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Placental pathology measures: Can they be rapidly and reliably integrated into large-scale perinatal studies?

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ABSTRACT

Introduction: Normal placental function is critical to optimize fetal growth and development, but few perinatal studies incorporate placental measures. Our objectives were to link clinical placental pathology records to birth records, and validate an automated abstraction strategy.
Methods: Of the 47,329 deliveries at our hospital from 2008 to 2012, we retrieved electronic copies of pathology reports (n = 21,585, 45.4%). Pathology data were extracted with Extensible Markup Language (XML) script using Java and structured query language (SQL) transformed the text information into variables that were linked to delivery data. A subgroup of records was selected for a validation study that compared automated to manual abstraction (n = 144).
Results: Linked birth-placental records included 93% of all preterm (<37 weeks, n = 5108) and 37.1% of term births (n = 14,019). Over 90% of deliveries complicated by preeclampsia, chronic hypertension, or gestational diabetes included pathology data. The validation study indicated excellent agreement, sensitivity and specificity between the two abstraction strategies.
Discussion: We demonstrate a reliable approach to electronically integrate placental pathology and delivery data. These linked data provide a platform to identify risk factors and sequelae associated with placental lesions.

1. Introduction

Normal placental function is critical to optimize fetal growth and development. The placenta links the mother and fetus during pregnancy, facilitates exchange of nutrients, oxygen and waste, and is the site of synthesis and selective transport of hormones and neurotransmitters. Morphological and histopathological placental examinations have yielded insight regarding morbidity and mortality in the fetus and offspring, as recently reviewed [1]. Pathology results may also provide information relevant to the management of subsequent pregnancies and maternal health. Placentas are examined routinely, and guidelines for these examinations have been established [2,3]. Although large perinatal registries have provided tremendous insight regarding risk factors and consequences of adverse pregnancy outcomes, placental data are included in only a handful.

The National Collaborative Perinatal Project (CPP), a multicenter cohort of more than 50,000 women recruited during pregnancy in the U.S. from 1959 to 1976, is perhaps the largest study to date to systematically collect placental characteristics to understand fetal and child health. These placental data collected over 50 years ago continue to provide insight into pregnancy course [4–6]. Indeed, an empiric approach has been utilized recently to collapse 103 gross and microscopic placental measures from this landmark study into 23 to 38 informative features related to offspring health [7]. At least one hospital cohort [8,9] and three prospective pregnancy cohorts [10–14] have more recently incorporated placental pathology data into studies of stillbirth, preterm delivery, hypertensive disorders of

Abbreviations: CPP, national collaborative perinatal project; MOMI, magee obstetric medical and infant; XML, extensible markup language; SQL, structured query language; SSIS, SQL server integration services; CLR, common language runtime; BMI, body-mass index.

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pregnancy and growth restriction. Placental characteristics have also been linked to long term offspring chronic disease risk [15]. These studies have been limited to a few variables such as placental weight that are captured on all deliveries [9] or very in depth research-focused characteristics available in smaller cohorts [10–12,14]. Often placental pathology studies utilize a case control design which present more opportunities for bias and may overestimate the magnitude of the true association compared to cohort studies [16]. In addition, the time-limited nature of these data collection approaches precludes evaluation of trends over time. Despite limitations, these approaches have yielded important insight at the population level that placental growth characteristics (weight, thickness, length) and classification of fetal and/or maternal lesions are related to offspring and maternal health. Information on placental characteristics and lesions may therefore contribute to our understanding of pregnancy pathology and consequences; however methods to efficiently and robustly include placental measures in contemporary pregnancy studies are needed.

We set out to include clinical placental pathology data within our large, tertiary hospital perinatal registry, the Magee Obstetric Medical and Infant (MOMI) database. Like the majority of perinatal registries, to date placental data have not been included in MOMI due to the classic narrative nature of these reports. The potential of these data are significant, however, as our hospital protocol has a broad set of indications for referral of a placenta for gross and microscopic evaluation, and about half of all deliveries are reviewed by pathology. Indications include stillbirth, pre-term delivery (<37 weeks), hypertension, gestational diabetes, fetal growth restriction (<10th percentile), anomalies, neonatal depression, and a variety of other conditions complicating pregnancy. Results are incorporated within the patient electronic delivery record.

Clinical pathology reports are stored in plain text format and include a descriptive narrative of results which documents the dimensions (weight, length, and thickness of the placenta), as well as diagnoses and presence or absence of maternal or fetal inflammatory and vascular lesions. To date, research review of these records has required time intensive manual abstraction. In order to create a more complete report of pathology related to pregnancy and delivery complications we explored the feasibility of electronic linkage to delivery data and automated abstraction of placental pathology data. We also conducted a validation study in a subset where manual and automated abstraction results were compared.

2. Materials and methods

Delivery data were collected from the Magee Obstetric Medical and Infant (MOMI) database. The MOMI database includes 265 variables for all deliveries at Magee-Womens Hospital in Pittsburgh, PA since 1995 (n = 165,000). Variables are derived from admitting services, ICD-9 codes, medical record data abstraction, the Pennsylvania state electronic birth record and ultrasound (Fig. 1, section B). The export interface allows rapid updates of all MOMI data contained in the hospital's central data repository. Data administrators then review, clean, code, and store these data. They perform validation studies to assess the accuracy and completeness of the data. Frequencies for all variables are reviewed for illogical or outlying values and codes not allocated. Improbable values are investigated by obtaining the medical record and verifying the data point. Births occurring between 2008 and 2012 were selected for this study as the placenta pathology records were uniformly reported during this period by two pathologists and thus amenable to automated abstraction. The University of Pittsburgh IRB approved the project, which did not require informed consent as all data were de-identified.

We identified 30,716 placenta pathology reports between 2008 and 2012. While the information contained in the pathology report is consistently documented, there are no discrete data fields. Therefore, the data were reformatted into Extensible Markup Language (XML) using Java. The XML file acts as staging area where the data can be transformed and cleaned using an XML schema. A SQL Server Integration Services package (SSIS) was then used to extract, transform and load the text information into SQL Server tables that were then linked to the MOMI database. Together with a placental pathologist we identified keywords to capture all possible description of lesions and diagnoses by creating a Common Language Runtime (CLR) package to deploy fuzzy matching with regular expression. Records were searched for key words, and we considered the scenario where the absence of feature was described (for example 'no chorioamnionitis was identified'). While the standardized reporting protocol by the two pathologists guided against this scenario, our data extraction process included a quality control phase that looked for this situation, and none were identified. In addition, our validation study ensured that we did

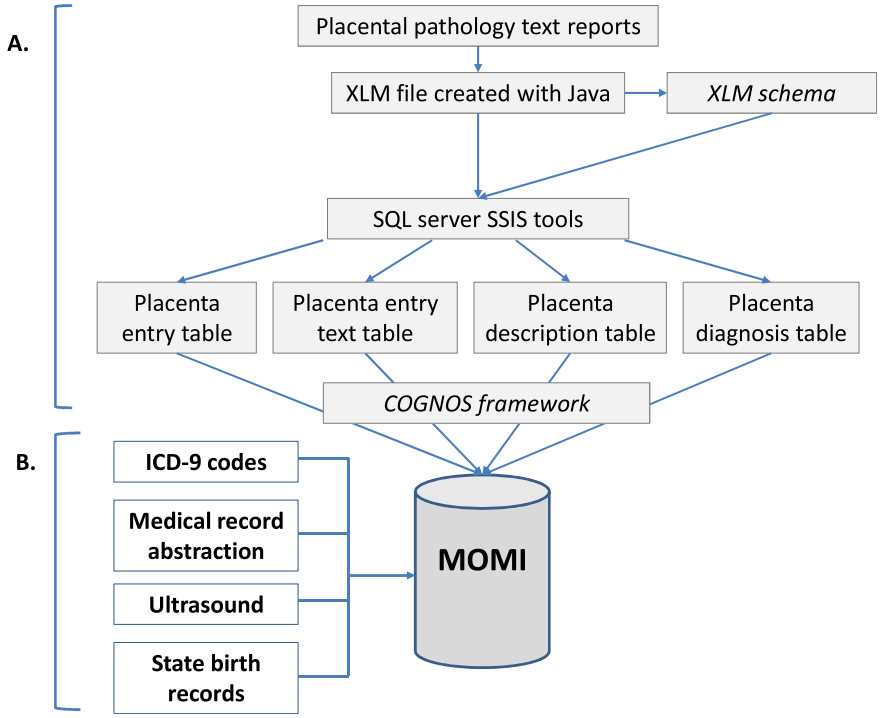

Fig. 1. Placental pathology linkage to perinatal registry. Automated abstraction process to transform placental pathology text reports into discrete data fields (A); Linkage to the existing magee obstetric and infant (MOMI) database that integrates and stores other clinical data (B).