
| Hypertension | 95 (26.8) | 102 (28.0) | .74 |
| COPD | 5 (1.4) | 2 (0.5) | .28 |
| Chronic cough | 11 (3.1) | 15 (4.1) | .55 |
| Prostatism | 35 (9.9) | 42 (11.5) | .47 |
| Diabetes | 17 (4.8) | 16 (4.4) | .86 |
| Cigarette smoker | 67 (18.9) | 65 (17.9) | .77 |
| Alcohol consumption >2 drinks/d | 38 (10.7) | 48 (13.2) | .30 |
| ASA health status class | | | |
| 1 | 227 (63.9) | 246 (67.6) | .43 |
| 2 | 113 (31.8) | 100 (27.5) | |
| 3 | 15 (4.2) | 18 (4.9) | |
| Surgical Pain Scale score, mean (SD)† | | | |
| At rest | 8.2 (13.1) | 8.2 (15.6) | .99 |
| Normal activities | 10.3 (14.9) | 10.4 (14.9) | .93 |
| Work/exercise | 17.1 (24.6) | 14.6 (20.7) | .20 |
| Pain unpleasantness | 12.9 (19.5) | 10.9 (17.9) | .15 |
| PCS score, mean (SD)‡ | 52.2 (7.9) | 51.5 (7.7) | .29 |
| AAS score, mean (SD) | | | |
| Sedentary | 94.3 (9.6) | 95.7 (8.0) | .03 |
| Ambulatory | 95.5 (9.8) | 97.1 (8.0) | .02 |
| Work/exercise | 92.1 (12.8) | 93.3 (11.9) | .28 |
| Total | 95.2 (8.4) | 96.5 (6.7) | .04 |
| Hernia characteristics, No. (%) | | | |
| Unilateral | 308 (86.5) | 311 (85.4) | .75 |
| Bilateral | 48 (13.5) | 53 (14.6) | |
| Primary | 322 (90.4) | 321 (88.2) | .34 |
| Recurrent | 34 (9.6) | 43 (11.8) | |
| Duration of hernia, No. (%) | | | |
| <6 wk | 56 (15.8) | 55 (15.1) | .73 |
| ≥6 wk | 256 (71.8) | 267 (73.4) | |
| Do not know | 44 (12.4) | 42 (11.5) | |
| Hernia enlarged in past 6 weeks, No. (%) | 34 (9.6) | 56 (15.4) | .04 |
| Hernia reducibility, No. (%) | | | |
| Spontaneously | 232 (65.1) | 235 (64.5) | .17 |
| Easily | 108 (30.4) | 120 (33.1) | |
| With difficulty | 15 (4.2) | 6 (1.7) | |
| Not reducible | 1 (0.3) | 3 (0.8) | |
| Hernia findings, No. (%) | | | |
| Palpable on impulse | 151 (42.5) | 142 (39.1) | .57 |
| Visible when standing | 184 (51.6) | 202 (55.4) | |
| Extends into scrotum | 21 (5.9) | 20 (5.6) | |

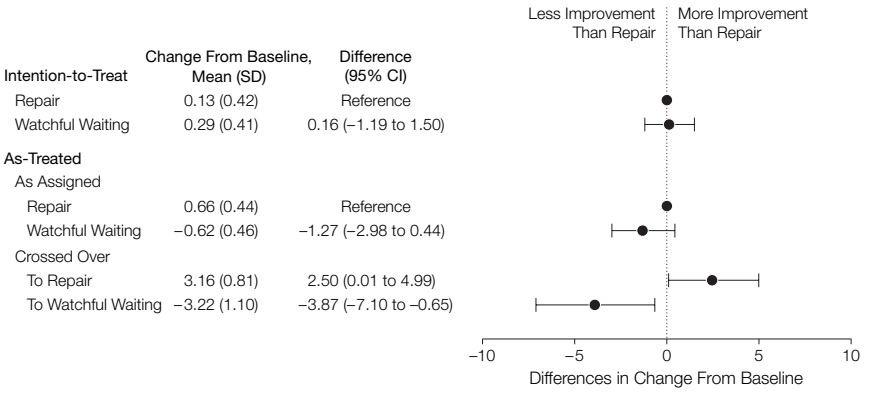
Abbreviations: AAS, Activities Assessment Scale; ASA, American Society of Anesthesiologists; BMI, body mass index; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; MI, prior myocardial infarction; PCS, physical component summary.
*Calculated as weight in kilograms divided by the square of height in meters.
†Comprises four 150-mm visual analog pain scales.
‡Scores range from 0-100, with a norm mean of 50.

**Figure 2.** Pain Interfering With Activities: Group Differences at 2 Years



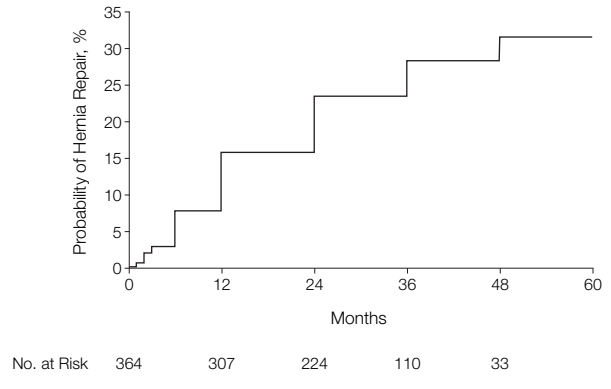

Reference group for intention-to-treat is tension-free repair (score=0); reference group for as-treated is patients randomized to and received tension-free repair (score=0).

**Figure 3.** Physical Component Score: Group Differences in 2-Year Change From Baseline




Reference group for intention-to-treat is tension-free repair (score=0); reference group for as-treated is patients randomized to and received tension-free repair (score=0).

**Figure 4.** Probability of Crossover From Watchful Waiting to Surgery




activities were noted in only 44% of the crossover group (n=29).

Patients also reported on their ability to perform a spectrum of everyday activities. In all categories of activities, intent-to-treat analyses indicated that patients receiving surgical repair showed significantly greater improvement than did watchful-waiting patients.

More than 97% of patients in both treatment groups were satisfied or very satisfied with the care they received.

### Outcomes at Last Follow-up

The mean (SD) time to crossover was 27.2 (13.7) months (median, 24.4 months); beyond 2 years, the crossover rate was 4% per year (FIGURE 4).

Of the 379 patients who underwent hernia repair, 20 were lost to follow-up or withdrew consent and 5 died. Of the 354 remaining patients, 1.4% had a recurrence (n=5), with a rate of 0.0045 recurrences per patient-year.

All randomly assigned patients were considered at risk for acute incarceration without strangulation until herniorrhaphy was performed. Acute hernia incarceration occurred in 1 patient (0.3%) within 2 years of assignment to watchful waiting, and 1 acute hernia incarceration with bowel obstruction occurred at 4 years in a watchful-waiting patient; this was reduced with sedation and repaired electively. The hernia accident rate was 0.0018 events per patient-year.

## COMMENT

Watchful waiting is a reasonable option for men whose inguinal hernia is minimally symptomatic. Two years after randomization, similar proportions of patients in the watchful-waiting and surgical repair groups had pain sufficient to limit usual activities, and their levels of physical functioning were similar. Patients assigned to watchful waiting who requested surgical repair most commonly reported increased pain as the reason for the crossover, and nearly half reported that pain interfered with normal activities. These symptoms improved for most patients after hernia repair.

Hernia accidents were extremely uncommon (rate of 1.8 per 1000 patient-years). Others have suggested that hernia accidents are more common in elderly patients, many of whom are unaware of their diagnosis and have not sought surgical care.[5,18] In a review of the VA database (W. Henderson, PhD, National Surgical Quality Improvement Program, written communication, 2005), the mean age of patients having hernia emergencies was 77 years, and the rate of death after repair was found to be only 2.2%. The low accident rate of 1.8 per 1000 patients per year found in this strategy, the low mortality rate associated with surgical repair, and the similar pain and health outcomes identified at 2 years suggest that deferring surgery for men without troublesome symptoms is a reasonable option.

By 2 years, 23% of our watchful-waiting patients crossed over to receive surgical repair. We had anticipated that progression of symptoms in some men assigned to watchful waiting would lead them to request repair. Unexpectedly, nearly the same proportion of men assigned to receive repair (17%) did not have the operation, despite being well informed that participation in this study would give them a 50% chance of being directed to an operative intervention. Crossovers from watchful waiting to surgical repair continued to the close of the study, reaching 31% at 4 years.

We explored some of the differences in characteristics and outcomes between the as-treated groups. It appeared that certain baseline characteristics of patients assigned to watchful waiting who requested surgical repair differed from those of the other groups. At baseline, these patients reported high levels of sensory and affective pain during their normal activities (as measured by the hernia-specific Surgical Pain Scale[11]) and had impaired physical function (as measured by the PCS of the Short Form-36 Version 2). Prostatism was also common. The men assigned to surgical repair who did not undergo repair may have been less healthy than patients in other groups, as indicated by a somewhat higher American Society of Anesthesiologists classification and greater frequency of diabetes and hypertension. This crossover group also had worse physical functioning at baseline, but after repair they experienced considerably greater improvement in physical functioning than did the patients who received surgical repair as assigned. It may be useful to consider these characteristics when recommending a therapeutic strategy for men with few hernia-related symptoms. These differences may be the result of unique characteristics of these patients or of therapeutic intervention. Results from as-treated analyses, however, must be interpreted with caution. The validity of intention-to-treat analyses is based on randomization of subjects into the treatment groups, helping to ensure that the groups are comparable and the differences found between them after an intervention are real.[19]

Minimally symptomatic men who choose to defer surgical repair also defer the small risk of adverse consequences of a tension-free repair. Adverse consequences of surgical repair were identified in some patients, including short-term complications in 32.7%; longer-term problems, including chronic pain sufficient to limit activities in 1.7% at 3 years and 1.3% at 4 years for the subset of the group available for analysis at these points; and recurrence of the hernia in 1.4%.

This study has several limitations. The mix of patients evaluated (predominantly white, privately insured) may not resemble those found in other settings. Progression of hernia-related symptoms is time-dependent and the main outcomes of the study were assessed at 2 years. For all patients, the median length of follow-up was only 3.2 years. Because the risk of a hernia accident increases with the length of time the hernia is present and because accidents are more common in elderly individuals, a longer follow-up period may be needed to ascertain the longer-term risks of either treatment strategy.[18] To this end, we have established a voluntary long-term registry of patients enrolled in this and its companion trial comparing open and laparoscopic hernia repair[2] to annually assess patient-reported outcomes and the occurrence of hernia accidents and recurrences.

## CONCLUSIONS

A strategy of watchful waiting is a safe and acceptable option for men with asymptomatic or minimally symptomatic inguinal hernias. Acute hernia incarcerations occur rarely, and patients who develop symptoms have no greater risk of operative complications than those undergoing prophylactic hernia repair.

**Author Affiliations:** Department of Surgery, Creighton University, Omaha, Neb (Dr Fitzgibbons); Department of Surgery, Omaha VA Medical Center, Omaha (Drs Fitzgibbons and Thompson); VA Cooperative Studies Program Coordinating Center, Hines, Ill (Dr Reda and Mss Giobbie-Hurder and Wang); Department of Preventive Medicine (Dr McCarthy) and Institute for Healthcare Studies (Drs Dunlop and Gibbs), Northwestern University, Chicago, Ill; Salt Lake City VA Health Care System and Department of Surgery, University of Utah, Salt Lake City (Dr Neumayer); Department of Surgery, McGill University, Montreal, Quebec (Dr Barkun); Marshfield Clinic Department of Surgery, Marshfield, Wis (Dr Hoehn); University of Texas Southwestern Medical Center at Dallas and Department of Surgery, Dallas VA Medical Center, Dallas, Tex (Drs Murphy and Sarosi); Lovelace Clinic Department of Surgery, Albuquerque, NM (Dr Syme); Department of Surgery, University of Nebraska, Omaha (Dr Thompson); and Department of Surgery, University of Illinois, Chicago (Dr Jonasson).

**Author Contributions:** Dr Jonasson had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
*Study concept and design:* Fitzgibbons, Gibbs, Dunlop, Reda, McCarthy, Neumayer, Jonasson.
*Acquisition of data:* Fitzgibbons, Giobbie-Hurder, Barkun, Hoehn, Murphy, Sarosi, Syme, Thompson, Jonasson.
*Analysis and interpretation of data:* Fitzgibbons, Giobbie-Hurder, Gibbs, Dunlop, Reda, McCarthy, Neumayer, Barkun, Hoehn, Sarosi, Syme, Thompson, Wang, Jonasson.
*Drafting of the manuscript:* Fitzgibbons, Giobbie-Hurder, Gibbs, Dunlop, McCarthy, Neumayer, Jonasson.
*Critical revision of the manuscript for important intellectual content:* Fitzgibbons, Giobbie-Hurder, Gibbs, Dunlop, Reda, McCarthy, Neumayer, Barkun, Hoehn, Murphy, Sarosi, Syme, Thompson, Wang, Jonasson.
*Statistical analysis:* Giobbie-Hurder, Dunlop, Reda, Wang.
*Obtained funding:* Fitzgibbons, Jonasson.
*Administrative, technical, or material support:* Fitzgibbons, Gibbs, Reda, McCarthy, Neumayer, Jonasson.
*Study supervision:* Fitzgibbons, Gibbs, Neumayer, Barkun, Hoehn, Murphy, Sarosi, Syme, Thompson, Jonasson.
**Financial Disclosures:** Dr Fitzgibbons has been retained as an expert witness by Davol, manufacturer

of mesh plug used in plug and patch surgical repair of hernia and is a consultant for TyRx Pharma Inc, developers of an antibiotic- and local anesthetic–impregnated mesh for tension-free repair of hernia. No other authors reported disclosures.

**Funding/Support** This study was funded by Agency for Healthcare Research and Quality grant RO1 HS 09860, and the American College of Surgeons provided logistic and budget management support.

**Role of the Sponsors:** The Agency for Healthcare Research and Quality had no role in the design and conduct of the study; the collection, management, analysis, and interpretation of the data; or the preparation, review, or approval of the manuscript. The American College of Surgeons had no role in the analysis and interpretation of data or in the preparation, review, or approval of the manuscript.

**Members of the Watchful Waiting vs Open Tension-free Repair Study (asterisks denote former participants):** *Chair:* R. J. Fitzgibbons (Creighton University); *Biostatistician:* A. Giobbie-Hurder; *Health Scientist:* J. O. Gibbs; *Lead Health Economist:* L. Manheim, D. Dobrez*; *Health Economist:* K. Stroupe; *Patient-Reported Outcomes Consultant:* M. McCarthy; *Coinvestigator:* L. Neumayer; *National Study Coordinator:* K. Kaczmarek; *Data and Safety Monitoring Board:* H. Buchwald (University of Minnesota Hospital and Clinics), R. Burney (University of Michigan), B. Craig (Purdue University), L. Kazis (Edith Norse Rogers Memorial Veterans Hospital), K. Kelly (Mayo Clinic–Scottsdale); *Executive Committee:* C. J. Carrico (deceased) (University of Texas Southwestern Medical Center, Dallas); J. Chmiel, D. Dobrez*, D. Dunlop, J. O. Gibbs, L. Manheim (Northwestern University); R. J. Fitzgibbons, Jr (Creighton University); J. Thompson (University of Nebraska Medical Center); A. Giobbie-Hurder, D. Reda (Cooperative Studies Program Coordinating Center); W. G. Henderson* (University of Colorado Health Outcomes Program); O. Jonasson (University of Illinois); J. Barkun, J. Meakins* (McGill University); J. Hoehn (Marshfield Clinic); J. Murphy, G. Sarosi (UT Southwestern Medical Center); W. Syme (Lovelace Health Systems); *Site Personnel:* J. Murphy, G. Sarosi, D. Climer, L. Kim* (Dallas, Tex); W. Syme, A. Von Worley, M. Kestner* (Albuquerque, NM); J. Hoehn, J. Kolb, K. Noreen*, N. Goldberg* (Marshfield, Wis); J. Barkun, D. Papamikhael, C. Flemming (Montreal, Quebec); R. J. Fitzgibbons, R. Christian, K. Kaczmarek, C. Marcuzzo*, M. Ricceri*, J. Ortiz, J. Thompson (Omaha, Neb); K. Richards, E. Callaham, S. Ali, S. Thomas*, K. Johnson* (American College of Surgeons); J. Wang, S. Heard, J. Motyka*, C. Sullivan* (Cooperative Studies Program Coordinating Center, Hines, Ill).

**Acknowledgment:** We thank William Henderson, PhD, University of Colorado Health Outcomes Program, Aurora, for his participation in the design and concept of the study, and we are grateful to C. James Carrico, MD (deceased), Department of Surgery, University of Texas Southwestern, Dallas, for his assistance with obtaining study funding.

## REFERENCES

**1.** Oberlin P, Boudet MJ, Vyrieres M, et al; French Associations for Surgical Research. Recurrence after inguinal hernia repair: prognostic facts in a prospective study of 1706 hernias. *Br J Surg*. 1995;82(suppl 1):65.

**2.** Neumayer L, Giobbie-Hurder A, Jonasson O, et al. Open mesh versus laparoscopic mesh repair of inguinal hernia. *N Engl J Med*. 2004;350:1819-1827.

**3.** Bay-Nielsen M, Thomsen H, Andersen FH, et al. Convalescence after inguinal herniorrhaphy. *Br J Surg*. 2004;91:362-367.

**4.** Cunningham J, Temple WJ, Mitchell P, Nixon JA, Preshaw RM, Hagen NA; Cooperative Hernia Study. Pain in the postrepair patient. *Ann Surg*. 1996;224:598-602.

**5.** Berger P. Resultat de l'examen de dix mille observations de hernies. *Extrait du Neuvieme Congrés Francais de Chirurgie.* Paris, France: 1896.

**6.** Neutra R, Velez A, Ferrada R, Galan R. Risk of incarceration of inguinal hernia in Cali, Colombia. *J Chronic Dis*. 1981;34:561-564.

**7.** Fitzgibbons RJ Jr, Jonasson O, Gibbs JO, et al. The development of a clinical trial to determine if watchful waiting is an acceptable alternative to routine herniorrhaphy for patients with minimal or no hernia symptoms. *J Am Coll Surg*. 2003;196:737-742.

**8.** American Society of Anesthesiologists. New classification of physical status. *Anesthesiology*. 1963;24:111.

**9.** Amid PK, Shulman AG, Lichtenstein IL. The Lichtenstein open "tension-free" mesh repair of inguinal hernias. *Surg Today*. 1995;25:619-625.

**10.** Ware JE Jr, Kosinski M, Keller SD. *SF-36 Physical and Mental Health Summary Scales: A User's Manual*. Boston, Mass: The Health Institute, New England Medical Center; 1994.

**11.** McCarthy M Jr, Chang CH, Pickard AS, et al. Visual analog scales for assessing surgical pain. *J Am Coll Surg*. 2005;201:245-252.

**12.** Ware JE Jr, Kosinski M, Gandek B. *SF-36 Health Survey Manual and Interpretation Guide*. Boston, Mass: The Health Institute, New England Medical Center; 1993.

**13.** McCarthy M Jr, Jonasson O, Chang CH, et al. Assessment of patient functional status after surgery. *J Am Coll Surg*. 2005;201:171-179.

**14.** O'Brien PC, Fleming TR. A multiple testing procedure for clinical trials. *Biometrics*. 1979;35:549-556.

**15.** Lee ET. *Statistical Methods for Survival Data Analysis*. 2nd ed. New York, NY: John Wiley & Sons Inc; 1992.

**16.** Hochberg Y, Tamhane AC. *Multiple Comparison Procedures*. New York, NY: John Wiley & Sons; 1987.

**17.** Nyhus LM. Individualization of hernia repair: a new era. *Surgery*. 1993;114:1-2.

**18.** Malek S, Torella F, Edwards PR. Emergency repair of groin herniae: outcome and implications for elective surgery waiting times. *Int J Clin Pract*. 2004;58:207-209.

**19.** Lee YJ, Ellenberg JH, Hirtz DG, Nelson KB. Analysis of clinical trials by treatment actually received: is it really and option? *Stat Med*. 1991;10:1595-1605.



diovascular disease and have served as a consultant to several of the above-listed entities. None of these entities played any role whatsoever in the design, interpretation, or drafting of the manuscript.[1] I regret making this omission.

**Paul M Ridker, MD**
**pridker@partners.org**
**Brigham and Women's Hospital**
**Boston, Mass**

**Financial Disclosures:** Dr Ridker reports that he has received research funding and research support from the National Heart, Lung, and Blood Institute, the Doris Duke Charitable Foundation, the Leducq Foundation, the Donald W. Reynolds Foundation, the American Heart Association, the James and Polly Annenberg La Vea Charitable Trusts, AstraZeneca, Bayer, Bristol-Myers Squibb, Dade-Behring, Novartis, Pharmacia, Roche, Sanofi/Aventis, and Variagenics. Dr Ridker reports being listed as a coinventor on patents held by the Brigham and Women's Hospital that relate to the use of inflammatory biomarkers in cardiovascular disease and has served as a consultant to Schering-Plough, Sanofi/Aventis, AstraZeneca, Isis Pharmaceuticals, Dade-Behring, and Interleukin Genetics.

**1.** Ridker PM, Torres J. Reported outcomes in major cardiovascular clinical trials funded by for-profit and not-for-profit organizations: 2000-2005. *JAMA*. 2006;295:2270-2274.
**2.** Albert MA, Danielson E, Rifai N, Ridker PM. Effect of statin therapy on C-reactive protein levels: the Pravastatin Inflammation/CRP Evaluation (PRINCE): a randomized trial and cohort study. *JAMA*. 2001;286:64-70.
**3.** Ridker PM, Goldhaber SZ, Danielson E, et al. Long-term, low-intensity warfarin therapy for prevention of recurrent venous thromboembolism. *N Engl J Med*. 2003;348:1425-1434.
**4.** Ridker PM, Cook NR, Lee I-M, et al. A randomized trial of low-dose aspirin in the primary prevention of cardiovascular disease in women. *N Engl J Med*. 2005;352:1293-1304.
**5.** Lee I-M, Cook NR, Gaziano JM, et al. Vitamin E in the primary prevention of cardiovascular disease and cancer: the Women's Health Study: a randomized controlled trial. *JAMA*. 2005;294:56-65.

## CORRECTIONS

**Incorrect Data and Statement:** In the Editorial entitled "The Asymptomatic Hernia: 'If It's Not Broken, Don't Fix It' " published in the January 18, 2006, issue of *JAMA* (2006;295:328-329), there was incorrect reporting of data and an incorrect statement. In the sentence beginning "The risk of hernia incarceration was low. . . . " on page 328, the data point reported as 0.03% should have read 0.3%. Also, in the sentence beginning "In counseling patients with hernias. . . . " on page 329, the statement reading "older, male veterans in Veterans Administration medical centers" should have read "older men in community and academic medical centers."

**Incorrect Value:** In the Original Contribution entitled "Watchful Waiting vs Repair of Inguinal Hernia in Minimally Symptomatic Men: A Randomized Clinical Trial" published in the January 18, 2006, issue of *JAMA* (2006;295:285-292), a *P* value was incorrectly reported. On page 285, in the "Results" section of the Abstract, the value reported as *P*=.52 for pain limiting activities should instead have been reported as *P*=.06; the corresponding value should also have been reported as *P*=.06 in the first paragraph on page 289.

**Incomplete Financial Disclosure:** In the Original Contribution entitled "Reported Outcomes in Major Cardiovascular Clinical Trials Funded by For-Profit and Not-for-Profit Organizations: 2000-2005" published in the May 17, 2006, issue of *JAMA* (2006;295:2270-2274), financial disclosures were omitted. Dr Ridker reports that he has received research funding and research support from the National Heart, Lung, and Blood Institute, the Doris Duke Charitable Foundation, the Leducq Foundation, the Donald W. Reynolds Foundation, the American Heart Association, the James and Polly Annenberg La Vea Charitable Trusts, AstraZeneca, Bayer, Bristol-Myers Squibb, Dade-Behring, Novartis, Pharmacia, Roche, Sanofi/Aventis, and Variagenics. Dr Ridker reports being listed as a coinventor on patents held by the Brigham and Women's Hospital that relate to the use of inflammatory biomarkers in cardiovascular disease and has served as a consultant to Schering-Plough, Sanofi/Aventis, AstraZeneca, Isis Pharmaceuticals, Dade-Behring, and Interleukin Genetics. Mr Torres reported no financial disclosures.

**Errors in Tables:** In the Original Contribution entitled "Effect of Blood Presssure Lowering and Antihypertensive Drug Class on Progression of Hypertensive Kidney Disease: Results From the AASK Trial" published in the November 20, 2002, issue of *JAMA* (2002;288:2421-2431), there were errors in 2 tables. On pages 2424 and 2425, all rows labeled "mean (SE)" in Tables 1 and 2 should have been labeled "mean (SD)." On page 2425, there were small errors in Table 2 (relative % errors from 0%-1.7%); the corrected **Table 2** appears below. There are no errors in the text describing the tables or in the interpretation of the results.

**Table 2.** Antihypertensive Therapy and Blood Pressure During Follow-up*

| | Blood Pressure Goal Intervention | | Drug Intervention | | |
|---|---|---|---|---|---|
| | Lower | Usual | Ramipril | Amlodipine | Metoprolol |
| Arterial pressure, mean (SD), mm Hg† | 95 (8) | 104 (7) | 100 (9) | 99 (8) | 100 (9) |
| Systolic blood pressure, mean (SD), mm Hg† | 128 (12) | 141 (12) | 135 (15) | 133 (12) | 135 (13) |
| Diastolic blood pressure, mean (SD), mm Hg† | 78 (8) | 85 (7) | 82 (9) | 81 (8) | 81 (9) |
| Visits with mean arterial pressure in goal, %† | 51.6 | 39.2 | 44.1 | 49.0 | 44.7 |
| Visits with mean arterial pressure of <107 mm Hg, %† | 81.3 | 64.1 | 71.4 | 76.5 | 71.8 |
| Visits with systolic/diastolic blood pressure of <140/90, %† | 68.5 | 35.3 | 51.1 | 54.5 | 50.8 |
| Visits with systolic/diastolic blood pressure of <125/75,%† | 24.6 | 6.1 | 16.1 | 14.2 | 14.8 |
| Visits with assigned primary drug, %‡ | 82.7 | 80.9 | 78.0 | 84.7 | 84.1 |
| Visits with high dose, %‡ | 63.6 | 45.4 | 54.3 | 55.3 | 54.0 |
| Visits with crossover to 1 of other 2 classes, %‡ | 9.3 | 8.0 | 10.9 | 6.5 | 7.6 |
| Total No. of drug classes, mean (SD)‡ | 3.07 (1.11) | 2.42 (1.17) | 2.69 (1.21) | 2.69 (1.22) | 2.81 (1.15) |
| Visits with level 2 (furosemide), %‡ | 83.2 | 67.4 | 74.9 | 72.0 | 77.1 |
| Visits with level 3 (doxazosin), %‡ | 55.8 | 35.0 | 42.6 | 47.1 | 46.9 |
| Visits with level 4 (clonidine), %‡ | 41.0 | 27.5 | 35.0 | 34.6 | 33.2 |
| Visits with level 5 (minoxidil), %‡ | 35.4 | 22.9 | 27.8 | 24.4 | 32.5 |
| Protocol visits held, % | 90.3 | 87.4 | 88.0 | 88.6 | 89.8 |
| GFRs performed, % | 83.2 | 80.0 | 80.9 | 81.9 | 82.0 |

*GFR indicates glomerular filtration rate.
†Blood pressure summaries include visits after 3 months and exclude GFR visits.
‡Medication summaries include all visits starting at month 1 and are censored on September 22, 2000, for the calcium channel blocker (amlodipine) group only.