厚生労働科学研究費補助金
がん臨床研究事業

がん患者の医療機関受診に関する動態調査

平成 18 年度～20 年度　総合研究報告書

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Ⅰ．総合研究報告書

厚生労働科学研究費補助金（がん臨床研究事業）
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研究要旨　地域がん登録資料に基づき、がんの部位・進行度などの特性毎に、患者居住地と診断・治療医療機関・所在地との関連を分析し、地域における患者動態を明らかにすること、また、患者動態と生存率との関連についても分析し、がん医療水準の均てん化推進の基礎資料とすることが本研究の課題である。H18 年度には、主要 5 部位のがんについて、治療医療機関と治療件数、地域の全患者数に占める当該医療機関での治療数の割合、治療医療機関別5年生存率を算出し、地域において必要となるがん診療連携拠点病院の数や診療数について、都市部の代表として大阪、地方の代表として福井と山形を例に分析した。H19 年度には、検討するがんの部位を拡げるとともに、地域を 11 府県に拡大し、がんの部位・進行度などの特性毎に、患者の居住地と診断時の医療機関・所在地との関連、さらに、治療内容、治療医療機関・住所地との関連、死亡診断した医療機関とその所在地、死亡場所に関する分析を行った。H20 年度は、3 年間の研究結果を統合することにより、がん医療水準の均てん化推進の方向性とそれを実現した場合の成果を提示した。今後 10 年のうちに「受療が望ましい」医療機関に主治療を集中する、均てん化と死亡の間にタイムラグが 5 年存在する、などと仮定した場合の、10 年後の全がん死亡数に対する死亡減少割合を、地域がん登録に基づく信頼度の高い生存率集計が可能な 5 府県において試算した。その結果、全がん死亡数に対する死亡減少割合は、大阪で 2.9%と最も大きく、新潟が 1.7%と最も小さいことが示唆された。

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4)平成 19 年 4 月 1 日から平成 20 年 3 月 31 日

A. 研究目的

地域の実情を反映したがん医療の均てん化に資する取り組みを推進するため、地域における患者動態を地域がん登録に基づき分析し、患者動態と生存率との関連についても評価を行う。現在、がん医療水準の均てん化を推進するためにがん診療連携拠点病院の整備が進められているが、がん診療連携拠点病院の指定にあたっても、地域における患者動態を踏まえることが必要であり、本研究によりその為の基礎資料を得る。本研究は 3 年計画で実施する。H18 年度には、主要 5 部位のがんについて、既に認定を受けている拠点病院が、地域のがん医療の中で果たしている寄与度とその成果を、地域がん登録の先進 3 府県（大阪、山形，福井）において分析した。H19 年度は、検討するがんを主要 5 部位以外にも拡げるとともに、出来るだけ多くの地域がん登録に協力を求め（一定の精度基準をクリアする宮城、新潟、千葉、神奈川、愛知、広島、鳥取、長崎の各県がん登録）、地域における患者動態の特性を明らかにすることとした。H20 年度には、信頼度の高い予後調査を実施している地域（大阪、福井、山形、宮城、新潟、長崎）で、患者動態と 5 年生存率との関連について包括的な分析を行い、3 ヵ年の成果を統合することにより、がん医療水準の均てん化推進の方向性とそれを実現した場合の成果を説得力ある形で提示する。

以下に、3 ヵ年にわたる本研究の方法と成果を報告する。

B. 研究方法

地域がん登録では、届出患者について、原発部位や組織型、患者住所等の標準項目だけでなく、診断・治療を担当した医療機関とその所在地を登録している登録もある。また、診断から 5 年目の生死確認を住民票照会により実施するか、もしくは、人口動態死亡情報を得て、登録患者における

死亡を高い精度で把握し、5 年相対生存率を算定できる登録もある。分担研究者が所属する登録において、予め研究班で標準化した手順で受療動態に関する下記の集計を実施し、それを中央に集め、地域間で比較・検討した。

①最新の 2000－2002 年もしくは 2001-2003 年診断の新発届出患者（上皮内がん・大腸粘膜がん・進行度不明を除外）について、がんの部位・進行度などの特性毎に、患者の居住地と診断時の医療機関・所在地との関連、さらに、治療医療機関・住所地との関連を、2 次医療圏（一部、基本医療圏）を単位に完結している割合を算出する。

②全部位及び主要 5 部位（胃、大腸、肝臓、肺、乳腺）のがんについて、拠点病院による治療数を、医療圏別に算出するとともに、府県全体の新発届出罹患数に占める割合を進行度別に算出する。

③5 年後の予後調査が完了している 1994-98 年もしくは 1995-99 年診断の主要 5 部位の新発届出患者（上皮内がん・大腸粘膜がん・進行度不明を除外）を集計対象として、進行度別 5 年相対生存率を、拠点病院で治療を実施した例と府県全域について算出し、比較する。

④上記 5 部位のがんについて、府県全体の罹患数の内、拠点病院で治療を受けた患者割合と拠点と地域間の 5 年相対生存率格差の大きさとの関連を分析する。なお生存率については、進行度分布の違いに起因する見かけの差を除くため、各府県のがん患者の進行度分布をあてはめ、拠点病院で治療を受けた患者での生存率を直接法で調整する。

⑤13 部位（食道、胃、大腸、肝、胆嚢・胆管、膵、肺、乳腺、子宮、卵巣、前立腺、膀胱、リンパ腫）および小児がん（15 歳以下の全部位）について、施設別治療件数を治療件数の上位施設から累積し、施設数と累積治療件数との関連を分析する。これより累積治療件数が全体の 50%（75%）を超える施設数を数え、現在のがん診療連携拠点病院及び大学病院の位置づけ、さらに、50%（75%）の治療件数をカバーする施設での月平均治療件数を算出する。集計対象は 1999-2001 年もしくは 2000 - 2002 年診断の新発届出患者とする。

⑥同じく 13 部位について、施設別治療件数の 4 区分別、進行度＜限局・領域・遠隔＞別に 5 年相対生存率を算出するとともに、性・年齢・進行度調整後の治療件数 4 区分のハザード比を算出し、治療件数と 5 年生存率との関連を分析する。集計対象は、5 年後の予後調査が完了している 1994-98 年もしくは 1995-99 年診断の新発届出患者とする。

⑦前項の施設別治療件数と 5 年相対生存率との分析結果をもとに、生存率が低いカテゴリーの施設で治療を受けた患者が、全て生存率の高いカテゴリーの施設で治療を受けたと仮定し、がん患者の 5 年相対生存率の向上度と死亡数の減少度を、府県毎・部位毎に試算する。

（倫理面への配慮）

各研究者は、「疫学研究に関する個人情報ガイドライン」や各地域がん登録の「資料利用に関する取扱要領」等に従い、がん登録資料利用適否の審査を受け、承認を得た上で、当該地域がん登録の事業者から研究に必要なデータ提供を受け、解析を実施した。本研究でとりわけ問題となる事項は、医療機関の特定につながる可能性の高い点である。がん登録事業から提供を受ける情報には、患者並びに医療機関を特定する項目は含まれないが、市区町村情報は含まれており、従って、数の限定される医療機関については、特定される可能性もある。ただし、本研究では個別の医療機関のがん診療の質や量に関心があるわけではなく、2 次医療圏や市区町村毎のがん診療提供機能の実態に関心があるので、研究結果の公表においても個別の医療機関が特定されないように格別の配慮をする。

C. 研究成果

1) 患者の居住地と診療医療機関・所在地との関連

患者居住地と診断医療機関との関連の解析は大阪、神奈川、千葉、鳥取の 4 府県で可能であった。全がんの 2 次医療圏での完結割合は、大阪府で最小（65%）、鳥取県で最大（92%）であった。しかし 40%以下の医療圏もあった。主治療医療機関との関連は、大阪、神奈川、千葉、宮城、山形、新潟の 6 府県で解析が可能であった。大阪府で最小（63%）、山形県で最大（95%）となった。しかし完結割合が極端に小さい（2%、15%以下）2 次医療圏もあった。

患者居住地と治療医療機関所在地との関連を、主要 5 部位別に見ると、大阪府では、大腸の完結割合が最も高く（73%）、肺が最も低かった（56%）。性、年齢、進行度、治療内容、発見経緯による違いも観察された。

2) がん診療連携拠点病院での治療割合

拠点病院で主治療を受けた患者割合の分析は、大阪、千葉、愛知、宮城（手術例のみ）、山形、新潟、福井、鳥取、長崎の 9 府県で可能であった。全がんについての患者割合は、大阪府で最小（25%）、福井県で最大（70%）となった。愛知県と宮城県を除けば、拠点病院での治療割合は、がんの拡がりが早期の患者ほど高い傾向を認めた。なお、長崎での集計対象には、上皮内、進行度不明を含み、その為、拠点病院での治療実施割合が、各進行度別で高く、全病期で低い成績となった。

主要 5 部位別には、大阪府では、乳がんで最も高く（30%）、肺がんで最も低く（22%）なった。

3) 拠点病院で治療を受けた患者の生存率と地域全体との比較

主要 5 部位の進行度別 5 年相対生存率の解析が大阪、山形、福井、宮城（手術例のみ）、新潟、長崎の 6 府県において可能であった。地域により程度に差があるが、拠点病院群での生存率が概して良好で、その差は、胃・大腸では「領域」、肝・肺では「限局」「領域」、乳腺では「遠隔」で大きい傾向を認めた。大阪府では、他県と比べ、拠点病院と府県全体との格差が目立ち、府県単位での生存率も低い傾向を認めた。

次に、府県全体の罹患数の内、拠点病院で治療を受けた患者割合と拠点と地域間の生存率格差の大きさとの関連を、5 府県（大阪、山形、福井、新潟、長崎）の 5 大がんについて分析した。両者は負の関係にあるが必ずしも直線的ではなく、大腸、乳房では 40%程度（胃も大腸と同じ傾向）、肝、肺では 60%程度のカバー率があれば、拠点と地域全体との生存率格差がかなり縮小するという結果が得られた。

4) がん医療の均てん化・集中化

大阪、千葉、愛知、宮城（手術例のみ）、山形、新潟、福井の 7 府県において 13 部位毎に（大阪、福井、愛知、宮城、新潟の 5 県では小児全がんも）施設別治療件数を治療件数の上位施設から累積し、施設数と累積治療件数との関連を分析した。

例えば肺がんでは、大阪、千葉、愛知などの大人口県では、全患者の 50%を治療件数上位 6-7 施設がカバーしており、これら施設には大学・拠点病院以外も存在した。その他の中小人口県では、治療件数上位 2-3 施設が全体の 50%をカバーしていた。なお、これら各府県の肺がん治療件数上位施設の月間治療件数は 6.2（山形）から 15.6（大阪）に分布した。また、次に治療件数が多い施設（全体の 75%までカバーするのに要する次のカテゴリーの施設）の月間肺がん治療件数は、2.5（福井）から 5.1（新潟）に分布した。

わが国では、とりわけ大阪、千葉、愛知など大人口県で、治療施設の集中化が進んでいないこと、また大学・拠点病院以外にも治療実績の多い施設が存在することが示された。

5) 施設の治療件数と 5 年生存率との関連

大阪、山形、福井、新潟、長崎、宮城の 6 府県において、治療件数により施設を多・中・少・極少の 4 群に分け、治療件数と 5 年生存率との関連を 13 部位毎に分析した（ただし宮城では手術例に限定）。部位・地域により程度に差があるが、多件数施設を基準に性・年齢・進行度調整のハザード比を算出すると、概して治療件数の少ない施設で治療を実施した患者の死亡率が高い傾向を認めた。胃・大腸・乳がんでは、全患者の 75%の治療件数をカバーする多、中、少件数病院での調整ハザード比がほぼ 1.0 と有意差がなかったが、極少件数施設では有意に高値となった。肺がんでは、治療件数のカテゴリーとハザード比との間に負の相関が認められた。

これらの結果から、主要 5 部位でも月間治療件数の少ない施設で治療している患者が相当数存在し、がん医療の均てん化を達成する上で、集中化と連携を一層推進することが重要と思われた。

6) がん医療水準均てん化によるがん死亡減少度

宮城を除く 5 府県での上記の分析結果をもとに、全てのがん患者が「受療の望ましい」カテゴリーの医療機関で治療を受けたと仮定し、その場合にがん患者の 5 年相対生存率が何ポイント向上するか、また致命率が何%低下するかを、13 部位別に試算した。

大阪では、卵巣がん、悪性リンパ腫、福井、山形では前立腺がん、長崎では肝がんの生存率がいずれも 10 ポイント以上向上すると推測された。さらに、これらを基に、今後 10 年のうちに「受療が望ましい」医療機関に主治療を集中する、均てん化と死亡の間にタイムラグが 5 年存在する、などと仮定した場合の、10 年後の全がん死亡数に対する死亡減少割合を試算した。その結果、全がん死亡数に対する死亡減少割合は、大阪で 2.9%と最も大きく、新潟が 1.7%と最も小さくなった。

D. 考察

地域がん登録資料に基づき、がんの部位・進行度などの特性毎に、患者居住地と診断・治療医療機関・所在地との関連を分析し、地域における患者動態を明らかにすること、また、患者動態と生存率との関連についても分析し、がん医療水準の均てん化推進の基礎資料とすることが本研究の課題である。診断・治療施設に関する情報の持ち方、また、予後調査の精度などに違いがあり、その為、全地域で統一的な解析が必ずしも実施できなかったが、本研究により、地域におけるがん患者の受療の実態がかなり明確になり、今後の課題についての示唆が得られた。

患者居住地と診断医療機関との関連は 4 府県で解析した。また、主治療医療機関との関連は 6 府県で解析できた。各府県では、医療圏を単位とした患者動態を詳しく分析し得た。

拠点病院で主治療を受けた患者割合は 9 府県において分析可能で 25%～70%に分布した。この割合は大人口県で低かったが、その背景には、大人口県には拠点病院以外にもがん診療に実績のある施設が多いこと、一方中小人口県では、拠点病院以外では十分ながん治療を受けられない状況があるものと想定される。ただし、いずれにせよ、拠点病院がカバーする患者割合が、米国などの状況（米国外科学会が認証するがん診療認定施設によ

る治療割合が 80%に上る）と対比すれば、少ないことは確かである。また、拠点病院での治療割合は、がんの拡がりが早期の患者ほど高い傾向を認めた。本来、拠点病院は、より高度な専門性を要する患者の治療に集中するべきであるという考えからすれば、現状は課題が大きいといえる。主要 5 部位の進行度別 5 年相対生存率の解析が 6 府県において可能であった。拠点病院群での生存率が概して良好で、その差は、胃・大腸では「領域」、肝・肺では「限局」「領域」、乳腺では「遠隔」で大きい傾向を認めた。しかしその程度には地域差も存在した。

治療医療機関数と累積治療件数との関連を 7 府県において分析し、さらに、施設別治療件数と 5 年生存率の関連を 6 府県において分析した。その結果、わが国では概して治療施設の集中化が進んでいないこと、治療件数の少ない施設で治療を実施した患者の生存率が低い傾向にあることが示唆された。患者背景の差を考慮する必要があり、治療件数による生存率の違いを、直接技術集積性に帰することは出来ないが、限られた医療資源を効率よく活用するという観点からも、がん医療における機能分担を今後一層推進するべきと考えられた。

E. 結論

地域がん登録資料を用いて、がん患者の受療動態を明らかにするとともに、受療動態による 5 年生存率の差異について分析した。がんの種類や進行度、患者の性年齢、居住地による特徴を抽出し得た。がん医療水準の均てん化推進の方向性を示すと共に、均てん化が実現した場合の死亡率減少度を、がん種別、地域別に試算し得た。これらの研究成果は、地域のがん対策を効果的・効率的に実施する上で重要と考える。

F. 研究発表

1.論文発表

1) Tsutsui A, Ohno Y, Hara J, Ito Y, Tsukuma H. Trends of centralization of childhood cancer treatment between 1975 and 2002 in Osaka, Japan. Jpn J Clin Oncol 2009, 39(2): 127-31.
2) Suzumura S, Ioka A, Nakayama T, Tsukuma H, Oshima A, Ishikawa O. Hospital procedure volume and prognosis with respect to testicular cancer patients: a population-based study in Osaka Japan. Cancer Science 2008, 99: 2260-3.
3) Coleman MP, Quaresma M, Berrino F, Lutz J-M, De Angelis R, Capocaccia R, Baili P, Rachet B, Gatta G, Hakulinen T, Micheli A, Sant M, Weir HK, Elwood JM, Tsukuma H, Koifman S, Azevedo e Silva G, Francisci S, Santaquilani M, Verdecchia A, Storm HH, Young JL, CONCORD Working Group Cancer survival in five continents: a worldwode population-based study. Lancet Oncology 2008, 9(8): 730-56.
4) Tanaka H, Imai Y, Hiramatsu N, Ito Y, Imanaka K, Oshita M, Hijioka T, Katayama K, Yabuuchi I, Yoshihara H, Inoue A, Kato M, Takehara T, Tamura S, Kasahara A, Hayashi N, Tsukuma H. Declining Incidence of Hepatocellular Carcinoma in Osaka, Japan, from 1990 to 2003. Ann Int Med 2008, 148: 820-6.
5) Toyoda Y, Nakayama T, Ioka A, Tsukuma H. Trends in lung cancer incidence by histological type in Osaka, Japan. Jpn J Clin Oncol 2008, 38(8): 534-9.
6) Tabata N, Ohno Y, Matsui R, Sugiyama H, Ito Y, Tsukuma H, Oshima A. Partial cancer prevalence in Japan up to 2020: Estimates based on incidence and survival data from population-based cancer registries. Jpn J Clin Oncol 2008, 38(2): 146-57.
7) 津熊秀明、今岡真義. 地域がん登録の現状と将来展望. 日本医師会雑誌 2008, 137 (2): 302-7.
8) 津熊秀明、井岡亜希子. 胃癌の罹患率と死亡率の動向-日本と世界. 日本臨牀. 2008, 66 (5): 51-6.
9) 津熊秀明、井岡亜希子、飯石浩康、山崎秀男. 早期胃癌の自然史に関する前向き研究—胃癌診療への考察. 胃と腸. 2008, 43 (12): 1777-83.
10) 志岐直美、大野ゆう子、清水佐知子、伊藤ゆり、井岡亜希子、津熊秀明. がん医療均てん化指標としてのがん患者受療動態と地域別生存率に関する研究. IT ヘルスケア誌 2008, 3(1): 58-61.
11) 持丸祐子、大野ゆう子、沼先穂高、手島昭樹、JASTRO データベース委員会、伊藤ゆり、津熊秀明. がん拠点病院が備えるべき集学的治療環境指標の研究. IT ヘルスケア誌 2008, 3(1): 54-57.
12) 津熊秀明. がん患者の受療動態－地域がん登録による協同調査結果より－. JACR Monograph. 2009, 14: 12-18.
13) Saika K, Ohno Y, Tanaka H, Hasegawa T, Tsukuma H, Oshima A The trend of the effect of surgical volume up to 5 years after resection for stomach and lung cancer patients. Jpn J Applied IT Healthcare. 2007, 1: 42-49.
14) Ioka A, Tsukuma H, Ajiki W, Oshima A. Hospital procedure volume and survival of cancer patients in Osaka, Japan: a population-based study with latest cases. Jpn J Clin Oncol 2007, 37(7): 544-553.
15) Ito Y, Ohno Y, Rachet, Coleman MP, Tsukuma H, Oshima A. Cancer survival trends in Osaka, Japan: the influence of age and stage at

diagnosis. Jpn J Clin Oncol. 2007, 37(6): 452-8.
16) Matsuno RK, Anderson WF, Yamamoto S, Tsukuma H, Pfeiffer RM, Kobayashi K, Devesa SS, Levine PH. Early- and late-onset breast cancer types among women in the United States and Japan. Cancer Epidemiol Biomarkers Prev 2007, 16(7): 1437-42.
17) Tanaka H, Uera F, Tsukuma H, Ioka A, Oshima A. Distinctive change in male liver cancer incidence rate between the 1970s and 1990s in Japan: comparison with Japanese-American and US whites. Jpn J Clin Oncol 2007, 37(3): 193-6.
18) Tsukuma H, Ajiki W, Ioka A, Oshima A and Research Group of Population-Based Cancer Registries of Japan. Survival of Cancer Patients Diagnosed between 1993 and 1996: a Collaborative Study of Population-Based Cancer Registries in Japan. Jpn J Clin Oncol 2006, 36: 602-607.
19) Ueda K, Kawachi I, Tsukuma H. Cervical and corpus cancer survival disparities by socioeconomic status in a metropolitan area of Japan. Cancer Sci 2006, 97:283-291.
20) Nomura E, Tsukuma H, Ajiki W, Oshima A. Population-based study of the relationship between hospital surgical volume and 10-year survival of breast cancer patients in Osaka, Japan. Cancer Sci 2006, 97(7): 618-622.
21) Shibata A, Matsuda T, Ajiki W, Sobue T. Trend in incidence of adenocarcinoma of the esophagus in Japan, 1993-2001. Jpn J Clin Oncol. 2008, 38(7): 464-8.
22) 柴田亜希子. がん検診と地域がん登録.日本がん検診・診断学会誌. 2009, 16(3) 14-18.
23) 柴田亜希子、松田 徹. 地域がん登録を用いた県内がん患者の医療機関受診に関する動態調査－診断時住所の医療圏と主治療医療機関の所在医療圏の関連について－. JACR モノグラフ 2008, 13: 43-45.
24) Suzuki A, Kuriyama S, Kawai M, Amari M, Takeda M, Ishida T, Ohnuki K, Nishino Y, Tsuji I, Shibuya D, Ohuchi N. Age-specific interval breast cancers in Japan: estimation of the proper sensitivity of screening using a population-based cancer registry.Cancer Sci 2008, 99(11) 2264-7.
25) Naganuma T, Kuriyama S, Kakizaki M, Sone T, Nakaya N, Ohmori-Matsuda K, Nishino Y, Fukao A, Tsuji I. Coffee consumption and the risk of oral, pharyngeal, and esophageal cancers in Japan: the Miyagi Cohort Study. Am J Epidemiol 2008, 168(12): 1425-32.
26) 小定美香、佐々木真理子、西野善一. 宮城県におけるがん罹患者の受療動態について. JACR モノグラフ 2008, 13: 40-42.
27) 藤田 学, 木下 愛, 服部昌和. 福井県におけるがん患者受療動態について. JACR モノグラフ 2008, 13: 46-48.
28) 木下 愛, 服部昌和, 藤田 学. 福井県における子宮がんの動向について. JACR モノグラフ 2007, 12: 42.
29) 藤田 学, 服部昌和. 福井県におけるがん罹患と生存率の推移. JACR モノグラフ 2006, 11: 68-69.

2.学会発表

1) Ioka A, Tsukuma H, Oshima A. Hospital procedure volume and survival for cancer patients in Osaka, Japan. 29th Annual Meeting of the International Association of Cancer Registries. Ljubljana, Slovenia, (Poster session) 17-20 September 2007
2) Tsukuma H, Ioka A, Shibata A, Matsuda T, Fujita M, Hattori M. Proportion and survival of cancer patients treated in the designated regional cancer hospitals: three prefectures comparison. 29th Annual Meeting of the International Association of Cancer Registries. Ljubljana, Slovenia, (Poster session) 17-20 September 2007
3) Tsukuma H, Ioka A, Matsuda T, Shibata A, Fujita M, Hattori M. Proportion and survival of cancer patients treated in the designated regional cancer hospitals: 3 prefectures comparison. 66th Annual Meeting of the Japanese Cancer Association, Yokohama, (Poster session) 3-5 October 2007
4) Tsukuma H, Ioka A, Shibata A, Fujita M, Komatsubara H, Soda M. Factors for the lower survival of cancer patients in Osaka a collaborative study of population-based cancer registries. 67th Annual Meeting of the Japanese Cancer Association. Nagoya, Japan; p.502 (O-29)[口演] 2008.
5) 鈴村滋生、中山富雄、津熊秀明、大島明. 大阪府におけるセミノーマ患者の受療動態と予後について. 第 18 回日本疫学会学術総会、東京、2008 年 1 月. ポスター

G. 知的財産権の出願・登録状況

なし

Ⅱ．研究成果の刊行に関する一覧表

研究成果の刊行に関する一覧表

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Tsutsui A, Ohno Y, Hara J, Ito Y, Tsukuma H.	Trends of centralization of childhood cancer treatment between 1975 and 2002 in Osaka, Japan.	Jpn J Clin Oncol			2009
Suzumura S, Ioka A, Nakayama T, Tsukuma H, Oshima A, Ishikawa O.	Hospital procedure volume and prognosis with respect to testicular cancer patients: a population-based study in Osaka Japan.	Cancer Science	99	2260-3.	2008
Coleman MP, Quaresma M, Berrino F, Lutz J-M, De Angelis R, Capocaccia R, Baili P, Rachet B, Gatta G, Hakulinen T, Micheli A, Sant M, Weir HK, Elwood JM, Tsukuma H, Koifman S, Azevedo e Silva G, Francisci S, Santaquilani M, Verdecchia A, Storm HH, Young JL, CONCORD Working Group	Cancer survival in five continents: a worldwode population-based study.	Lancet Oncology	9(8)	730-56	2008
Tanaka H, Imai Y, Hiramatsu N, Ito Y, Imanaka K, Oshita M, Hijioka T, Katayama K, Yabuuchi I, Yoshihara H, Inoue A, Kato M, Takehara T, Tamura S, Kasahara A, Hayashi N, Tsukuma H.	Declining Incidence of Hepatocellular Carcinoma in Osaka, Japan, from 1990 to 2003.	Ann Int Med	148	820-826	2008
Toyoda Y, Nakayama T, Ioka A, Tsukuma H.	Trends in lung cancer incidence by histological type in Osaka, Japan.	Jpn J Clin Oncol	38(8)	534-9	2008

Tabata N, Ohno Y, Matsui R, Sugiyama H, Ito Y, Tsukuma H, Oshima A.	Partial cancer prevalence in Japan up to 2020: Estimates based on incidence and survival data from population-based cancer registries.	Jpn J Clin Oncol	38(2)	146-57	2008
津熊秀明、今岡真義.	地域がん登録の現状と将来展望.	日本医師会雑誌	137 (2)	302-307	2008
津熊秀明、井岡亜希子.	胃癌の罹患率と死亡率の動向-日本と世界.	日本臨牀.	66 (5)	51-56.	2008
津熊秀明、井岡亜希子、飯石浩康、山崎秀男.	早期胃癌の自然史に関する前向き研究—胃癌診療への考察.	胃と腸.	43 (12)	1777-83.	2008
志岐直美、大野ゆう子、清水佐知子、伊藤ゆり、井岡亜希子、津熊秀明.	がん医療均てん化指標としてのがん患者受療動態と地域別生存率に関する研究.	IT ヘルスケア誌	3(1)	58-61	2008
持丸祐子、大野ゆう子、沼先穂高、手島昭樹、JASTRO データベース委員会、伊藤ゆり、津熊秀明.	がん拠点病院が備えるべき集学的治療環境指標の研究.	IT ヘルスケア誌	3(1)	54-57	2008
津熊秀明.	がん患者の受療動態－地域がん登録による協同調査結果より－.	JACR Monograph.	14	12-18.	2009
Saika K, Ohno Y, Tanaka H, Hasegawa T, Tsukuma H, Oshima A	The trend of the effect of surgical volume up to 5 years after resection for stomach and lung cancer patients.	Jpn J Applied IT Healthcare.	1	42-49	2007
Ioka A, Tsukuma H, Ajiki W, Oshima A.	Hospital procedure volume and survival of cancer patients in Osaka, Japan: a population-based study with latest cases.	Jpn J Clin Oncol,	37(7)	544-553	2007
Ito Y, Ohno Y, Rachet, Coleman MP, Tsukuma H, Oshima A.	Cancer survival trends in Osaka, Japan: the influence of age and stage at diagnosis.	Jpn J Clin Oncol	37(6)	452-458	2007
Matsuno RK, Anderson WF, Yamamoto S, Tsukuma H, Pfeiffer RM, Kobayashi K, Devesa SS, Levine PH.	Early- and late-onset breast cancer types among women in the United States and Japan.	Cancer Epidemiol Biomarkers Prev	16(7)	1437-42	2007

Tanaka H, Uera F, Tsukuma H, Ioka A, Oshima A.	Distinctive change in male liver cancer incidence rate between the 1970s and 1990s in Japan: comparison with Japanese-American and US whites.	Jpn J Clin Oncol	37(3)	193-196.	2007
Tsukuma H, Ajiki W, Ioka A, Oshima A and Research Group of Population-Based Cancer Registries of Japan.	Survival of Cancer Patients Diagnosed between 1993 and 1996: a Collaborative Study of Population-Based Cancer Registries in Japan.	Jpn J Clin Oncol	36	602-607	2006
Ueda K, Kawachi I, Tsukuma H.	Cervical and corpus cancer survival disparities by socioeconomic status in a metropolitan area of Japan.	Cancer Sci	97	283-291	2006
Nomura E, Tsukuma H, Ajiki W, Oshima A.	Population-based study of the relationship between hospital surgical volume and 10-year survival of breast cancer patients in Osaka, Japan.	Cancer Sci	97(7)	618-622	2006
Shibata A, Matsuda T, Ajiki W, Sobue T.	Trend in incidence of adenocarcinoma of the esophagus in Japan, 1993-2001.	Jpn J Clin Oncol	38(7)	464-8.	2008
柴田亜希子.	がん検診と地域がん登録.	日本がん検診・診断学会誌.	16(3)	14-18	2009
柴田亜希子、松田　徹.	地域がん登録を用いた県内がん患者の医療機関受診に関する動態調査－診断時住所の医療圏と主治療医療機関の所在医療圏の関連について－.	JACR モノグラフ	13	43-45.	2008
Suzuki A, Kuriyama S, Kawai M, Amari M, Takeda M, Ishida T, Ohnuki K, Nishino Y, Tsuji I, Shibuya D, Ohuchi N.	Age-specific interval breast cancers in Japan: estimation of the proper sensitivity of screening using a population-based cancer registry.	Cancer Sci	99(11)	2264-7	2008.

Naganuma T, Kuriyama S, Kakizaki M, Sone T, Nakaya N, Ohmori-Matsuda K, Nishino Y, Fukao A, Tsuji I.	Coffee consumption and the risk of oral, pharyngeal, and esophageal cancers in Japan: the Miyagi Cohort Study.	Am J Epidemiol	168(12)	1425-32	2008.
藤田　学，服部昌和	福井県におけるがん罹患と生存率の推移	JACR Monograph	No.11	P68-P69	2006
木下　愛，服部昌和，藤田　学	福井県における子宮がんの動向について	JACR Monograph	No.12	P42	2007
藤田　学，服部昌和，木下　愛	福井県におけるがん患者受療動態について	JACR Monograph	No.13	P46-P47	2008

Ⅲ．研究成果の刊行物・別刷

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Epidemiology Note

Trends of Centralization of Childhood Cancer Treatment Between 1975 and 2002 in Osaka, Japan

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Objective: To analyze the tendency to centralize childhood cancer treatment among cancer treatment hospitals in Osaka, Japan over a 28-year period.
Methods: The subjects were patients under the age of 15, newly diagnosed with cancer in Osaka between 1975 and 2002 ($n = 4738$). They were categorized into three groups by the time diagnosed (1975–84, 1985–93 and 1994–2002). The International Classification of Childhood Cancer was used as the disease classification. The degree of centralization was examined using a Pareto analysis, the Gini coefficient and the annual average number of cases per hospital.
Results: During this period, the number of children with cancer in Osaka has decreased by nearly half, from 2.1 to 1.2 million and the number of hospitals treating childhood cancer decreased from 37 to 20. However, the Pareto curve and Gini coefficient were almost constant (0.747, 0.737, 0.756 in Gini coefficient for the three diagnosed periods). The annual average numbers of cases per hospital were much low and marginally increased from 5.6 during 1975–84 to 6.1 during 1994–2002 in the hospitals that treated 90% of all cancers.
Conclusions: The degree of centralization appeared to be almost constant from 1975 to 2002 regardless of the decrease in hospitals treating cancer patients.

Key words: childhood cancer – centralization – population-based cancer registry

INTRODUCTION

Recent studies have suggested that there is a relation between better survival and hospital procedure volume (1–3). There also seems to be a relation between childhood cancer patients under the age of 15 referred to specialist centers and better survival (4–5).

The incidence rates of childhood cancer are very low and almost the same worldwide, and were 154 per million for boys and 158 per million for girls in Osaka in 2004 (6). So, centralization is thought to be particularly important to attain better survival for rare childhood cancers (4–5).

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In fact, childhood cancer treatment has been centralized in the UK, Georgia and Germany (7–10), although the child and family are heavily burdened with ambulant treatment and hospital stays. For example, at 244 820 km^2 and with 11.1 million children in 2001, the UK has only 22 treatment centers, which have treated ~90% of newly diagnosed cases (~1350 cases per year in the early 2000s) (7–8). In Osaka with an area of 1898 km^2 and 1.3 million children in 1995, nine specific hospitals had treated ~70% of cases (~180 cases per year) during 1989–98 (11). This information suggests that childhood cancer treatment had been decentralized in Osaka (7–10).

The child population in Osaka has reduced by about half, from 2.1 million in 1975 to 1.2 million in 2005, because of a decreasing birth rate. According to this decline, the

number of childhood cancer patients and the annual treatment volume per hospital should also have decreased. On the other hand, childhood cancer treatment was supposed to have been centralized to specific hospitals in 1990s mainly because of following three factors. First, the number of medical lawsuits increased and this led doctors to refer patients that were difficult to diagnose to specialists (12). Second, multi-center cooperative studies began to conduct larger scale investigations into childhood cancer so that patients could be treated at specific hospitals (13). Third, two large and specialized hospitals for pediatric medicine were built and a university hospital relocated to Osaka in the early 1990s.

We investigated the trend of centralization of cancer patients to specific hospitals from 1975 to 2002 using the data from the population-based Osaka Cancer Registry (OCR).

PATIENTS AND METHOD

Data Sources

Osaka Prefecture is an area with 8.8 million people, and the population covered by the OCR was the largest in Japan till 2006. The proportion of death certificate only (DCO) cases was <2.9% for children under the age of 15 between 1981 and 89, and that of registered patients was estimated to be from 85 to 94% (14). We used this OCR as our source database.

Subjects

Our subjects were patients under the age of 15 and newly diagnosed with cancer between 1975 and 2002 (5291 cases). We then excluded carcinoma *in situ* (two cases), patients who had no information on a treatment (153 cases), those who did not specify both treating hospital code and diagnosing hospital code (three cases), and those that received treatment in other prefectures (417 cases). The final number of subjects for our study was 4738.

We needed to know the number of patients by treatment hospital in order to investigate the degree of centralization. For the analysis, we principally used the treating hospital code (3741 cases). The diagnosing hospital codes were used only when the patients had no information on the treating hospital (997 cases).

The patients were then divided into three period groups by the diagnosed year: 1975–84 (1976 cases), 1985–93 (1661 cases) and 1994–2002 (1101 cases). We then used these data to investigate the centralization tendency.

Classification of Childhood Cancer

Childhood cancer is histologically very diverse and some histological types occur in many different sites. Since 1996, the International Classification of Childhood Cancer (ICCC) has been used for international comparisons of statistical analyses (15). We used twelve diagnostic groups on the basis of ICCC in this research for our classification of childhood cancer.

Method

A Pareto analysis was used to investigate the centralization tendency for childhood cancer treatment. The process for the Pareto analysis was as follows.

A table was prepared to list the number of patients that each hospital treated, and the rows were arranged in descending order of the number of the patients. A column was added to this table that shows the cumulative percentage of the patients in descending order.

In order to find how many hospitals have treated childhood cancers, we counted up the cumulative frequency of hospitals when the cumulative percentage of patients was upper 50 and 75% and when it was 100% by year, diagnosed period and ICCC. We also plotted the Pareto curves with the cumulative percentage of hospitals and patients for the three diagnosed periods.

The Gini coefficient was also calculated as an index of the centralization of treatment for the three diagnosed period groups and the ICCC group. This is defined as follows (16):

$$\text{Gini} = \frac{1}{2n^2\bar{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j|$$

Graphically, the Gini coefficient covers twice the area between the Pareto curve and the line of equality. The Gini coefficient ranges between 0 and 1. A 'one' means all the patients were treated at one specific hospital.

Furthermore, the annual average number of cases per hospital was calculated and compared with those of European countries and the USA (8–10).

We used R version 2.4.0 for all the analysis in this study.

RESULTS

The number of children in Osaka during this 28-year period decreased to nearly half, from 2.1 to 1.2 million. That of the hospitals treating childhood cancer also decreased from 37 in 1975 to 20 in 2002, and in particular, decreased from 37 in 1993 to 32 in 1994. After 1993, the number of the newly diagnosed patients drastically decreased from 161 in 1993 to 107 in 2002.

Figure 1 shows the change in the Pareto curve and the Gini coefficient for all childhood cancer cases for the diagnosed period. The Gini coefficients were almost constant (0.747, 0.737, 0.756 for the three periods), and a weak centralization can be found during 1994–2002 when looking at the Pareto curve.

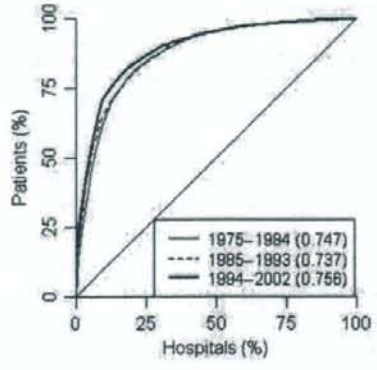

Figure 1. Pareto curve and Gini coefficient by diagnosed period. The Pareto curve shows a weak concentration between the periods of 1975–84 and 1994–2002; however, the Gini coefficient varied very little.

Table 1 shows each cumulative frequency of hospitals and the Gini coefficient by the ICCC and diagnosed period. Each cumulative frequency of hospitals slightly increased or was constant during 1975–84 and 1985–93, but reduced by about half during 1994–2002, except for the hospitals treating upper 50% of malignant bone tumors (VIII). The variations in Gini coefficient were small throughout all three periods. The Gini coefficients by the ICCC groups ranged from 0.275 to 0.665. The rarer the ICCC group was, the smaller the Gini coefficient was. In particular, the low level of centralization was shown for the rarely diagnosed groups: retinoblastoma (V), renal tumors (VI), hepatic tumors (VII), malignant bone tumors (VIII), carcinomas and other malignant epithelial neoplasms (XI) and other and unspecified malignant neoplasms (XII).

The annual average numbers of cases per hospital were less 2.2 in all hospitals during the three diagnosed periods (1975–84: 2.17, 1985–93: 2.15, 1994–2002: 2.18). In hospitals that treated upper 90% of all cancers, those were 5.6 during 1975–84, 5.5 during 1985–93 and 6.1 during 1994–2002. In the early 1990s, those were ~61.4 in the UK, ~60.9 in Georgia and ~32.4 in Germany (8–10). Even hospitals that treated upper 50% of all cancers, the annual average numbers of cases were 14.1 during 1975–84, 15.4 during 1985–93 and 20.4 during 1994–2002. Those were one-third the number compared with ~56.3 in Germany (10). In addition, during 1994–2002, for 10 out of 12 ICCC groups, the annual average number of cases per hospital was less than one person.

DISCUSSION

The trend of centralization of childhood cancer treatment was studied based on the population-based cancer registry in Osaka. Little was previously known about this trend. Our study is valuable because we used population-based data that had about an 85–94% registration rate for children, and we looked at the information for a 28-year period (14).

After 1993, each cumulative frequency of hospitals decreased to about half along with the number of newly diagnosed cancers, and the degree of centralization was almost constant during the three diagnosed periods. These results suggest that childhood cancers have continually been treated at many different hospitals, and the reduction in the number of cases also reduced each cumulative frequency of hospitals. From 1993 to 1994, each cumulative frequency of hospitals reduced approximately by one-third. Around 1993, three large hospitals completed or relocated, so this was supposed to have influenced the trend of hospitals that accessed childhood cancer.

The annual number of cases by the ICCC deserves attention in terms of absolute smallness (Table 1). Despite this smallness, patients were treated at many different hospitals. And the annual average number of cases per hospital has remained very small, which was much lower compared to that in the UK, Georgia and Germany. In addition, each diagnostic group includes many types of cancer and their different treatments. So, centralization to specific hospitals is necessary to improve survival.

Looking at the results, the rarer the ICCC group was, the smaller the Gini coefficient was. Of the types of cancer found in children, clinical trials have been mainly conducted on the more common tumors, such as leukemia (I) or lymphomas and reticuloendothelial neoplasms (II) (13,17). This would have helped to more centralize the more common types of childhood cancer. More influential reasons for doing this would be as follows. Patients were able to freely select and attend treatment hospitals in the Japanese medical system, although they did not usually have enough information on where were specialists. Of total 566 hospitals in Osaka, patients had to find an appropriate one under uncertainty and incomplete information (18). Regretfully, general practitioners had not strictly referred cancer patients to childhood cancer specialists.

From a statistical point of view, the Gini coefficient for a small sample is known to include a downward bias (19,20). The Gini coefficients of each category may have a downward bias, and look to lower centralization, particularly during 1994–2002. Each cumulative frequency of hospitals for sympathetic nervous system tumors (IV) was exceptional compared with those of the other diagnostic groups. This was due to the mass screening at 6 months of age for neuroblastoma (IVa) that was introduced in 1985 and had continued into the 2000s across Japan. As a result of overdiagnosis, the annual age-standardized incidence rate increased by about three times in children from the periods of 1970–84 to 1985–94 (21). Table 1 also shows the increase in the total number of cases of sympathetic nervous system tumors (IV). However, as <10 hospitals carried out mass screening in Osaka, each cumulative frequency of hospitals during 1985–93 is about equal to those during 1994–2002.

Table 1. Cumulative frequency of hospital, Gini coefficient, and number of cases by the International Classification of Childhood Cancer, and diagnosed period

	Diagnosed period	Cumulative frequency of hospitals			Gini coefficient	Annual no. of cases	Total no. of cases
		50%	75%	100%			
I Leukemia	1975–1984	8	17	63	0.619	57.3	573
	1985–1993	7	15	53	0.607	49.0	441
	1994–2002	4	8	36	0.631	37.1	334
II Lymphomas and reticuloendothelial neoplasms	1975–1984	7	16	48	0.524	18.3	183
	1985–1993	7	12	41	0.544	19.0	171
	1994–2002	4	9	26	0.487	11.6	104
III Central nervous system and miscellaneous intracranial and intraspinal neoplasms	1975–1984	5	11	43	0.642	40.9	409
	1985–1993	6	14	47	0.591	33.9	305
	1994–2002	4	10	33	0.564	19.2	173
IV Sympatheic nervous system tumors	1975–1984	4	8	24	0.552	11.9	119
	1985–1993	3	7	28	0.657	22.9	206
	1994–2002	1	3	15	0.665	17.8	160
V Retinoblastoma	1975–1984	2	4	8	0.431	7.6	76
	1985–1993	2	3	9	0.463	4.0	36
	1994–2002	1	2	5	0.357	3.9	35
VI Renal tumors	1975–1984	4	9	19	0.441	7.0	70
	1985–1993	5	11	25	0.451	7.1	64
	1994–2002	2	5	12	0.448	3.9	35
VII Hepatic tumors	1975–1984	4	7	16	0.404	4.1	41
	1985–1993	3	6	15	0.471	4.8	43
	1994–2002	2	4	9	0.370	2.6	23
VIII Malignant bone tumors	1975–1984	3	6	21	0.589	7.5	75
	1985–1993	3	7	23	0.575	8.6	77
	1994–2002	3	5	11	0.402	5.2	47
IX Soft-tissue sarcomas	1975–1984	6	14	34	0.484	9.7	97
	1985–1993	6	15	36	0.472	12.1	109
	1994–2002	3	6	19	0.518	8.1	73
X Germ-cell, trophoblastic and other gonadal neoplasms	1975–1984	7	17	44	0.505	13.9	139
	1985–1993	6	16	42	0.501	15.0	135
	1994–2002	4	10	23	0.413	7.1	64
XI Carcinomas and other malignant epithelial neoplasms	1975–1984	4	8	16	0.382	3.4	34
	1985–1993	5	10	16	0.275	3.0	27
	1994–2002	3	6	10	0.275	2.2	20
XII Other and unspecified malignant neoplasms	1975–1984	9	18	46	0.476	16.0	160
	1985–1993	5	12	23	0.383	5.2	47
	1994–2002	4	10	18	0.306	3.7	33
Total	1975–1984	7	15	91	0.747	197.6	1976
	1985–1993	6	15	86	0.737	184.6	1661
	1994–2002	3	8	56	0.756	122.3	1101

With the exception of neuroblastoma (IVa), the survival of many diagnostic groups in Osaka was lower than that in England and Wales and in the USA, and the report suggested that the reason for this was insufficient introduction and practice of chemotherapy (22). Our study suggested that the low centralization of patients is also related to the lower survival. Previous studies also suggested that the lower survival will also related to the treatment volume in the field of surgery or radiotherapy, although these subjects were adult cancers (23,24). Therefore, to centralize childhood cancer to specific hospitals and to perform a higher volume of procedures are important to ensure better survival. For the centralization of treatment, however, the burden children and their families must deal within their daily lives would increase. A social support system would be needed to achieve and maintain centralization.

In our study, although the identification of treating hospitals was the point, 997 cases did not have treating hospital codes so that the diagnosing hospital code was alternatively adopted. The bias derived from this substitution is assumed minor, because the proportion of cases that the diagnosing hospital code was same as the treating hospital one was 91.8% (3435 cases).

These data included newly diagnosed patients only, so that the specialists might feel that the small degree of centralization would not reflect the realization for childhood cancer treatment. Further study would be needed to investigate the centralization taking into account the succession of treatment.

We confirmed that the hospitals that treated childhood cancers decreased approximately by half during the 1990s, because childhood cancer decreased because of a lower birth rate. The degree of centralization seemed almost constant from 1975 to 2002. The annual average number of cases per hospital marginally increased, although it still was much lower compared with European countries and the USA.

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Conflict of interest statement

None declared.

References

1. Dickstein RJ, Barone JG, Liao JG, Burd RS. The effect of surgeon volume and hospital characteristics on in-hospital outcome after ureteral reimplantation in children. *Pediatr Surg Int* 2006;22:417–21.
2. Killeen SD, O'sullivan MJ, Coffey JC, Kirwan WO, Redmond HP. Provider volume and outcomes for oncological procedures. *Br J Surg* 2005;92:389–402.
3. Ioka A, Tsukuma H, Ajiki W, Oshima A. Hospital procedure volume and survival of cancer patients in Osaka, Japan: a population-based study with latest cases. *Jpn J Clin Oncol* 2007;37:544–53.
4. Stiller CA. Centralisation of treatment and survival rates for cancer. *Arch Dis Child* 1988;63:23–30.
5. Stiller CA, Draper GJ. Treatment centre size, entry to trials, and survival in acute lymphoblastic leukaemia. *Arch Dis Child* 1989;64:657–61.
6. Osaka Prefectural Department of Public Health and Welfare, Osaka Medical Association, Osaka Medical Centre for Cancer and Cardiovascular Diseases. Annual Report of Osaka Cancer Registry No. 71 - Cancer Incidence and Medical Care in Osaka in 2004 and the Survival in 2000: OPDPHW; 2008.
7. Children's Cancer and Leukaemia Group [homepage on the Internet]. Leicester: Children's cancer, Inc.; c2006-08 [cited 2008 Aug 27]. Available from: http://www.ukccsg.org/.
8. Ablett S, Pinkerton CR. Recruiting children into cancer trials–role of the United Kingdom Children's Cancer Study Group (UKCCSG). *Br J Cancer* 2003;88:1661–5.
9. Howell DL, Ward KC, Austin HD, Young JL, Woods WG. Access to pediatric cancer care by age, race, and diagnosis, and outcomes of cancer treatment in pediatric and adolescent patients in the state of Georgia. *J Clin Oncol* 2007;25:4610–5.
10. Kaatsch P, Spix C. German Childhood Cancer Registry, Annual Report 2003. Mainz: German Childhood Cancer Registry; 2004.
11. Ajiki W, Tsukuma H, Oshima A. Step toward the realization of a population-based national childhood cancer registry in Japan: recommendation from population-based cancer registry. *Jpn J Pediatr Oncol.* 2002;39:150–8. (in Japanese).
12. Kobayashi H. Risk-management in Pediatric wards. *Juntendo Med J* 2005;51:490–500. (in Japanese).
13. Makimoto A, Kawamoto H. Future strategy for developing childhood cancer treatment (Featuring article Recent outcomes and problems in childhood cancer). *Pediatr Jpn* 2005;46:1995–2002 (in Japanese).
14. Ajiki W, Hanai A, Tsukuma H, Fujimoto I, Oshima A, Parkin DM. International Incidence of childhood cancer, vol.II (IACR scientific publications; 144). Lyon, the International Agency for Research on Cancer 1998,189–91.
15. Kramárová E, Stiller CA. The international classification of childhood cancer. *Int J Cancer* 1996;68:759–65.
16. Gini C. Sulla misura della concentrazione e della variabilità dei caratteri. Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti, A.A. 1913–1914. 1914;73:1203–48.
17. Makimoto A. Infrastructure development for establishing the clinical trials for child solid tumors in Japan (Featuring article New treatment of solid tumors). *J Pediatr Pract* 2004;67:577–82. (in Japanese).
18. Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labor and Welfare. Survey of Medical Care Institutions 2002. Health, Labor and Welfare Statistics Association. Tokyo (Japan): Health, Labor and Welfare Statistics Association; 2004 (in Japanese).
19. Lerman RI, Yitzhaki S. Improving the accuracy of estimates of Gini coefficients. *J Econ* 1989;42:43–7.
20. George D. The small-sample bias of the Gini coefficient: results and implications for empirical research. *Rev Econ Stat* 2003;85: 226–34.
21. Ajiki W, Tsukuma H, Oshima A, Kawa K. Effects of mass screening for neuroblastoma on incidence, mortality, and survival rates in Osaka, Japan. *Cancer Causes Control* 1998;9:631–6.
22. Ajiki W, Tsukuma H, Oshima A. Survival rates of childhood cancer patients in Osaka, Japan. *Jpn J Clin Oncol* 2004;34:50–4.
23. Tanisada K, Teshima T, Ohno Y, Inoue T, Abe M, Ikeda H, et al. Patterns of Care Study quantitative evaluation of the quality of radiotherapy in Japan. *Cancer* 2002;95:164–71.
24. Saika K, Ohno Y, Tanaka H, Hasegawa T, Tsukuma H, Oshima A. The trend of the effect of surgical volume for stomach and lung cancer patients. *Jpn J Appl IT Healthc* 2007;1:42–9.

Hospital procedure volume and prognosis with respect to testicular cancer patients: a population-based study in Osaka, Japan

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Establishment of gold-standard chemotherapy and the subsequent development of salvage therapy have much improved the prognosis of patients with testicular germ cell cancer. However, not all patients with this disease get the best possible outcome in Osaka, Japan. A population-based study of testicular cancer cases diagnosed during 1993–1999 was performed using the Osaka Cancer Registry database to verify changes in prognosis and to examine their relationship with hospital procedure volume. Patients' referrals to hospitals during 1990–2001 were also examined to evaluate the degree of centralization. The 5-year relative survival rate of testicular cancer as well as testicular germ cell cancer in Osaka during 1993–1999 was markedly improved compared with that of previous periods (1975–1992); but remained lower than those reported in the EUROCARE-4 and Surveillance Epidemiology and End Results program. There appeared to be a significant association between survival and hospital procedure volume, even with adjustment made for clinical stage, age and histology. Centralization of referrals had not progressed during the past 12 years. In conclusion, the prognosis of testicular cancer in Osaka has improved remarkably, but nevertheless has remained lower than in the EU and/or the USA. Little progress has been made in centralization of hospital referrals. (*Cancer Sci* 2008; 99: 2260–2263)

Since the introduction of cisplatin-containing chemotherapy in the late 1970s, the standard chemotherapy protocol of cisplatin, etoposide and bleomycin has markedly improved the prognosis of testicular germ-cell cancer (TGCC).[1] Furthermore, subsequently developed salvage chemotherapy regimens, salvage surgery, highly stereotactic radiation therapy and progress in diagnostic modalities have further improved survival even with advanced-stage cancer and/or distant metastasis.[2–4] TGCC is known worldwide as a curable malignancy and with the medical progress described above, we would have expected to see equivalent prognostic improvements in Osaka, Japan. However, the 5-year prognoses of patients in Osaka diagnosed with testicular cancer (TC) were worse than those from the Surveillance Epidemiology and End Results (SEER) program,[5] possibly because of insufficient diffusion of the standard chemotherapy to smaller hospitals.[6] Following this previous report from the years 1975–1992, we have further updated the observation period of survival, analyzed the association between hospital procedure volume and survival and evaluated the centralization of patients' hospital referral using the Osaka Cancer Registry (OCR) database.

Materials and Methods

Data sources. Subjects with TC (ICD10, C62) were retrieved from the OCR database. The subjects included for survival analysis were reported cases diagnosed during 1993–1999, as the latest 5-year follow-up data in the OCR were cases diagnosed by 1999. Subjects with second primary testicular tumors were excluded from survival analysis as in the EUROCARE study.[7] Subjects included for evaluation of referral trend were diagnosed during 1990–2001.

Histological classification. TC was categorized as being of germ cell origin (TGCC, International Classification of Disease for Oncology in Morphology (ICD-O-M): seminoma 9060–9102, non-seminoma 9070–9073, 9080–9085, 9102, 9100–9101), non-germ cell origin or not otherwise specified (NOS, ICD-O-M: 8000–8004) according to histology. We focused on TGCC as well as TC to consider the possible distortion raised by NOS cases.

Categorization for hospital procedure volume and patients' hospital referral period. To evaluate the survival difference between hospitals, hospitals were categorized into three groups (A, B and C) according to patient procedure volume, in other words the number of patients treated. The three groups contained almost the same numbers of patients. To evaluate the hospital referral trend, the 12 years of 1990–2001, including the survival study period of 1993–1999, was divided into three consecutive 4-year periods.

Relative survival. The Kaplan–Meier method was used for calculating survival and the 95% confidence interval. The starting point of survival time was defined as the date of the first diagnosis and the end-point was death from any cause. The closing date was defined as 5 years after the starting point. Cases lost to follow-up were censored at the latest date when they were confirmed as being alive. The expected survival was estimated by the Ederer II method,[8] using the survival probability in the general population similar to the subjects with respect to sex, age and calendar year. A survival probability table prepared by the National Cancer Center,[9] was used. Relative survival was calculated as the ratio of observed to expected survival.

Hazard ratio. Prognostic factors of TGCC were analyzed using the Cox proportional hazards model. Independent variables were the hospital groups, clinical stage (distant/localized and regional), histology (non-seminoma/seminoma) and age. Clinical stage was defined as follows:

(1) localized: cancer confined to the original organ;
(2) regional: cancer spread to regional lymph nodes and/or immediately adjacent tissues;
(3) distant: cancer metastasis to distant tissues.

We evaluated the adjusted model adaptation using Akaike's Information Criterion.[10]

Hospital referral trends. The relative cumulative frequency curve (Lorenz curve[11]) between cases and hospitals was drawn inversely to evaluate the trend of hospital referrals. The curve of each consecutive 4-year period was evaluated for 'centralization' (trend

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