Study of the effect of using antihemorrhagic drugs and the use of intraarticular drain after arthroscopic anterior cruciate ligament reconstruction on the outcome of the procedure

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Background
Reconstruction of the anterior cruciate ligament (ACL) is crucial for maintenance of the stability of the knee. ACL reconstruction is a bloody operation owing to the formation of transosseous tunnels. Blood might obscure the view during surgery and may collect postoperatively to impair the range of movement and slow down the rate of rehabilitation. The use of intraarticular (IA) drains might be helpful in that issue; however, the risk of introduction of infection to the joint might be increased.
Hypothesis
The purpose of this study was to determine whether the use of IA drains are necessary for improving outcomes after arthroscopic ACL reconstruction and also whether the use of preoperative antihemorrhagic drugs might preclude the use of IA drains.
Patients and methods
A total of 60 adult patients (60 knees) with documented ACL injury were eligible for arthroscopically assisted ACL reconstruction. The patients were randomly divided into two groups, each consisting of 30 patients. Both groups had anatomical single-bundle ACL reconstruction using the transaccessory femoral portal approach. The ACL graft substitute was hamstring tendon autograft in 25 cases and quadriceps tendon autograft in five cases.
In the first group, an IA drain was fixed at the end of surgery, without preoperative antihemorrhagic drugs. The second group was given antihemorrhagic drugs IV (tranexamic acid 500 mg/5 ml, trade name Kapron) 1 h before surgery, and no drain was applied at the end of the operation. The patients were examined for the degree of knee swelling, pain as assessed by the visual analog scale, amount of blood collected, and range of movement. These parameters were reassessed after 2 weeks and at the end of the follow-up at 3 months postoperatively.
Results
Group 1 with the drain tended to have less pain and swelling in the immediate postoperative period, more wasting of the quadriceps at the end of follow-up, and comparatively lower mean range of motion (ROM) at the end of follow-up.
On the contrary, group 2 without drain tended to have more swelling in the immediate postoperative period, which decreased dramatically over time to be significantly lower than that in patients in group 1 at a comparable stage of follow-up. Only four patients developed significant hemarthrosis that needed aspiration with a wide-bore needle in group 2. The final mean ROM is significantly better in this group. The rate of infection tended to be lower in group 2 without a drain, but with no statistically significant results.
Conclusion
The use of IA drain after arthroscopic ACL reconstruction decreases pain and swelling in the immediate postoperative period. However, patients among group 2 despite having more pain and swelling in the immediate postoperative period recovered more rapidly and more effectively, having a comparatively better ROM and less wasting of the quadriceps at the end of follow-up. The rate of infection tended to be lower in group 2 without a drain, but with no statistically significant results.
The preoperative use of parenteral antihemorrhagic medication decreases the intraoperative bleeding and improves visualization during arthroscopic surgery; moreover, it may be beneficial in decreasing the postoperative hemarthrosis.

Keywords:
anterior cruciate ligament reconstruction, antihemorrhagic drugs, intraarticular drains

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Introduction and idea of the research

Reconstruction of the anterior cruciate ligament (ACL) is crucial for maintenance of the stability of the knee. ACL reconstruction is a bloody operation owing to the formation of transosseous tunnels. Blood might obscure the view during surgery and may collect postoperatively to impair the range of movement and slow down the rate of rehabilitation. The use of intraarticular (IA) drains might be helpful in that issue; however, the risk of introduction of infection to the joint might be increased [1,2].

Drains have long been used by many surgeons on the premise that hematoma collecting postoperatively might cause swelling and increased pain, consequently delaying rehabilitation and early start of the active range of movements. The latter seems to be critical after arthroscopic ACL reconstruction, especially that these patients are relatively young and usually go through these surgeries to improve their functional level and the level of their sports participation. The role of the drains has been debated in many studies, especially after arthroplasty, on the presumption that drains might increase the risk of infection. Meanwhile, the preoperative use of antihemorrhagic drugs might decrease the postoperative blood collection and preclude the use of IA drains. Only few research studies have studied the effect of using drains after arthroscopic procedures [3–6].

Therefore, this research studies the use of parenteral hemostatic drugs, which may preclude the use of the IA drain postoperatively and decrease the bleeding intraoperatively, thus making the view clearer during arthroscopic surgery. Moreover, the ability of the body to absorb the residual blood after surgery without any functional impairment was challenged in this study.

The purpose of this study was to determine whether the use of IA drains is necessary for improving outcomes after arthroscopic ACL reconstruction or not and also whether the use of preoperative antihemorrhagic drugs might preclude the use of IA drains.

Patients and methods

A total of 60 adult patients (60 knees) with documented ACL injury eligible for arthroscopically assisted ACL reconstruction were included. The study was approved by ethical committee of El Hadra University Hospital, Department of Orthopedic and Trauma Surgery, Faculty of Medicine, Alexandria University. All patients were operated upon in El Hadra University Hospital after they had signed an informed consent form. The patients were randomly divided into two groups, each consisting of 30 patients. Both groups had anatomical single-bundle ACL reconstruction using the transaccessory femoral portal approach. The ACL graft substitute was hamstring tendon autograft in 25 cases and quadriceps tendon autograft in five cases.

In the first group, an IA drain was fixed at the end of surgery, without preoperative antihemorrhagic drugs. The second group was given antihemorrhagic drugs IV (tranexamic acid 500 mg/5 ml, trade name Kapron; Amoun Pharmaceuticals, 1st Industrial Zone, Block 13015 El Obour City, Cairo, Egypt) 1 h before surgery and no drain was applied at the end of the operation (Fig. 1). After surgery, the patients were given the same schedule of postoperative analgesic medication according to the hospital policy to avoid bias during assessment of pain.

The patients were examined for the degree of knee swelling, pain as assessed by the visual analog scale, amount of blood collected, and range of movement. These parameters were reassessed after 2 weeks and at the end of the follow-up of 3 months postoperatively.

This is a double-blind prospective randomized clinical study whereby a closed envelope was delivered to the first author (M.A.) at the end of the surgery whether to

Figure 1

Anatomical ACL reconstruction using the hamstring tendon autograft through the transfemoral portal technique with no IA drain affixed after surgery. ACL, anterior cruciate ligament; IA, intraarticular.

use an IA drain or not. Fully informed consent was taken from the patient clarifying the presumed advantages and disadvantages of both options. All the patients were followed up in the OPD by a second surgeon. The patients were instructed not to reveal any data about whether a drain was used or not during their visits to the OPD.

Exclusion criteria:

The following were the exclusion criteria:

(1) Significant pain preoperative (narcotic dependent).
(2) Marked swelling (grade 3 or 4 effusion).
(3) Bleeding tendency or patients on anticoagulant therapy.
(4) Revision surgeries.
(5) Patients with associated meniscal or cartilage injuries.

Inclusion criteria:

(1) Patients undergoing primary ACL reconstruction having an isolated ACL injury were excluded.

Both groups were of comparable demographic data, with no statistically significant difference regarding the age and sex as well as the BMI. There was predominance of males in both groups. There was significantly longer duration since injury in group 2. The average tourniquet time was shorter in group 2, with a mean of 76.2±11.3 min, as compared with group 1, which was 81.7±14.7; however, the difference was not statistically significant. The ACL graft substitute was hamstring tendon autograft in 25 cases in both groups and five cases had quadriceps tendon autograft.

Statistical analysis

The data was collected and entered into the personal computer. Statistical analysis was done using the Statistical Package for the Social Sciences (SPSS, version 20) software (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

Arithmetic mean and SD were used. For categorical parameters, χ^2 test was used, whereas for numerical data, t test was used to compare the two groups. The level of significant was 0.05.

Results

The average amount of blood totally drained 24 h after surgery in the first group was 100.0±45.5 ml.

The intraoperative bleeding was significantly less among the second group patients and was controlled with regular pump pressure of 60 mmHg (Table 1). On the contrary, intraoperative bleeding was not controlled with regular pump pressure, and control of bleeding required increase of the pump pressure in ten out of 30 cases among the first group who did not receive antihemorrhagic drugs preoperatively.

None of our cases were complicated by wound dehiscence. There was no significant difference between the two groups regarding the infection rate. Four cases among group 1 developed mild superficial infection with only one case of deep infection requiring arthroscopic drainage and lavage with retention of the graft. In contrast, the second group had only one case that developed superficial wound infection.

The presence of hemarthrosis requiring drainage using a wide-bore needle was significantly more in the second group. This was done in four (13.4%) cases, whereas none of the cases in group 1 developed significant hemarthrosis.

The pain as assessed by the visual analog scale was significantly higher among the second group on the second postoperative day, with no significant difference in the pain level thereafter (Fig. 2).

Regarding swelling (degree of effusion), there were no significant differences between both groups on the second postoperative day. In the second postoperative week, the swelling tended to be more among the second group, with no statistical significance. However, in the eighth postoperative week, the swelling was significantly less in the second group (Fig. 3).

The range of movement recovered much better in the second group, to be significantly better in the second as well as the 12th week at the end of follow-up (Fig. 4). There was no significant difference between both groups regarding the weight-bearing ability.

The average mid-thigh circumference was significantly higher in the second group on the second postoperative day as well as in the 12th postoperative week, with no difference in between both (Fig. 5).

To summarize, group 1 with the drain tended to have less pain and swelling in the immediate postoperative period, more wasting of the quadriceps at the end of follow-up, and comparatively lower mean of the range of motion (ROM) at the end of follow-up.

Table 1 Comparison between the demographic as well as clinical variables between the two groups

Variables	Group 1 (with IA drain)	Group 2 (without IA drain)	*P*
Age	24.1±3.9	24.6±4.0	0.685
Sex [*n* (%)]			
Male	28 (93.3)	26 (86.7)	0.389
Female	2 (6.7)	4 (13.3)	
Duration since injury before reconstruction (months)	14.4±7.4	17.7±6.6	0.038
BMI (kg/m^2)	21.9±2.2	22.4±2.1	0.183
Tourniquet time (min)	81.7±14.7	76.2±11.3	0.06
Amount of blood in CC totally drained 24 h after surgery	100.0±45.5	NA	–
ACL graft substitute [*n* (%)]			
Hamstring tendon autograft	25 (83.3)	25(83.3)	1.00
Quadriceps tendon autograft	5(16.7)	5 (16.7)	
Intraoperative intraarticular bleeding [*n* (%)]			
Controlled with regular pump pressure of 60 mmHg	20 (66.7)	28 (93.3)	0.009
Uncontrolled (need to increase pressure)	10 (33.3)	2 (6.7)	
Synovitis [*n* (%)]			
Mild	20 (66.7)	22 (73.3)	0.861
Moderate	8 (26.7)	7 (23.3)	
Severe	2(6.7)	3 (10.0)	
Wound dehiscence	0	0	–
Infection [*n* (%)]			
None	25 (83.3)	29 (96.7)	0.212
Mild superficial	4 (13.3)	1 (3.3)	
Deep (require drainage and arthroscopic lavage)	1 (3.3)	0	
Need for emergency drainage of hemarthrosis [*n* (%)]			
Aspiration with a wide-bore needle	0	4 (13.3)	0.038
Need for salvage procedure (arthroscopic debridement with or without retention of the graft)	1 (3.3)	0 (0.0)	–

ACL, anterior cruciate ligament; IA, intraarticular.

On the contrary, group 2 without drain tended to have more swelling in the immediate postoperative period that decreased dramatically over time to be significantly lower than patients in group 1 at a comparable stage of follow-up. Only four patients developed significant hemarthrosis that needed aspiration with a wide-bore needle in group 2. The final mean ROM was significantly better in this group. The rate of infection tended to be lower in group 2 without a drain, with no statistically significant results (Table 2).

Discussion

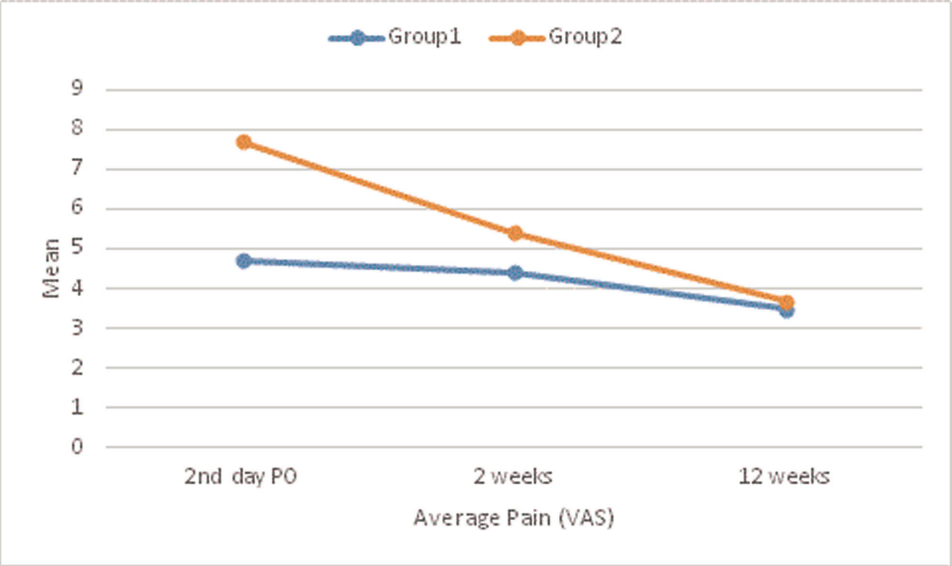
The most important finding of this study is that the historical belief that the regular use of an IA drain after arthroscopic ACL reconstruction would improve the functional outcome and decrease the rate of infection has been challenged [6–9].

Surgeons have long used drains routinely after arthroscopic ACL reconstruction on the premise that they would prevent blood collection postoperatively and hence, decrease pain and swelling resulting in faster rehabilitation and better functional outcome. Meanwhile, there was a lower rate of infection and wound complication. In this study, this concept has been challenged, as in spite of the fact that pain and swelling was less in group 1 with the IA drain in the immediate postoperative period, no statistically significant differences were detected thereafter. On the contrary, the swelling in group 2 decreased dramatically over time to be significantly lower than patients in group 1 at a comparable stage of follow-up. Moreover, the functional outcome seems to be better in group 2 with less wasting of the quadriceps and better range of movement than group 1 at a comparable stage of follow-up [10–12].

The results of this study challenge the routine use of drains after arthroscopic ACL reconstruction. This is consistent with other studies in joint arthroplasty and orthopedic trauma. To our knowledge and through review of literature, only few research studies dealt with this topic in arthroscopic surgery and none of them studied the effect of using antihemorrhagic drugs [3,5,8].

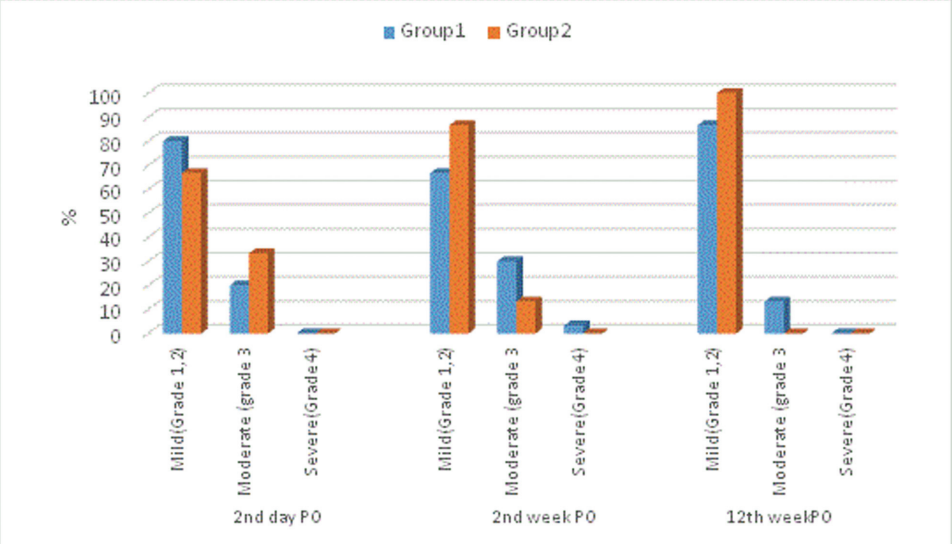
Moreover, contrary to the belief that using a drain might decrease the wound complication and the rate of infection, the latter tended to be lower in group 2

Figure 2



The pain as assessed by the VAS was significantly higher among the second group in the second postoperative day however no significant difference in the pain level thereafter. VAS, visual analog scale.

Figure 3



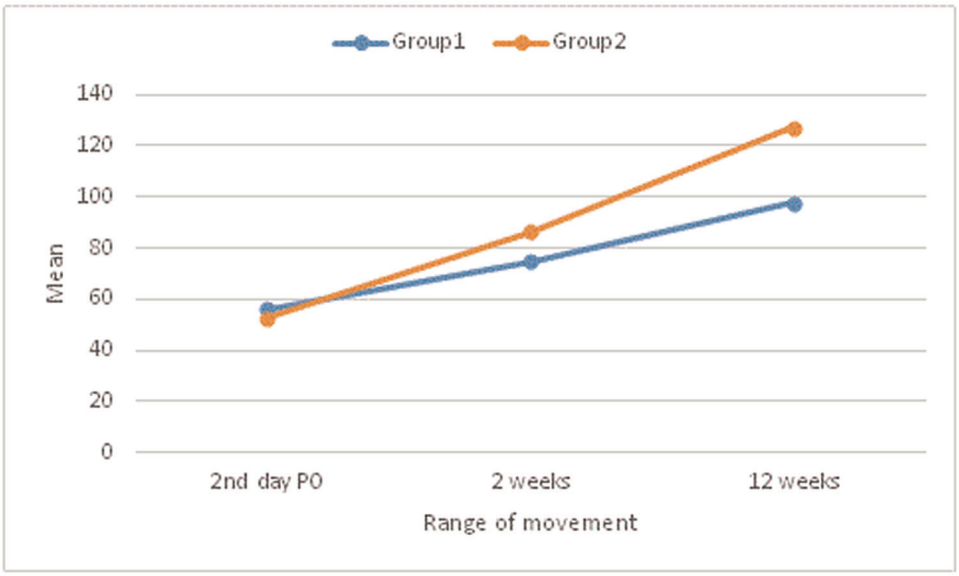
The swelling (effusion) which tended to be more in the second group only in the second postoperative week.

without a drain, with no statistically significant results. Thus, avoiding drains could eliminate potential complications of drain use such as retrograde infection and painful removal. Although retrograde infection is very uncommon, patients frequently complain of the pain associated with drain removal [11–13].

On the contrary, despite the fact that not using a drain would shorten the postoperative hospital stay, also obviate the need for a clinic visit on the first postoperative day, and avoid the cost of the drain, thus decreasing the burden on the health care provider, however, some of the cases without drain might develop hemarthrosis that require aspiration with a wide-bore needle under strict aseptic technique. Consequently, the benefit in this issue is debatable [13–16].

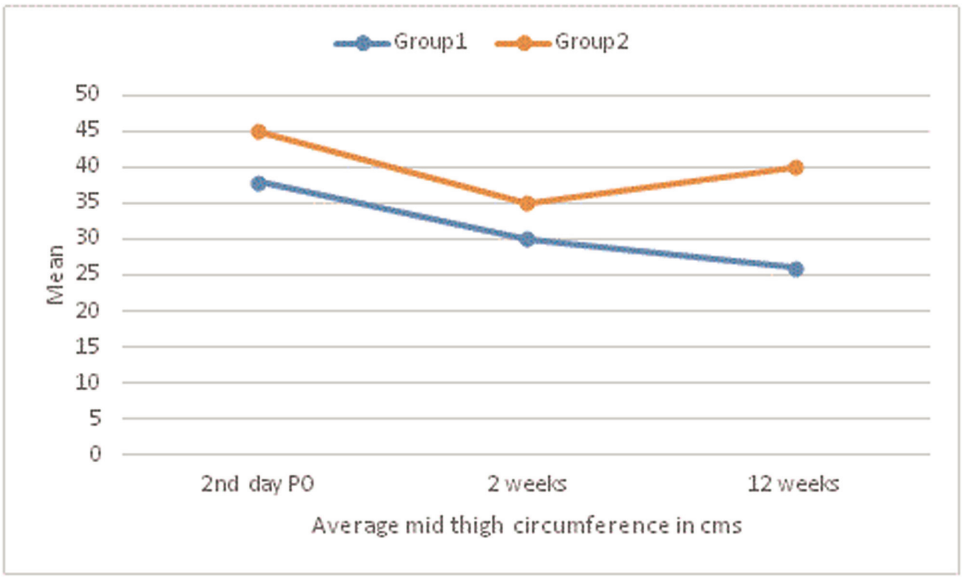
The preoperative use of antihemorrhagic drugs in the form of antifibrinolytic agents such as tranexamic acid (Kapron; 500 mg/5 ml) significantly decreased the intraoperative IA bleeding, allowing it to be controlled under regular pump pressure of 60

Figure 4



Significantly better recovery of the ROM in the second group. ROM, range of motion.

Figure 5



The average mid-thigh circumference was significantly higher in the second group in the second postoperative day as well as in the 12th postoperative week.

mmHg, thus permitting better arthroscopic visualization. The latter affects better perfection of the procedure and decreases the operation time, thus minimizing the rate of infection. This decrease of the intraoperative bleeding with the subsequent decrease of postoperative hemarthrosis might also encourage surgeons to stop using IA drains after ACL reconstruction [13,14].A potential limitation of this study is that it is not a fully double-blinded study. As preoperatively, only the patients did not know whether a drain will be fixed for them. At follow-up visits, they were instructed to not reveal their treatment group, in an effort to conceal the patients' group identity from the secondary surgeon who reviewed all the patients at follow-up.

The drawback of study is the relatively small number of cases. Consequently, it is recommended to repeat it on a larger scale, preferably on a multicenter base in order to reach to a solid conclusion whether to use an IA drain or not after ACL reconstruction.

Table 2 Comparison between the postoperative assessment parameters between both groups

Variables	Group 1 (with IA drain)	Group 2 (without IA drain)	*P*
Average pain (VAS)			
2nd day PO	4.7±1.1	7.7±0.8	0.001
2 weeks	4.4±0.5	5.4±0.6	0.068
12 weeks	3.5±0.5	3.7±0.7	0.331
Degree of swelling (effusion) [*n* (%)]			
2nd day PO			
Mild (grades 1 and 2)	24 (80)	20 (66.7)	
Moderate (grade 3)	6 (20)	10 (33.3)	0.241
Severe (grade 4)	0	0	
2nd week PO [*n* (%)]			
Mild (grades 1 and 2)	20 (66.7)	26 (86.7)	
Moderate (grade 3)	9 (30)	4 (13.3)	0.15
Severe (grade 4)	1 (3.3)	0	
12th week PO [*n* (%)]			
Mild (grades 1 and 2)	26 (86.7)	30 (100)	
Moderate (grade 3)	4 (13.3)	0	0.03
Severe (grade 4)	0	0	
Range of movement			
2nd day PO	56.3±12.5	52.7±6.4	0.103
2 weeks	74.7±15.9	86.3±5.6	0.031
12 weeks	97.7±13.8	127.3±5.8	0.001
Straight leg raising (positive cases) [*n* (%)]			
2nd day PO	28 (93.3)	26 (86.7)	0.112
2 weeks	27 (90.0)	29 (96.7)	0.311
12 weeks	4 (13.3)	30 (100.0)	0.0001
Weight bearing (positive cases) [*n* (%)]			
2nd day PO	28 (93.3)	30 (100)	0.411
2 weeks	27 (90.0)	30 (100)	0.231
12 weeks	28 (93.3)	30 (100)	0.411
Average mid-thigh circumference (cm)			
2nd day PO	38±3.02	45±4.1	0.013
2 weeks	30±2.98	35±3.82	0.116
12 weeks	26±3.01	40±3.69	0.001

IA, intraarticular; VAS, visual analog scale.

Conclusion

The use of IA drain after arthroscopic ACL reconstruction decreases pain and swelling in the immediate postoperative period. However, patients in group 2 despite having more pain and swelling in the immediate postoperative period recovered more rapidly and more effectively, having a comparatively better ROM and less wasting of the quadriceps at the end of follow-up. The rate of infection tended to be lower in group 2 without a drain, with no statistically significant results.

The preoperative use of parenteral antihemorrhagic medication decreases the intraoperative bleeding and improves visualization during arthroscopic surgery, and also may be beneficial in decreasing postoperative hemarthrosis.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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