Influence of pre-operative variables on length of stay and outcome after unicompartmental knee replacement

T Smith, A Cooper, C Darrah, M Glasgow, S Donell

Citation

T Smith, A Cooper, C Darrah, M Glasgow, S Donell. *Influence of pre-operative variables on length of stay and outcome after unicompartmental knee replacement*. The Internet Journal of Orthopedic Surgery. 2008 Volume 12 Number 1.

Abstract

The objective of this study was to determine whether pre-operative characteristics correlate with length of hospital stay or post-operative outcomes at 1 year following medial unicompartmental knee replacements (UKR). One hundred and eighty nine UKR patients and 223 knees were assessed pre-operatively and at one year post-operatively. The pre-operative variables of interest included: gender, age, body mass index (BMI), smoking history, uni- or bilateral procedures, pre-operative location, operative location, pre-operative Oxford Knee Score (OKS), clinical and functional American Knee Society Score (AKS) or Short Form-12 (SF-12). One year outcomes included the OKS, the clinical and functional AKS, SF-12, knee range of motion, and maximum and minimum visual analogue scale (VAS) pain scores, and length of hospital stay. Findings suggested that most pre-operative variables assessed correlated to maximum pain outcomes, and that the pre-operative clinical and functional AKS and SF-12 scores correlated with 1 year OKS and clinical AKS. Length of stay correlated with pre-operative OKS, SF-12, functional AKS, age and whether patients underwent uni- or bilateral procedures. Further study is recommended to compare these findings with alternative UKR populations.

INTRODUCTION

The medial unicompartmental knee replacement (UKR) initially presented with unfavourable post-operative results and corresponding high failure rates [1234]. However, with the refinement of surgical techniques and implant design, and with patient selection becoming more defined, UKR is presently regarded as a clinically successful procedure to improve function, reduce pain and provide excellent implant survival in patients with unicompartmental arthritis of the knee [5678910].

Previous literature has identified prognostic indicators for total knee replacements [1112131415 16]. These have identified variables such as age, gender, weight, smoking and level of activity, as important pre-operative factors on outcome. To our knowledge, only age and, as a secondary evaluation, body mass index (BMI) have been assessed as potential prognostic indicators for UKR populations [17 18 19]. These have been investigated using small samples, with the exception of Price et al's study [19]. Furthermore, although pre-operative functional level and degree of pre-operative angular deformity have been suggested as possible prognostic indicators [20 21 22 23], a review of the literature did not identify any studies to validate such statements.

In response to this, the purpose of this study was to determine whether gender, age, BMI, smoking history, uni- or bilateral procedures, pre-operative location, operative location, pre-operative Oxford Knee Score (OKS), clinical and functional American Knee Society Score (AKS), Short Form-12 (SF-12) correlate with length of stay or 1 year OKS, clinical AKS, SF-12, knee range of motion, and maximum and minimum visual analogue scale (VAS) pain scores, in a cohort of medial UKR patients. This is warranted, as we hypothesis that by identify demographic and pre-operative factors at the time of consultation, the surgeon may better able to predict the outcome of UKR.

PATIENTS AND METHODS

We retrospectively reviewed a prospective database of UKR surveillance. All UKRs were performed between the 1st January 2004 and 31st December 2006. Patients were considered for a UKR if they presented with: significant and functionally limiting pain related to medial compartment osteoarthritis; with no significant anterior or lateral pain; varus deformity less than 15°; fixed flexion deformity not greater than 10°; knee flexion of at least 110º under anaesthetic to allow access for preparation of the femoral condyle; correctable varus deformity; and an intact anterior and posterior cruciate ligaments and collateral ligaments.

Exclusion criteria included: evidence of medial or lateral subluxation or posterior tibial bone loss to strongly suggest damage to the cruciate mechanism; inflammatory arthritis; previous high tibial osteotomy with overcorrection; sepsis; tibial or femoral shaft deformity; lateral compartment or severe patellofemoral joint osteoarthritis.

In all cases the Oxford Phase 3 UKR (Biomet, Warsaw, USA) was used. The operations were performed by 10 different consultant orthopaedic surgeons. All performed a minimal access medial parapatellar approach, using a skin incision of 8 to 10 centimetres. Femoral and tibial tray components were cemented. Intra-operative flexion and extension testing was performed prior to wound closure. In addition, prior to closure, local anaesthetic was infiltrated into the knee. Either clips or dissolvable sutures were used for skin closure and covered with a gauge, wool and crepe dressing.

All patients were prescribed paracetomol and codeine, and, if required diclofenac or oramorph in severe pain. Venous thromboprophylaxis involved intra-operative calf stimulation and early mobilisation. Low molecular weight heparin was only used in patients with risk factors for venous thromboembolism. Patients began mobilising and knee exercises after two hours post-operatively, supervised by physiotherapists. The aim was to discharge patients on the first post-operatively day.

Data was collected pre-operatively by Consultant Orthopaedic teams and the institute's UKR Review programme. Pre-operatively, data collected included: gender, age, BMI, smoking history, uni- or bilateral procedures, pre-operative location (either Orthopaedics surgeon clinic or Specialist nurse and physiotherapist clinics), operative location (either National Health Service acute hospital or Independent hospital), pre-operative OKS, clinical and functional AKS and SF-12. At 1 year, data was collected by the institute's UKR review programme. Data collected included: length of hospital stay, OKS, the clinical AKS, SF-12, knee range of motion, and maximum and minimum VAS pain scores.

Since the data collected was retrospectively analysed as part of an ongoing hospital audit, ethical approval was not sought.

ANALYSIS

The data's distribution was assessed by analysing histogram results. These suggested that the length of stay and 1 year outcome measurements were not normally distributed, therefore, non-parametric statistical analysis would be more appropriate.

The primary analysis was a correlation between age and hospital length of stay as assessed using the Spearman's rank correlation coefficient. For interval and ordinal data, was assessed for the existence of a relationship between age, BMI, pre-operative OKS, clinical and functional AKS and SF-12 with length of stay and one year outcome measures, using the Spearman's rank correlation coefficient [$_{24}$]. A Mann-Whitney test was used to assess for a difference between the genders, operative location, and smoking incidence, with length of stay and the 1 year outcomes which included: OKS, the clinical AKS, SF-12, knee range of motion, and maximum and minimum VAS pain scores. A Kruskal-Wallis test was performed to assess for differences between procedure type (uni-, bilateral, total knee replacement and UKR) and pre-operative location with length of stay and 1 year outcome scores.

Analysis was performed on Statistical Package for the Social Sciences (SPSS) 16.0 (SPSS Inc, Chicago, Illinois).

RESULTS

Two hundred and twenty three unicompartmental knee replacements were reviewed, including 34 bilateral procedures between 1st January 2004 and 31st December 2006 in two hospitals. The demographic details and length of stay and 1 year outcome data is presented (Table 1 to 4).

AGE

There was a statistically significant correlation between age and maximum VAS pain score where younger patients reported greater maximum VAS pain scores than older patients (p=0.02). There was no significant correlation between age and the other 1 year outcomes or length of stay.

GENDER

There was a significant difference between males and females for 1 year OKS (p=0.01), although with a median difference of 1 point. Although similar median and inter-quartile range values, there was a significant difference between genders for maximum VAS pain scores, where males reported greater pain than females (p=0.01). There was no statistically significant difference with gender for clinical AKS, SF-12 or knee range of motion measures at 1 year assessment.

Table 1: Demographic data

Pre-Ax – Pre-Assessment
Pre-op – Pre-operative
TKR – Total knee replacement

Table 2: Statistical analysis of pre-operative variables to length of stay and 1 year clinical outcomes.

Clin – Clinical
LOS – Length of stay
Max – maximum
Min – minimum
Pre-Ax – Pre-Assessment
Pre-op – Pre-operative
TKR – Total knee replacement
ROM – Range of motion

Table 3: Length of stay and 1 year outcomes

IQR – Inter-quartile range
ROM – Range of motion

Table 4: Nominal pre-operative data for length of stay and 1 year clinical outcome.

Clin – Clinical
IQR - Inter-quartile range
LOS – Length of stay
Max – maximum
Min – minimum
Pre-Ax – Pre-Assessment
Pre-op – Pre-operative
TKR – Total knee replacement
ROM – Range of motion

PROCEDURE

There was no statistically significant difference at 1 year for any outcome measure between those subjects who had unilateral, bilateral, or TKR and UKR procedures during the same operation. There was a difference in length of stay where bilateral procedures stayed longer in hospital than unilateral procedures ($p<0.001$).

BMI

There was a significant correlation between the groups for maximum and minimum VAS pain scores, where those who presented with a higher BMI reported higher VAS maximum and minimum scores ($p<0.01$; $p=0.04$). There was no statistical difference in 1 year outcomes or length of stay for the other outcome measures.

PRE-OPERATIVE OKS

There was only a relationship in pre-operative OKS for length of stay ($p<0.01$), 1 year clinical AKS ($p<0.01$) and VAS pain ($p<0.01$).

PRE-OPERATIVE CLINICAL AKS

There was no correlation between pre-operative AKS scores and 1 year outcome, except for clinical AKS ($p<0.01$), OKS ($p=0.01$) or maximum VAS pain ($p<0.01$).

PRE-OPERATIVE FUNCTIONAL AKS

There was a correlation between functional AKS and 1 year OKS ($p=0.02$), clinical AKS ($p=0.01$), length of stay ($p<0.01$) and maximum VAS pain scores ($p<0.01$). For the other outcomes, no statistically significant correlation was identified.

PRE-OPERATIVE SF-12

There was a correlation between pre-operative SF-12 and all 1 year outcomes except minimum VAS pain (Table 2). There was a correlation between pre-operative SF-12 and length of stay ($p<0.01$).

PRE-OPERATIVE LOCATION

There was no difference between the groups for pre-operative location for any outcome except that of maximum VAS pain scores ($p=0.05$). This suggested that those with greater VAS pain scores attended the UKR pre-assessment clinic, rather than a consultant led pre-assessment clinic.

OPERATIVE LOCATION

There was no difference in outcome between patients in a National Health Service (NHS) facility, compared to a private hospital. The exception to this was that those who underwent surgery in the NHS hospital reported significantly higher clinical AKS scores than those from the independent hospital ($p<0.01$).

SMOKING INCIDENCE

There was no difference between smoker and non-smokers for length of stay or any outcome measures at 1 year.

DISCUSSION

The objective of this study was to determine whether gender, age, BMI, smoking history, uni- or bilateral procedures, pre-operative location, operative location, pre-operative OKS, clinical and functional AKS or SF-12 scores correlated to length of stay or to post-operative outcomes at 1 year

following medial UKR. The findings of this study suggested that a number of pre-operative characteristics and assessment scores may be associated with 1 year outcomes and length of stay.

The results of this study indicated that patient's BMI influenced pain scores only. Kort et al [18] reported little correlation between outcome and BMI and noted that BMI only related to range of motion. There was no correlation between BMI pre-operatively and post-operative scores in total knee replacement populations in Benjamin et al's paper [25]. However, this finding was not observed in studies by Amin et al [11] or Franklin et al [26] which noted that in total knee replacement populations functional outcomes differed in those with a higher than lower BMI patients when assessed with functional measurements. With an aging population, a rapid rise in average body-weight and the prevalence of obesity [27], clinicians may encounter a greater proportion of morbidly obese patients requiring knee arthroplasty [11]. The findings of Amin et al's [11] total knee replacement study suggested that patients should be advised to lose weight pre-operatively as a prerequisite for surgery, in order to optimise post-operative range of motion. We did not assess the revision or complication rate of our cohort at 1 year. Further study may be indicated to assess whether BMI or patient weight was related to post-operative complications such as implant loosening, or technical difficulties. This may be of particular importance given Kort et al's [18] statement that obesity can cause technical difficulties in UKR.

Smoking was not shown to be associated with post-operative outcome for any outcome measure or length of stay in this study. This finding is contrary to Møller et al's [12] findings which suggested that smoking was the single most important risk factors for the development of post-operative complications in total knee replacements. Our cohort indicated that based on 1 year post-operative outcomes, smoking may not necessarily be an important factor when estimating outcome in UKR populations.

Gender was shown to be associated with 1 year OKS and maximum VAS pain scores in this UKR cohort. Such limited association between gender and 1 year results have been reported in total knee replacement data, to suggest that gender is not a prognostic indicator for post-operative outcomes [28]. Although the literature on total knee replacements has reported that post-operative pain may be greater for women, this was largely not reflected in UKR patients [29]. Similarly, there was no difference seen in length of stay between genders in this UKR cohort. This finding was comparable with Smith et al's [30] cohort of total knee replacement and Forrest et al's [14] hip and knee arthroplasty population. However, this result is contrary to that of Bozic et al [15], Liebergall et al [31], Vincent et al [32], Watkins et al [33] and Hayes et al's [34] findings, which suggested that hospital length of stay was greater for women compared to men, following joint arthroplasty surgery.

Age has been purported to be one of the most important factors in the decision-making process for UKR [35]. This case series suggested that with the exception of maximum VAS pain scores, there was no significant difference in 1 year outcomes for pre-operative assessments with age. This was in agreement with Price et al's [19] study for knee range of motion at 10 years following UKR. There was no correlation between age pre-operative and post-operative scores in total knee replacement populations [25]. Age was shown to correlate with length of stay. This was supported by previous hip and knee arthroplasty case series [1415303236]. Given that authors have suggested that the long-term survivorship of the Oxford UKR has given surgeons increased confidence to use this prosthesis in younger generations of patients [37], it is important that results such as this, suggesting that age does not influence outcome at 1 year is important. In total knee replacement populations, age seems to be associated with post-operative complications and implant rates which is not reflected in unicompartmental cases [16].

One year outcomes did not differ between those patients who underwent unilateral to bilateral procedures in this cohort. Similar results were noted by Sofat et al [38] who reported no significant difference between the type of procedure and post-operative OKS values. The only difference being that those who underwent unilateral procedures found it less difficult to kneel than those with bilateral procedures.

Rees et al [39] acknowledged that surgeon's experience of UKR had an important influence on post-operative outcome. This variable was not assessed in our study, and it is suggested that further assessment of this factor is evaluated with a longer follow-up period that Rees et al's [39] one year period, to determine whether revision rates are influenced by surgical experience.

Pre-operative location and operative location were not associated with length of stay or post-operative outcome;

with the exception of maximum VAS pain and clinical AKS values respectively. Similarly, the findings of this study suggested that pre-operative assessment of OKS, AKS, and most notably as Table 4 suggests, pre-operative SF-12 scores would be important variables to influence outcomes at 1 year. Further study is now required to compare whether these outcomes correlate to post-operative results in differing populations. This may be of particular note given that variations were noted between outcomes in total knee replacement cohorts when comparing patients from the United Kingdom, North America and Australia. Accordingly, an assessment of pre-operative data compared to post-operative outcomes may be warranted from additional countries to this UK population.

This paper presented some methodological limitations. Firstly, although the study followed patients for a minimum of one year, further evaluation is indicated to evaluate outcomes over a longer period in order to assess the effect of demographic variables on prosthesis wear and revision rates. It is our intention to re-evaluate this cohort at five years. Due to the retrospective nature of this case series, we did not assess our prognostic indicators against matched groups for each variable; this may have improved methodological rigor by controlling other variables to solely examine the effects of each variable on outcome. Further study is suggested to undertake such a design, to further develop the evidence-base on this topic. In addition, this study only assessed medial Oxford UKR. Further study is recommended to determine whether the findings of this study are transferable to patients following a lateral UKR, or other prosthesis designs such as to compare those of mobile or fixed bearings implants.

CONCLUSION

The findings of this study suggest that most pre-operative variables assessed correlated to maximum pain outcomes, and that the pre-operative clinical and functional AKS and SF-12 scores correlated with 1 year OKS and clinical AKS. Length of stay correlated with pre-operative OKS, SF-12, functional AKS, age and whether patients underwent uni- or bilateral procedures. Further study is recommended to evaluate this study's findings to UKR populations in differing centres using mobile and fixed implants and of different surgical and post-operative regimes.

ACKNOWLEDGEMENTS

Funds have been received by the department from Biomet to support the research physiotherapists involved in this study.

CORRESPONDENCE TO

Mr T O Smith Institute of Orthopaedics – Centre Block Norfolk and Norwich University Hospital Colney Lane Norwich Norfolk NR4 7UY Telephone Number 01603 286286 Email Address toby.smith@nnuh.nhs.uk

References

1. Naudie D, Guerin J, Parker DA, Bourne RB, Rorabeck CH. Medial unicompartmental knee arthroplasty with Miller-Galante prosthesis. J Bone Joint Surg 86-A: 1931-1935.
2. Ridgeway SR, McAuley JP, Ammeen DJ, Engh GA. The effect of alignment of the knee on the outcome of unicompartmental knee replacement. J Bone Joint Surg 2002; 84-B: 351-355.
3. Insall J, Aglietti P. A five to seven-year follow-up of unicondylar arthroplasty. J Bone Joint Surg 1980; 62-A: 1329-1337.
4. Laskin RS. Unicompartmental tibiofemoral resurfacing arthroplasty. J Bone Joint Surg 1978; 60-A: 182-185.
5. Steele RG, Hutabarat S, Evans RL, Ackroyd CE, Newman JH. Survivorship of the St Georg Sled medial unicompartmental knee replacement beyond ten years. J Bone Joint Surg 2006; 88-B: 1164-1168.
6. Argenson J, Benkeddache Y, Aubaniac J. Modern unicompartmental knee arthroplasty with cement. A three to ten-year follow-up study. J Bone Joint Surg; 84-A: 2235-2239.
7. Newman JH. UKR-time for caution? Knee 2004; 11: 337-339.
8. Newman JH, Ackroyd CE, Shah NA. Unicompartmental or total knee replacement: five year results of a prospective randomised control trial of 102 osteoarthritic knees with unicompartmental arthritis. J Bone Joint Surg 1998; 80-B: 862-865.
9. Murray DW, Goodfellow JW, O'Connor JJ. The Oxford medial compartmental arthroplasty: a ten year survival study. J Bone Joint Surg 1998; 80-B: 983-989.
10. Ansari S, Newman JH, Ackroyd CE. St Georg sledge for medial compartment knee replacement. Acta Orthop Scand 1997; 68: 430-434.
11. Amin AK, Clayton RAE, Patton JT, Gaston M, Cook RE, Brenkel IJ. Total knee replacement in morbidly obese patients. Results of a prospective, matched study. J Bone Joint Surg 2006; 88-B: 1321-1356.
12. Møller AM, Pedersen T, Villebro N, Munksgaard A. Effect of smoking on early complications after elective orthopaedic surgery. J Bone Joint Surg 2003; 85-B: 178-181.
13. Vazquez-Vela Johnson G, Worland RL, Keenan J, Norambuena N. Patient demographics as a predictor of the ten-year survival rate in primary total knee replacement. J Bone Joint Surg 2003; 85-B: 52-56.
14. Forrest G, Fuchs M, Gutierrez A, Girardy J. Factors affecting length of stay and need for rehabilitation after hip and knee arthroplasty. J Arthroplasty 1998; 13: 186-190.
15. Bozic KJ, Wagie A, Naessens JM, Berry DJ, Rubash HE. Predictors of discharge to an inpatients extended care facility after total hip or knee arthroplasty. J Arthroplasty 2006; 21: 151-156.
16. SooHoo NF, Lieberman JR, Ko CY, Zingmond DS. Factors predicting complication rates following total knee replacement. J Bone Joint Surg 2006; 88-A: 480-485.

17. Pennington DW, Swienckowski JJ, Lutes WB, Drake GN. Unicompartmental knee arthroplasty in patients sixty years of age or younger. J Bone Joint Surg 2003; 85-A: 1969-1973.
18. Kort NP, van Raay JJAM, van Horn JJ. The Oxford phase III unicompartmental knee replacement in patients less than 60 years of age. Knee Surg Sports Traumatol Arthroscopy 2007; 15: 356-360.
19. Price AJ, Dodd CAF, Svard UGC, Murray DW. Oxford medial unicompartmental knee arthroplasty in patients younger and older than 60 years of age. J Bone Joint Surg 2005; 87-B: 1488-1492.
20. Bert JM, Smith R. Failure of metal-backed unicompartmental arthroplasty. Knee 1997; 4: 41-48.
21. Stern SN, Becker MW, Insall JN. Unicondylar knee arthroplasty: an evaluation of selection criteria. Clin Orthop 1993; 286: 143-148.
22. Larsson SE, Larsson S, Lundkvisk S. Unicompartmental knee arthroplasty. Clin Orthop 1988; 232: 174-181.
23. Marmor L. Unicompartmental knee arthroplasty: ten- to 13-year follow-up study. Clin Orthop 1988; 226: 14-20.
24. Bland M. An introduction to medial statistics. 3rd ed. Oxford; Oxford University Press: 2006.
25. Benjamin J, Johnson R, Porter S. Knee scores change with length of follow-up after total knee arthroplasty. J Arthroplasty 2003; 18: 867-871.
26. Franklin PD, Li W, Ayers DC. The Chitranjan Ranawat Award: functional outcome after total knee replacement varies with patient attributes. Clin Orthop Relat Res 2008; 466: 2597-2604.
27. Bjorntorp P. Obesity. Lancet 1997; 350: 423-426.
28. Brander VA, Stulberg SD, Adams AD, Harden RN, Bruehl S, Stanos SP, Houle T. Predicting total knee replacement pain: a prospective, observational study. Clin Orthop Relat Res 2003; 416: 27-36.
29. Thomas T, Robinson C, Champion D, McKell M, Pell M. Prediction and assessment of the severity of post-operative pain and of satisfaction with management. Pain 1998; 75: 177-815
30. Smith IDM, Elton R, Ballantyne JA, Brenkel IJ. Pre-operative predictors of the length of hospital stay in total knee replacements. J Bone Joint Surg 2008; 90-B: 1435-1440.
31. Liebergall M, Soskolne V, Mattan Y, Feder N, Segal D, Spira S, Schneidman G, Stern Z, Israeli A. Preadmission screening of patients scheduled for hip and knee replacement: impact of length of stay. Clin Perform Qual Health Care 1999; 7: 17-22.
32. Vincent KR, Vincent HK, Lee LW, Alfano AP. Outcomes in total knee arthroplasty patients after inpatient rehabilitation: influence of age and gender. Am J Phys Med Rehabil 2006; 85: 482-489.
33. Watkins JR, Bryan S, Muris NM, Buxton MJ. Examining the influence of picture archiving communication systems and other factors upon the length of stay for patients with total hip and total knee replacements. Int J Technol Assess Health Care 1999; 15: 497-505.
34. Hayes JH, Cleary R, Gillespie WJ, Pinder IM, Sher JL. Are clinical and patient assessed outcomes affected by reducing length of hospital stay for total hip arthroplasty. J Arthroplasty 2000; 15: 448-452.
35. Barnes CL, Mesko JW, Teeny SM, York SC. Treatment of medial compartment arthritis of the knee. J Arthroplasty 2006; 21: 950-956.
36. Husted H, Holm G, Jacobsen S. Predictors of length of stay and patient satisfaction after hip and knee replacement surgery. Fast-track experience in 712 patients. Acta Orthopaedica 2008; 79: 168-173.
37. Fisher N, Agarwal M, Reuben SF, Johnson DS, Turner PG. Sporting and physical activity following Oxford medial unicompartmental knee arthroplasty. Knee 2006; 13: 296-300.
38. Sofat R, Ramkumar U, Wellsted D, Parmar H. Is there a difference between the ability to kneel after unilateral and bilateral total knee replacement? Acta Orthop Belg 2006; 72: 578-582.
39. Rees JL, Price AJ, Beard DJ, Dodd CAF, Murray DW. Minimally invasive Oxford unicompartmental knee arthroplasty: functional results at 1 year and the effect of surgical inexperience. Knee 2004; 11: 363-367.

Author Information

TO Smith, MSc BSc. (Hons) MCSP
Research Physiotherapist in Orthopaedics, Norfolk and Norwich University Hospital NHS Foundation Trust, Institute of Orthopaedics, Norfolk and Norwich University Hospital

A. Cooper, Dip HE RGN ONC
Orthopaedic Clinical Research Practitioner, Norfolk and Norwich University Hospital NHS Foundation Trust, Institute of Orthopaedics, Norfolk and Norwich University Hospital

C. Darrah, MSc RGN
Clinical Research Manager Orthopaedics, Norfolk and Norwich University Hospital NHS Foundation Trust, Institute of Orthopaedics, Norfolk and Norwich University Hospital

MM Glasgow, FRCS (Orth)
Consultant Orthopaedic Surgeon, Norfolk and Norwich University Hospital NHS Foundation Trust, Institute of Orthopaedics, Norfolk and Norwich University Hospital

ST Donell, FRCS (Orth) MD
Consultant Orthopaedic Surgeon, Norfolk and Norwich University Hospital NHS Foundation Trust, Institute of Orthopaedics, Norfolk and Norwich University Hospital