Active management of labor: a cost analysis of a randomized controlled trial

Rebecca G Rogers
Michael O Gardner
Kevin J Tool
Jeanne Ainsley
George Gilson

Department of Obstetrics and Gynecology
University of New Mexico Health Sciences Center
2211 Lomas Blvd, NE
Albuquerque, NM
87131

Correspondence to:
Dr Rogers
rrogers@obgyn.unm.edu

Competing interests:
None declared

West J Med
2000;172:240–243

ABSTRACT ● **Objective** To compare the costs of a protocol of active management of labor with those of traditional labor management. ● **Design** Cost analysis of a randomized controlled trial. ● **Methods** From August 1992 to April 1996, we randomly allocated 405 women whose infants were delivered at the University of New Mexico Health Sciences Center, Albuquerque, to an active management of labor protocol that had substantially reduced the duration of labor or a control protocol. We calculated the average cost for each delivery, using both actual costs and charges. ● **Results** The average cost for women assigned to the active management protocol was $2,480.79 compared with an average cost of $2,528.61 for women in the control group (P = 0.55). For women whose infant was delivered by cesarean section, the average cost was $4,771.54 for active management of labor and $4,468.89 for the control protocol (P = 0.16). Spontaneous vaginal deliveries cost an average of $27.00 more for actively managed patients compared with the cost for the control protocol. ● **Conclusions** The reduced duration of labor by active management did not translate into significant cost savings. Overall, an average cost saving of only $47.91, or 2%, was achieved for labors that were actively managed. This reduction in cost was due to a decrease in the rate of cesarean sections in women whose labor was actively managed and not to a decreased duration of labor.

Many obstetricians are concerned about the increase in the rate of cesarean sections in the United States. In 1970, the overall incidence of cesarean section was 5%.[1] By 1983, the rate had increased to 21%; it peaked at 24.7% in 1988[2,3] and remains greater than 20% of all deliveries.[4] Lowering the rate of cesarean delivery decreases maternal risk for associated morbidity and should, therefore, significantly decrease the costs of delivery.

The active management of labor, first introduced by O'Driscoll et al in the 1960s at the National Maternity Hospital in Dublin, Ireland,[5] is a group of interventions initially devised to ensure short labors in nulliparous women. In addition, active management of labor was noted to be associated with a lower cesarean section rate,[6,7] which was thought to be due to a decrease in the number of cesarean deliveries performed for dystocia. Three randomized studies have been done to evaluate the efficacy of active management of labor.[8-10] These studies have demonstrated significant decreases in the duration of labor and the incidence of infectious morbidity, as well as a trend toward lower cesarean section rates.

Rogers et al[10] reported their experience with a protocol of active management of labor at the University of New Mexico Health Sciences Center, Albuquerque. A randomized trial, carried out between August 1992 and April 1996, compared two protocols, one using an active management of labor and the other a standard management of labor. No significant differences between the patient populations, neonatal outcomes, the incidence of uterine hyperstimulation, the use of epidural analgesia, infectious morbidity, or cesarean delivery rates were observed. A significant reduction in the duration of labor and a trend toward fewer cesarean deliveries were observed in the group whose labor was actively managed. In the present study, we undertook to evaluate the differences in cost of the two protocols. We hypothesized that the reduction in the duration of labor for women whose labor was actively managed would translate to significant cost savings. This is a cost-minimization analysis of a prospective trial of a protocol of active management of labor.

PARTICIPANTS AND METHODS

The New Mexico active management of labor trial has been previously described in detail.[10] Briefly, nulliparous women (N=405) were randomly assigned to an active management of labor (n=200) or a control protocol. The active management protocol consisted of a strict diagnosis of labor based on regular palpable uterine contractions and a cervical effacement of at least 80%. The women were then admitted to the hospital for labor and delivery. Amniotomy was performed within 1 hour of admission, and a regimen of high-dose oxytocin was begun at 6 mU/min and increased 6 mU/min every 15 minutes until seven contractions in 15 minutes or adequate labor progress was obtained. Dilatation of 1 cm per hour during the first stage of labor and 1 cm of descent per hour during the second stage of labor defined adequate progress.

The control protocol consisted of admission to the hospital for labor and delivery with a cervical dilatation of 4 cm in the presence of regular uterine contractions. Amniotomy was performed at the attending physician's discretion. A regimen of low-dose oxytocin was begun at 1 mU/min and increased by 1 mU/min every 30 minutes until adequate labor was achieved.

Cost-minimization evaluations compare treatment strategies for patients whose treatment outcomes are similar, to reveal which treatment strategy, if any, results in decreased costs.[11,12] Although actual costs represent the best estimate of the true value of a service or procedure, they are often available only in the form of charges, which give a relative value to the service or procedure.[11] We assumed the perspective of a third-party payer and used charges as proxies for costs when actual costs were not available.[13] When possible, costs were used. For material costs, the actual cost of disposable equipment was used. The cost of disposable equipment used on the postpartum ward was determined for women following cesarean section, operative vaginal deliveries, and vaginal deliveries. For labor costs, the hourly cost to care for a woman was determined by dividing the average hourly wage of a labor and delivery nurse at our institution ($17.76/h) by the average number of patients assigned to each nurse. Likewise, the hourly cost to care for a patient on the postpartum ward was determined by dividing the average hourly wage of a postpartum nurse at our institution ($18.75/h) by the average number of patients assigned to each nurse. For cesarean sections, the hourly wage of an average scrub technician and neonatal nurse was also included. Wages are similar to charges and may not reflect the actual cost of supplying the provider to care for the patient. Because each arm of the study used the same providers, a relative comparison of charges between the two groups can be made.

To reflect the relative room costs, the hotel fee for the use of the labor and delivery and postpartum rooms per hour of use was calculated. The cost of the physician was included by using hospital fees for a vaginal delivery or cesarean section. Ancillary services such as laboratory costs and diagnostic services were not included because no differences in the postpartum complication rates of chorioamnionitis, hemorrhage, or fetal outcomes were found between the two arms of the study. For the cost analysis, the duration of labor and delivery was defined as the time of admission to the hospital until one hour after delivery. The duration of labor was defined as the time between the diagnosis of labor until delivery. Time spent on the postpartum ward was defined as one hour after delivery until discharge from the hospital, as recorded by the discharging nurse.

For statistical analysis, we used unpaired *t* tests for the comparison of means, the Fisher exact test, and χ^2 analysis where appropriate. Bivariate analysis of variance was used where subgroups were compared. Data were expressed as the mean±SD. Significance was set at $P < 0.05$. All costs are expressed as dollar values for 1996. Using our common SD of $529.00 for the costs, our sample sizes are able to detect $148.00 differences in average costs between the two protocols, with 80% power analysis and an α of 0.05.

RESULTS

Rogers et al[10] reported that the duration of labor in the group whose labor was actively managed was significantly shortened by 1.7 hours compared with that in a control group (active management, 9.7 hours, vs control group, 11.4 hours; $P = 0.001$). In addition, a trend toward a decreased cesarean section rate was observed in the actively managed group that was not statistically significant (active management, 7.5%, vs control group, 11.7%; $P = 0.36$). No difference was observed in the average duration of stay on the postpartum ward (active management, 35 hours, vs control group, 37 hours; $P = 0.10$). No differences were observed between the groups in age, gestational period, or ethnicity. Although the average dose of oxytocin was higher in the active management group than in the control group, there was no difference in the number of patients requiring augmentation of labor (active management, 56%, vs control group, 51%; $P = 0.39$), nor were differences noted between the two groups in the incidence of epidural analgesia, uterine hyperstimulation, or postpartum hemorrhage. Apgar scores, fetal weights, and admissions to the newborn intensive care unit were not significantly different.

The total cost for the care of each patient was calculated (table). The average cost for a woman randomly assigned to the active management of labor was $2,480.79, and the average cost for a woman allocated to the control group was $2,528.61 ($P = 0.55$). This amounts to an average saving of $47.82 per patient, or 2% of the average cost for women managed by the active management of labor protocol. For women whose infant was delivered by cesarean section, the average cost for the active management of labor was $4,771.54 compared with

Costs of labor by mode of delivery*

Method of delivery	Actively managed labor, $	Control, $	
Total deliveries	**(n = 200)**	**(n = 205)**	***P***
Materials	193.13 ± 83.21	136.21 ± 100.00	0.16
Labor	188.78 ± 86.00	185.42 ± 77.87	0.68
Fee	1,320.03 ± 245.90	1,352.95 ± 299.54	0.23
Hotel	848.86 ± 424.16	854.04 ± 377.88	0.90
Total	2,480.79 ± 765.85	2,528.61 ± 789.48	0.54
Vaginal deliveries	**(n = 185)**	**(n = 181)**	***P***
Materials	101.00 ± 30.6	102.00 ± 34.10	0.85
Fee	1,250.00 ± 0	1,250.00	>0
Hotel	769.06 ± 278.48	749.26 ± 234.72	0.47
Total	2,294.04 ± 350.83	2,267.00 ± 298.43	0.43
Cesarean deliveries	**(n = 15)**	**(n = 24)**	***P* Value**
Materials	394.60 ± 17.48	392.41 ± 17.82	0.71
Labor	370.17 ± 126.86	328.82 ± 72.12	0.20
Fee	2,179.00 ± 0	2,116.50 ± 3.06	0.44
Hotel	1,827.77 ± 648.32	1,631.17 ± 329.80	0.21
Total	4,771.54 ± 778.18	4,468.89 ± 550.96	0.16

*Values are given as mean ± SD US dollars for 1997. Total deliveries = vaginal deliveries plus cesarean deliveries in each column.

$4,468.89 for women in the control group ($P = 0.16$). The average cost for normal spontaneous vaginal deliveries in the active management of labor group was $2,294.04 compared with $2,267.00 in the control group ($P = 0.56$). We further calculated the respective costs of actively managed patients and control patients according to materials costs, labor costs, fees, hotel costs, and mode of delivery (table).

In a threshold sensitivity analysis, to reverse our finding of no significant difference in costs, the average total cost for all deliveries would have had to differ by $152.00 (rather than the nearly $48.00 difference observed).

DISCUSSION

In this study, we tried to determine if the decreased time in labor and the trend toward a decreased cesarean section rate with a protocol of active management of labor would translate into a significant cost savings. Actual hospital costs and hospital charges were used. Although actual costs are a better measure of the relative value of a service or procedure, they can be difficult to determine for hotel costs and the cost of the services of salaried personnel, such as physicians. This use of charges to make relative group comparisons has been done previously.[11] Hospital charges vary significantly from institution to institution, and they are frequently based solely on an admitting diagnosis or primary procedure, but they give an approximation of the relative cost of a patient's stay. As expected, hospital costs are lower than charges. For example, the charge for a patient on the labor and delivery ward at our institution is $841.00 for the first hour and $62.00 per hour for each additional hour, whereas the cost for nursing care on the labor and delivery ward is $8.88 per hour and the cost for disposable equipment for an average labor is $17.17, excluding the delivery. A limitation of using costs on a per-patient basis is that many costs associated with providing support personnel, equipment, and structural facilities are impossible to determine. Here we have further detailed our analysis of the relative contribution of costs of disposable materials, labor costs, physician fees, and hotel costs. None of the costs or charges used varied significantly between the two groups. Our power analysis revealed that with the number of patients in this study, we would be able to detect a difference in relative costs or charges between the two arms of the study of $148.00 or greater. Differences in cost of less than this may not be economically relevant because outcomes were similar.

One of the weaknesses of our study is the inability to include all the tenets of the active management of labor protocol as used by O'Driscoll et al,[5,6] specifically, the use of one-on-one labor attendants, or doulas. The use of a labor attendant reduces the risk of cesarean section and the need for pain medication and may translate into considerable cost savings.

The average cost for the care of actively managed patients was less than that for patients managed according to the standard protocol. This translates into a small cost saving of $47.82 for each patient whose labor was managed according to the active management of labor protocol. The active management of labor protocol was slightly more expensive when broken down by the mode of delivery. A cesarean delivery in an actively managed patient cost an average of $302.65 more than the cost of a cesarean section for control patients. Normal vaginal deliveries cost an average of $27.00 more than that for the control group. The overall cost savings in the active management of labor group must then be due to the reduction in the cesarean section rate rather than the shortened labor because the increased cost of deliveries in this group is offset by the decreased rate of cesarean sections. There is no clear explanation for the increased cost associated with deliveries in the actively managed group. Differences in costs between groups could not be attributed to the cost of oxytocin.

The decrease in costs, should a reduction in cesarean section rates remain consistent, would translate into substantial savings in patients needing multiple cesarean sections. For example, the average cost of a cesarean section was $4,771.54 for women whose labor was actively managed and $4,468.89 for women in the control group. With a cesarean section rate of 7.5% for actively managed women versus 11.7% for controls, and a rate of repeated cesarean section for patients who have had a primary cesarean section of about 40% at our institution, the savings in a reduction in the number of repeated cesarean sections would appreciate for subsequent pregnancies.

Although the previously confirmed decreased duration of labor for the group having active management did not translate into dramatic cost savings, the reduction in the duration of labor still may be clinically and economically important. The protocol for the active management of labor has consistently been a safe management plan for both infants and their mothers. It is reasonable to assume that many patients would consider a decrease in the duration of labor of 1.7 hours to be appreciable and desirable. With the safety and equivalent costs of the active management of labor protocol relative to a standard labor management protocol, women's preference should be studied to determine if widespread use of this labor strategy should be implemented.

References

1 Bottoms SF, Rosen MG, Sokol RJ. The increase in the cesarean birth rate. *N Engl J Med* 1980;302:559-563.

2 Rutkow IM. Obstetric and gynecologic operations in the United States, 1979 to 1984. *Obstet Gynecol* 1986;67:755-759.

3 Taffel SM, Placek PJ, Moien M. 1988 U.S. cesarean-section rate at 24.7 per 100 births: a plateau? [Letter] *N Engl J Med* 1990;323:199-200.

4 Clarke SC, Taffel S. Changes in cesarean delivery in the United States, 1988 and 1993. *Birth* 1995;22:63-67.
5 O'Driscoll K, Jackson RJA, Gallagher JT. Prevention of prolonged labour. *BMJ* 1969;2:477-480.
6 O'Driscoll K, Foley M, MacDonald D. Active management of labor as an alternative to cesarean section for dystocia. *Obstet Gynecol* 1984;63:485-490.
7 Taffel SM, Placek PJ, Liss T. Trends in the United States cesarean section rate and reasons for the 1980-85 rise. *Am J Public Health* 1987;77:955-959.
8 Lopez-Zeno JA, Peaceman AM, Adashek JA, et al. A controlled trial of a program for the active management of labor. *N Engl J Med* 1992;26:450-454.
9 Frigoletto FD Jr, Lieberman E, Lang JM, et al. A clinical trial of active management of labor [erratum published in *N Engl J Med* 1995;333:1163]. *N Engl J Med* 1995;333:745-750.
10 Rogers R, Gilson GJ, Miller AC, et al. Active management of labor: does it make a difference? *Am J Obstet Gynecol* 1997;177:599-605.
11 Gardner M. Cost analysis in obstetrics and gynecology. *Clin Obstet Gynecol* 1998;41:296-306.
12 Keeler EB. Decision analysis and cost-effectiveness analysis in women's health care. *Clin Obstet Gynecol* 1994;37:207-215.
13 Gardner M, Rouse DJ, Goldenberg RL, et al. Cost comparison of induction of labor versus expectant management in pregnancies lasting longer than 41 weeks. *Am J Managed Care* 1996;2:814-818.

COMMENTARY

The active management of labor: is it worth the cost?

In 1969, O'Driscoll and colleagues, in a seminal work published in the *BMJ*,[1] detailed the active management of labor to prevent primigravid patients from laboring more than 24 hours. Not until 1992 was a similar active-management protocol shown in a randomized trial to shorten labor.[2] Since that time, several randomized controlled trials have examined various components of active management and have shown reductions in the length of labor, with a trend toward fewer cesarean deliveries.[3,4] None of the studies found an increase in adverse outcomes with this approach.

Given this evidence, why has active management (as described by O'Driscoll and coworkers) not become the standard of care in the United States? First, the original protocol calls for one-to-one support by nurses of women in labor, something not routinely offered in US hospitals. Second, O'Driscoll and associates describe as a fundamental mistake the current common practice of admitting patients before they are truly in labor—a useful way to ensure adequate pain control for a primigravid woman with painful contractions but no cervical change, but perhaps a substantial impediment to reducing the high cesarean delivery rate. Financial incentives may also be misaligned in the current US health care system. That is, attending obstetricians may have little interest in shortening labor and decreasing the use of cesarean sections if, as a result, they must work harder or get paid less for their time.

The cost analysis by Rogers and colleagues of the active management of labor attempts to show whether a third-party payer would have incentive to adopt such an approach.[5] Cost analysis can play an important role in guiding the decisions of group health care providers, particularly decisions about two broad groups of interventions: those that improve health but increase cost, and those that worsen health but save money.[6]

Shortening labor and possibly reducing the rate of cesarean delivery rate would be considered by most to be improvements in health. Assuming that vaginal delivery is preferred over cesarean, and shorter labors are better than longer, then if active management saves money, or is neutral with regard to costs, it should be adopted. In general, we do not require interventions that improve health to save money. If an intervention costs money, then a cost-benefit analysis would be needed.

The analysis by Rogers and associates depends on the former case being satisfied because they do not attempt to weigh the health consequences of active management. They conclude that cost savings derived from active management are minimal, if they exist at all. This finding is less well grounded than it first appears because of the way the authors handle a common problem in cost analysis. Specifically, faced with the difficult task of estimating costs, they substitute charges and sum the two. Their rationale—that they are assuming the position of a third-party payer—does not fully justify this decision. An indemnity insurance plan would be interested only in charges; that the hospital may charge more than it costs to deliver some services and less than it costs to deliver others would not matter to them one bit. A closed-panel health maintenance organization, on the other hand, would care only about costs; indeed, "charges" may be a meaningless term in that setting.

Summing costs and charges has the effect of muddying the waters with regard to the worth of active management. Consider what would happen if the cost of disposable equipment and charges for labor and delivery (two items for which the authors estimated cost) dropped dramatically in the active-management arm, but the hospital charge was unchanged (as would be expected if obstetric services are charged by diagnosis and procedure, not time). The large drop in cost would be swamped by the lack of change in charges. Even if such a drop produced a significant fall in overall cost, a third-party payer could hardly be faulted for not caring. After all, the cost savings have gone to the hospital's bottom line.

Michael S Broder
Department of Obstetrics and Gynecology
UCLA School of Medicine, Los Angeles
RAND Health
1700 Main St
PO Box 2138
Santa Monica, CA
90401-2138

Correspondence to:
Dr Broder
mbroder@rand.org

Competing interests:
None declared

West J Med
2000;172:243–244